Appendix to Annex I to ED Decision 2018/001/R

'Acceptable Means of Compliance (AMCs) and Guidance Material (GM) to Part-FCL Amendment 4'

Appendix

'SUBJECT 010 — AIR LAW'

to

AMC1 FCL.310; FCL.515(b); FCL.615(b)

'Theoretical knowledge examinations'

of Annex I

— FOR INFORMATION ONLY —

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SUBJECT 010 — AIR LAW

Note that the term 'mass' is used to describe a quantity of matter, and 'weight' when describing the force. However, the term 'weight' is normally used in aviation to colloquially describe mass. The professional pilot should always note the units to determine whether the term 'weight' is being used to describe a force (e.g. unit newton) or quantity of matter (e.g. unit kilogram).

(1) The subjects 'Air law' and 'ATC procedures' are primarily based on ICAO documentation and European Union regulations.

(2) National law should not be taken into account for theoretical examination purposes; it should remain relevant though during practical training and operational flying.

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
010 00 00 00		**AIR LAW**								
010 01 00 00		**INTERNATIONAL LAW: CONVENTIONS, AGREEMENTS AND ORGANISATIONS**								
010 01 01 00		**The Convention on International Civil Aviation (Chicago) — ICAO Doc~~OC~~ 7300/9** **Convention on the High Seas (Geneva, 29 April 1958)**								
010 01 01 01		***The establishment of the Convention on International Civil Aviation, Chicago, 7 December 1944.***								
(01)	X	Explain the ~~historical background~~ circumstances that led to the establishment of the Convention on International Civil Aviation, Chicago, 7 December 1944. ***Source:*** **ICAO Doc 7300/9 Preamble**	X	X	X	X	X			
010 01 01 ~~01~~ 02		***Part I — Air navigation***								
(01)	X	~~Be familiar with~~ Recall the general contents of relevant parts of the following c~~C~~hapters:	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		— general principles and application of the Convention; — flight over territory of C~~c~~ontracting States; — nationality of aircraft; — ~~measures to facilitate air navigation;~~ — ~~conditions to be fulfilled with respect to aircraft;~~ — international standards and recommended practices (SARPs), especially notification of differences and validity of endorsed certificates and licences. ***Source*: ICAO Doc 7300/9 Part 1, Articles: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 16, 17, 18, 19, 20, 37, 38, 39, 40**								
(02)	X	General principles Describe the application of the following terms in civil aviation: — sovereignty; — territory~~,~~ and high seas~~,~~ according to the UN Convention on the High Seas. ***Source:*** **Convention on the High Seas (Geneva, 29 April 1958) Articles 1, 2** **ICAO Doc 7300/9 Part 1, Articles 1, 2**	X	X	X	X	X			
(03)		~~Define~~ Explain the following terms and ~~explain~~ how they apply to international air traffic: — right of non-scheduled flight ~~(~~including the two technical freedoms of the air~~)~~; — scheduled air services; — cabotage;	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		— landing at customs airports; — ~~applicability of air regulations;~~ — R~~r~~ules of the A~~a~~ir; — search of aircraft. ***Source:* ICAO Doc 7300/9, Articles 5, 6, 7, 10, 12, 16**								
(04)	X	~~Describe~~ Explain the duties of Contracting States in relation to: — documents carried on board ~~of~~ the aircraft: • certificate of registration; • certificates of airworthiness; • licences of personnel; • recognition of certificates and licences; — cargo restrictions; — photographic apparatuses. ***Source:* ICAO Doc 7300/9, Articles 29, 31, 32, 33, 35, 36**	X	X	X	X	X			
010 01 01 ~~02~~ 03		***Part II — The International Civil Aviation Organization (ICAO)***								
(01)	X	Describe the objectives of ICAO. ***Source: ICAO DOC 7300/9 Article 44***	X	X	X	X	X			
(02)	X	~~Explain~~ Recognise the organisation and duties of the ICAO Assembly, Council and Air Navigation Commission (ANC). ***Source:* ICAO Doc 7300/9, Articles 48, 49, 50, 54, 56, 57**	X	X	X	X	X			
~~LO (03)~~		~~Explain the organisation and duties of the ICAO Headquarters and Regional Offices.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (04)~~		~~Describe the worldwide ICAO regions.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(05)	X	~~Be familiar with~~ Describe the ~~hierarchy of the ICAO~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~publications (SARPs, Docs):~~ — annexes to the Convention.~~;~~ — ~~documents.~~ ***Source*: ICAO Doc 7300/9, Articles 54, 90, 94, 95**								
010 01 02 00		**Other conventions and agreements**								
010 01 02 01		***The International Air Services Transit Agreement (ICAO Doc 7500)***								
~~LO (01)~~		Explain the two technical freedoms of the air. ***Source:* ICAO Doc 7500**	X	X	X	X	X			
010 01 02 02		***The International Air Transport Agreement (ICAO Doc 9626)***								
(01)		Explain the three commercial freedoms of the air. ***Source:* ICAO Doc 9626**	X	X	X	X	X			
~~LO (02)~~		~~Describe the legal situation within the EU with regard to the Freedoms of the Air.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
010 01 02 03		***Suppression of U~~u~~nlawful A~~a~~cts A~~a~~gainst the S~~s~~afety of C~~c~~ivil A~~a~~viation~~;~~ — T~~t~~he ~~Conventions of~~ Tokyo, The Hague and Montreal Convention of 1988***								
~~LO (01)~~		~~Explain the facts that led to the Conventions and Supplements concerning unlawful acts against the safety of civil aviation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~Explain the content of the Convention on Unlawful Acts Committed on Board Aircraft.~~ ~~(Doc 8364 — Convention on Offences and Certain Other Acts Committed on Board Aircraft, Tokyo, 14 September 1963)~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (03)~~		~~Explain the content of the Convention on Suppression of Unlawful Seizure of Aircraft.~~ ~~(Doc 8920 — Convention for the Suppression of Unlawful Seizure of Aircraft, The Hague, 16 December 1970, and Protocol for the Suppression of Unlawful Acts against the Safety of Civil Aviation, Montreal, 23 September 1971)~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			No practical use
~~LO (04)~~		~~Explain the content of the Convention on Suppression of Unlawful Acts of Violence at Airports Serving International Civil Aviation in accordance with Doc 8966 — Convention for the Suppression of Unlawful Acts against the Safety of Civil Aviation, done at Montreal on 23.9.1971, and signed at Montreal on 24 February 1988).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			No practical use
(05)		Describe the measures and actions to be taken by the pilot-in-command (PIC) of an aircraft in order to suppress unlawful acts against the safety of the aircraft. ***Source:*** **ICAO Doc 9518 — Protocol supplementary to the Convention for the Suppression of Unlawful Acts Against the Safety of Civil Aviation, done at Montreal on 23 September 1971, and signed at Montreal on 24 February 1988** ~~(Doc 9518 — Protocol supplementary to the Convention for the Suppression of Unlawful Acts Aagainst the Safety of Civil Aviation, done at Montreal on 23 September 1971, and signed at Montreal on 24 February 1988)~~	X	X	X	X	X			
010 01 02 04		***~~Bilateral agreements~~ Intentionally left blank***								
~~LO (01)~~		~~Explain the reason for the existence of bilateral agreements for scheduled air transport~~ ~~(Digest of Bilateral Air Transport Agreements, ICAO Doc~~	~~X~~		~~X~~	~~X~~				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~9511).~~								
010 01 02 05		***International private law***								
~~LO (01)~~		~~Explain the Conventions and Protocols designed to cover liability towards persons and goods in accordance with the Warsaw System based on the Convention for the Unification of Certain Rules Relating to International Carriage by Air, Warsaw, 2 October 1929.~~	X	X	X	X	X			
(02)		Explain the legal significance of the issue of a passenger ticket ~~and/~~or of baggage/cargo documents (that it forms a contract).	X	X	X	X	X			
(03)		Describe the consequences for an airline ~~and/~~or the PIC when a passenger ticket is not issued (that the contract is unaffected).	X	X	X	X	X			
~~LO (04)~~		~~Explain that the liability towards persons and goods may be unlimited on the basis of the Montreal Convention of 28 May 1999.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(05)	X	Explain the consequences for an airline operator of Regulation (EC) No 261/2004~~about~~ on passenger rights in the event ~~case~~ of delay, cancellation or denial of boarding. ***Source:* Regulation (EC) No 261/2004**	X	X	X	X	X			
(06)		Explain the liability limit in relation to destruction, loss, damage or delay of baggage.	X	X	X	X	X			
~~010 01 02 06~~		***~~Operators' and pilots' liabilities towards persons and goods on the ground in case of damage and injury caused by the operation of the aircraft~~***								
~~LO (01)~~		~~Explain the Conventions and Protocols designed to cover liability towards persons and goods on the ground based on~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~the International Convention for rules relating to Damage Caused by aircraft, signed at Rome on 29 May 1933 and on 7 October 1952, and at Montreal on 23 September 1978.~~								
~~***010 01 02 07***~~		~~***The Convention of Rome (1933) and other documents related to rights in aircraft***~~								
~~LO (01)~~		~~Understand the rules relating to international recognition of rights in aircraft and the rules relating to precautionary arrest of aircraft.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
010 01 03 00		**World organisations**								
010 01 03 01		***The International Air Transport Association (IATA)***								
(01)		Describe the ~~general organisation and~~ objectives of IATA. ***Source:* http://www.iata.org/about/pages/mission.aspx**	X		X	X				
010 01 04 00		**European organisations**								
010 01 04 01		***European Aviation Safety Agency (EASA) — Regulation (EC) No 216/2008***								
(01)	X	Describe the ~~general organisation and~~ objectives of EASA.	X	X	X	X	X			
(02)		Describe the role of EASA in European civil aviation.	X	X	X	X	X			
~~LO (03)~~		~~Describe the role of the National Aviation Authorities (NAAs) in relation to EASA.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(03)		~~Give an overview of the EASA Regulations' structure.~~ State that the structure of the regulatory material related to EASA involves: — hard law (regulations, implementing rules); — soft law (including certification specifications, acceptable means of compliance, guidance material.)	X	X	X	X	X			

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		State the meaning of the terminology associated with the EASA regulations' structure, specifically: regulations; implementing rules; certification specifications; acceptable means of compliance; guidance material.	X	X	X	X	X			
~~LO (05)~~		~~Describe the relationship between EASA, ICAO and other organisations.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
010 01 04 02		***EUROCONTROL***								
(01)	X	Describe the ~~objectives of the Convention relating to the Cooperation for the Safety of Air Navigation (EUROCONTROL) and the~~ Single European Sky (SES) ~~R~~regulations.	X	X	X	X	X			
~~***010 01 04 03***~~		~~***European Civil Aviation Conference (ECAC)***~~								
~~LO (01)~~		~~Give a brief summary of the European Civil Aviation Conference (ECAC).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
010 02 00 00		**AIRWORTHINESS OF AIRCRAFT, AIRCRAFT NATIONALITY AND REGISTRATION MARKS**								
010 02 01 00		~~**ICAO Annex 8 and the related Certification Specifications**~~ ***Intentionally left blank***								
~~LO (01)~~		~~Explain the definitions of ICAO Annex 8.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~Explain how the Airworthiness Standards of ICAO Annex 8 and the Certification Specifications (CSs) are related to each other.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~State which aircraft the Standards of ICAO Annex 8 and the CSs shall apply to.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
010 02 02 00		**Certificate of Airworthiness (CofA)**								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
010 02 02 01		***Certificate of Airworthiness (CofA) — Details***								
(01)		State the issuing authority of a CofA. ***Source:* ICAO Annex 8, Chapted 3.2 Issuance and continued validity of a Certificate of Airworthiness**	X	X	X	X	X			
(02)		State the necessity to ~~have~~hold a CofA. ***Source:* ICAO Doc 7300, Article 31**	X	X	X	X	X			
(03)	X	Explain the prerequisites ~~various elements that are required~~ for the issue of a CofA according to Commission Regulation (EU) No 748/2012. ***Source:* Commission Regulation (EU) No 748/2012, SUBPART H**	X	X	X	X	X			
(04)		State who shall determine an aircraft's continuing airworthiness. ***Source:* ICAO Annex 8, Chapter 3.2 Issuance and continued validity of a Certificate of Airworthiness**	X	X	X	X	X			
(05)		Describe how a ~~Certificate of Airworthiness~~ CofA can be renewed or may remain valid. ***Source:* ICAO Annex 8** **Chapter 3.2 Issuance and continued validity of a Certificate of Airworthiness;** **Chapter 3.5 Temporary loss of airworthiness;** **Chapter 3.6 Damage to aircraft**	X	X	X	X	X			
~~010 03 00 00~~		**~~AIRCRAFT NATIONALITY AND REGISTRATION MARKS~~**								
~~010 03 01 00~~ **010 02 03 00**		**Definitions of ICAO Annex 7 — Aircraft Nationality and Registration Marks**								
010 02 03 01		***ICAO Annex 7 — Definitions***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(01)	X	Recall the definition of the following terms: — aircraft; — heavier-than-air aircraft; — State of Registry. ***Source:*** **ICAO Annex 7, Chapter 1 Definitions**	X	X	X	X	X			
~~**010 03 02 00**~~ **010 02 04 00**		**Aircraft nationality, common marks and registration marks to be used**								
010 02 04 01		***Nationality marks, common marks and registration marks – assignment and location*** ***Source: ICAO Annex 7***								
(01)		State the location of nationality marks and of common marks and registration marks. ***Source:*** **ICAO Annex 7, Chapter 4.3 Heavier-than-air aircraft** **ICAO Annex 7, Chapter 9 Identification plate**	X		X					
~~LO (02)~~		~~Explain the combination of nationality and registration marks (sequence, use of hyphen).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(03)		~~State~~ Explain who is responsible for assigning nationality marks, common marks and registration marks. ***Source:*** **ICAO Annex 7, Chapter 3 Nationality, common and registration marks to be used**	X	X	X	X	X			
010 03 00 00		**Intentionally left blank**								
010 04 00 00		**PERSONNEL LICENSING**								
010 04 01 00		**ICAO Annex 1**								
010 04 01 01		***Differences between ICAO Annex 1 and ~~the Aircrew~~***								

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Regulation (EU) No 1178/2011 (hereinafter: the Aircrew Regulation)								
(01)	X	Describe the relationship and differences between ICAO Annex 1 and the Aircrew Regulation.	X	X	X	X	X	X		
010 04 02 00		**Aircrew Regulation — Annex I (Part-FCL)** ***Source:*** **Aircrew Regulation**								
010 04 02 01		***Definitions***								
(01)		Define the following: Category, class and type of aircraft, cross-country, dual instruction time, flight time, student pilot-in-command (SPIC), instrument time, instrument flight time, instrument ground time, ~~MCC , multi-pilot aircraft,~~ night, private pilot, proficiency check, renewal, revalidation, skill test, solo flight time~~, type of aircraft~~. ***Source:*** **Aircrew Regulation, point FCL.010 Definitions**	X	X	X	X	X	X	X	
(02)		Define the following: Multi-crew cooperation (MCC), multi-pilot aircraft, rating. ***Source:*** **Aircrew Regulation, point FCL.010 Definitions**	X	X	X	X	X			
010 04 02 02		***Content and structure***								
(01)	X	Explain the structure of Part-FCL. ***Source:*** **Aircrew Regulation, Article 1 Subject matter**	X	X	X	X	X	X	X	
~~(02)~~		~~Understand the difference between Part-FCL and AMC/GM to Part-FCL.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(03)		Explain the requirements to act as a flight crew member of a civil aircraft registered in a Member State, and know the general principles of the licensing system (light aircraft pilot	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		licence (LAPL), private pilot licence (PPL), commercial pilot licence (CPL), multi-crew pilot licence (MPL), airline transport pilot licence (ATPL)).								
~~LO (04)~~		~~State to what extent Member States will accept certificates issued by other Member States.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(05)	X	List the two factors that are relevant to the exercise of the privileges of a licence. ***Source:* Aircrew Regulation, point FCL.040 Exercise of the privileges of licences**	X	X	X	X	X	X		
(06)	X	State the circumstances in which a language proficiency endorsement is required. ***Source:* Aircrew Regulation, point FCL.055 Language proficiency**	X	X	X	X	X	X		
(07)	X	List the restrictions for licence holders with an age of 60 years or more. ***Source:* Aircrew Regulation, point FCL.065 Curtailment of privileges of licence holders aged 60 years or more in commercial air transport**	X	X	X	X	X			
(08)	X	Explain the term 'competent authority'. ***Source:* Aircrew Regulation, point FCL.001 Competent authority**	X	X	X	X	X	X		
(09)		Describe the obligation to carry and present documents (e.g. a flight crew licence) under Part-FCL. ***Source:* Aircrew Regulation, point FCL.045 Obligation to carry and present documents**	X	X	X	X	X	X		
010 04 02 03		***Commercial ~~p~~Pilot ~~l~~Licence (CPL)***								
(01)	X	State the requirements for the issue of a CPL.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **Aircrew Regulation** **point FCL.300 CPL — Minimum age;** **Appendix 3, D. CPL integrated course — Aeroplanes, Flying Training (8, a–f);** **Appendix 3, E. CPL modular course — Aeroplanes, Experience (12, a–d)**								
(02)		State the privileges of a CPL. ***Source:*** **Aircrew Regulation, point FCL.305 CPL — Privileges and conditions**	X	X	X	X	X			
010 04 02 04		***Airline t~~T~~ransport p~~P~~ilot l~~L~~icence (ATPL) and m~~M~~ulti-crew p~~P~~ilot l~~L~~icence (MPL)***								
(01)	X	State the requirements for the issue of an ATPL~~ and MPL~~. ***Source:*** **Aircrew Regulation, point FCL.500 ATPL — Minimum age** **Aircrew Regulation, point FCL.510.A ATPL(A) — Prerequisites, experience and crediting ((a) and (b))** **Aircrew Regulation, point FCL.510.H ATPL(H) — Prerequisites, experience and crediting**	X		X	X				
(02)		State the privileges of an ATPL ~~and MPL~~. ***Source:*** **Aircrew Regulation, point FCL.505 ATPL — Privileges**	X		X	X				
(03)	X	State the requirements for the issue of an MPL. ***Source:*** **Aircrew Regulation, point FCL.400.A MPL — Minimum age** **Aircrew Regulation, point FCL.410.A MPL — Training course and theoretical knowledge examinations and Appendix 5 (items 1 to 8)**	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		State the privileges of an MPL. ***Source:* Aircrew Regulation, point FCL.405.A MPL — Privileges**	X							
010 04 02 05		***Ratings***								
(01)		~~Explain~~ State the requirements for class ratings, their validity and privileges. ***Source:*** **Aircrew Regulation, point FCL.740 Validity and renewal of class and type ratings** **Aircrew Regulation, point FCL.705 Privileges of the holder of a class or type rating** **Aircrew Regulation, point FCL.720.A Experience requirements and prerequisites for the issue of class or type ratings — aeroplanes**	X	X						
(02)		~~Explain~~ State the requirements for type ratings, their validity and privileges. ***Source:*** **Aircrew Regulation, point FCL.705 Privileges of the holder of a class or type rating** **Aircrew Regulation, point FCL.720.A Experience requirements and prerequisites for the issue of class or type ratings — aeroplanes** **Aircrew Regulation, point FCL.740 Validity and renewal of class and type ratings**	X	X	X	X	X			
(03)		~~Explain~~ State the requirements for instrument ratings, their validity and privileges (instrument rating (IR), competency-based instrument rating (CBIR) and en-route instrument rating (EIR)).	X		X			X	X	

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **Aircrew Regulation, point FCL.610 IR — Prerequisites and crediting** **Aircrew Regulation, point FCL.605 IR — Privileges** **Aircrew Regulation, point FCL.625 IR — Validity, revalidation and renewal**								
(04)		State the requirements for other ratings, their validity and privileges according to Part-FCL. ***Source:*** **Aircrew Regulation, point FCL.900 Instructor certificates** **Aircrew Regulation, point FCL.915 General prerequisites and requirements for instructors** **Aircrew Regulation, point FCL.940 Validity of instructor certificates**	X	X	X	X	X			
010 04 03 00		**Aircrew Regulation — Annex V (Part-MED)**								
010 04 03 01		**Aircrew Regulation — Part-MED — Details**								
(01)	x	Describe the relevant content of Part-MED — Medical ~~R~~requirements (administrative parts and requirements related to licensing only). ***Source:*** **Aircrew Regulation, point MED.A.001 Competent authority** **Aircrew Regulation, point MED.A.005 Scope** **Aircrew Regulation, point MED.A.045 Validity, revalidation and renewal of medical certificates**	X	X	X	X	X	X		
(02)		State the requirements for the issue of a medical certificate. ***Source:*** **Aircrew Regulation, point MED.A.040 Issue, revalidation and renewal of medical certificates**	X	X	X	X	X	X		

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)		Name the ~~kind~~ class of medical certificate required when exercising the privileges of a CPL, MPL or ATPL. ***Source:* Aircrew Regulation, point MED.A.030 Medical certificates**	X	X	X	X	X			
(04)		State the actions to be taken in case of a decrease in medical fitness. ***Source:* Aircrew Regulation, point MED.A.020 Decrease in medical fitness**	X	X	X	X	X	X		
010 05 00 00		**RULES OF THE AIR ACCORDING TO ICAO ANNEX 2 AND SERA(COMMISSION IMPLEMENTING REGULATION (EU) No 923/2012 AND ITS REFERENCES AND SUBSEQUENT AMENDMENTS.**								
010 05 01 00		**Overview ~~Definitions~~ of ICAO Annex 2 and SERA (Commission Implementing Regulation (EU) No 923/2012 and its references and subsequent amendments)**								
010 05 01 01		**ICAO Annex 2 and SERA – Relationship and content**								
(01)		Explain the ~~main content~~ scope and purpose ~~definitions~~ of ICAO Annex 2. ***Source:* ICAO Annex 2, Foreword, Applicability**	X	X	X	X	X	X		
(02)		Explain the main content of SERA. ***Source:* SERA, Article 1 Subject matter and scope**	X	X	X	X	X	X		
010 05 02 00		**Rules of the Air**								
010 05 02 01		**Applicability of the Rules of the Air**								
(01)		Explain the principle of territorial application of the various Rules of the Air, e.g. ICAO, SERA, national rules.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **ICAO Annex 2, Chapter 2, 2.1 Territorial application of the rules of the air** **SERA.1001 and SERA.2001**								
(02)		Explain the necessity to comply ~~compliance~~ with the Rules of the Air. ***Source*****: SERA.2005 Compliance with the rules of the air**	X	X	X	X	X			
(03)		State ~~who on board~~ the responsibilities the PIC ~~of an aircraft is primarily responsible for the operation of the aircraft in accordance with the Rules of the Air~~. ***Source:*** **SERA.2010 Responsibilities**	X	X	X	X	X			
(04)		Indicate under what circumstances departure from the Rules of the Air may be allowed. ***Source*****: SERA.2010 Responsibilities**	X	X	X	X	X			
(05)		Explain the duties of the PIC concerning pre-flight actions in case of an instrument flight rule (IFR) flight ***Source:*** **SERA.2010 Responsibilities**	X		X			X	X	
(06)		State ~~who~~ that the PIC of an aircraft has the final authority as to the disposition of the aircraft while in command. ***Source:*** **SERA.2015 Authority of pilot-in-command of an aircraft**	X	X	X	X	X			
(07)		Explain when the ~~problematic in the~~ use and effects of psychoactive substances by flight crew members is prohibited. ***Source:*** **SERA.2020 Problematic use of psychoactive substances**	X	X	X	X	X	X		
010 05 03 00		**General rules**								
010 05 03 01		**General rules – Collision avoidance – SERA**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Describe the rules for the avoidance of collisions. ***Source:* SERA Chapter 2 Avoidance of collisions (except water operations)**	X	X	X	X	X			
(02)		Describe the lights, including their angles, to be displayed by aircraft. ***Source:* SERA.3215 Lights to be displayed by aircraft**	X	X	X	X	X			
(03)		~~Understand~~ Interpret marshalling signals. ***Source*: SERA Appendix 1, Chapter 4 Marshalling signals**	X	X	X	X	X			
(04)		State the basic requirements for minimum height (HGT) for the flight over congested areas of cities, towns or settlements, or over an open-air assembly of persons. ***Source:* SERA.3105 Minimum heights**	X	X	X	X	X			
(05)		Define when the cruising levels shall be expressed in terms of flight levels (FLs). ***Source:* SERA.3110 Cruising levels**	X	X	X	X	X			
(06)		Define under what circumstances cruising levels shall be expressed in terms of altitudes (ALT). ***Source:* SERA.3110 Cruising levels**	X	X	X	X	X			
(07)		Explain the limitation for proximity to other aircraft and the right-of-way rules, including holding at runway (RWY)-holding positions and lighted stop bars. ***Source:* SERA.3205 Proximity** **SERA.3210 Right-of-way**	X	X	X	X	X			
(08)		Describe the meaning of light signals displayed to and by the aircraft. ***Source:* SERA.3215 Lights to be displayed by aircraft** **SERA, Appendix 1, Chapter 3 Signals for aerodrome traffic**	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(09)		Describe the requirements when carrying out simulated instrument flights. ***Source:*** **SERA.3220 Simulated instrument flights**	X		X			X	X	
(10)		Indicate the basic rules for an aircraft operating on and in the vicinity of an aerodrome (AD). ***Source:*** **SERA.3225 Operation on and in the vicinity of an aerodrome**	X	X	X	X	X			
(11)		Explain the requirements for the submission of an air traffic service (ATS) flight plan. ***Source:*** **SERA.4001 Submission of a flight plan**	X	X	X	X	X			
~~LO (12)~~		~~Explain why a time check has to be obtained before the flight.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	X	
(13)		Explain the actions to be taken in case of flight plan change or delay. ***Source:*** **SERA.4015 Changes to a flight plan** **SERA.8020 Adherence to flight plan**	X	X	X	X	X	X		
(14)		*State the actions to be taken in case of inadvertent changes to track, true airspeed (TAS) and time estimate affecting the current flight plan.* ***Source: SERA.8020 Adherence to flight plan***	X	X	X	X	X	X		
(15)		Explain the procedures for closing a flight plan. ***Source:*** **SERA.4020 Closing a flight plan**	X	X	X	X	X			
(16)		State for which flights an air traffic control (ATC) clearance shall be obtained. ***Source:*** **SERA.8015 Air traffic control clearances**	X	X	X	X	X			
(17)		State how a pilot may request ~~an~~ ATC~~air traffic control~~ clearance.	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		Source: **SERA.8015 Air traffic control clearances**								
(18)		State the action to be taken if an ATC~~air traffic control~~ clearance is not satisfactory to a PIC~~pilot-in-command~~. ***Source:*** **SERA.8015 Air traffic control clearances**	X	X	X	X	X			
(19)		Describe the required actions to be carried out if the continuation of a controlled visual flight rule (VFR) flight in visual meteorological conditions (VMC) is not practicable anymore. ***Source***: **SERA.8020 Adherence to flight plan**	X		X	X		X	X	
(20)		Describe the provisions for transmitting a position report to the appropriate ATS unit including time of transmission and normal content of the message. ***Source:*** **SERA.8025 Position reports**	X	X	X	X	X	X	X	
(21)		Describe the necessary action when an aircraft experiences a communication (COM) failure. ***Source:*** **SERA.8035 Communications**	X	X	X	X	X	X	X	
(22)		State what information an aircraft being subjected to unlawful interference shall give to the appropriate ATS unit.	X	X	X	X	X	X		
010 05 04 00		**Visual f~~F~~light r~~R~~ules (VFRs)**								
010 05 04 01		**Visual flight rules (VFRs) — SERA**								
(01)		Describe the VFRs~~Visual Flight Rules~~ as contained in Commission implementing regulation (EU) No 923/2012 ~~Chapter 4 of ICAO Annex 2~~. ***Source:*** **SERA.5001 VMC visibility and distance from cloud minima** **SERA.5005 Visual flight rules**	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		SERA.5010 Special VFR in control zones								
010 05 05 00		**Instrument f~~F~~light r~~R~~ules (IFRs)**								
010 05 05 01		**Instrument flight rules (IFRs) — SERA**								
(01)		Describe the IFRs~~Instrument Flight Rules~~ as contained in Commission implementing regulation (EU) No 923/2012 ~~Chapter 5 of ICAO Annex 2~~. ***Source:*** **SERA.5015 Instrument flight rules (IFR) — Rules applicable to all IFR flights** **SERA.5020 IFR — Rules applicable to IFR flights within controlled airspace** **SERA.5025 IFR — Rules Applicable to IFR flights outside controlled airspace**	X		X			X	X	
010 05 06 00		**Interception of civil aircraft**								
010 05 06 01		**Interception of civil aircraft — SERA**								
(01)		List the possible reasons for intercepting a civil aircraft. ***Source:* SERA.11015 Interception**	X	X	X	X	X			
(02)		State what primary action should be carried out by an intercepted aircraft. ***Source:* SERA.11015 Interception**	X	X	X	X	X			
(03)		State which frequency should primarily be tried in order to contact an intercepting aircraft. ***Source:* SERA.11015 Interception**	X	X	X	X	X			
(04)		State on which mode and code a transponder on board the intercepted aircraft should be operated.	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **SERA.11015 Interception**								
(05)		Recall the interception signals and phrases. ***Source:*** **SERA.11015 Interception, Tables S11-1, S11-2, S11-3**	X	X	X	X	X			
010 06 00 00	**X**	**~~PROCEDURES FOR AIR NAVIGATION SERVICES —~~ AIRCRAFT OPERATIONS ~~(PANS- OPS)~~**								
010 06 01 00		**Intentionally left blank**								
010 06 0~~1~~2 00		**~~Foreword and introduction~~ Definitions and abbreviations (PANS-OPS Flight Procedures (ICAO Doc 8168, Volume I)**								
~~LO (01)~~		~~Translate the term 'PANS-OPS' into plain language.~~	~~X~~		~~X~~			~~X~~		
~~LO (02)~~		~~State the general aim of PANS-OPS Flight Procedures (ICAO Doc 8168, Volume I).~~	~~X~~		~~X~~			~~X~~		
010 06 02 0~~0~~1		**Definitions and abbreviations – ICAO Doc 8168, Volume 1**								
(01)	X	Recall all definitions included in ICAO Doc 8168, Volume I, Part I, Chapter 1. **Source: ICAO Doc 8168, Volume I, Part I, Section 1, Chapter 2**	X		X			X		
(02)	X	Interpret all abbreviations as shown in ICAO Doc 8168, Volume I, Part I, Chapter 2.	X		X			X		
010 06 03 00		**Departure procedures — (ICAO Doc 8168, Volume I)**								
010 06 03 01		***General criteria (assuming all engines operating)***								
(01)	X	~~Name~~ State the factors dictating the design of instrument departure procedures. ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 2, Chapter 1, 1.1 General**	X		X			X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		Explain in which situations the criteria for omnidirectional departures are applied. **_Source_: ICAO Doc 8168, Volume I, Part I, Section 3, Chapter 1, 1.3 Instrument departure procedure: 1.3.1; 1.3.2; 1.3.3**	X		X			X	X	
_010 06 03 02_		**_Standard instrument departures (SIDs)_**								
(01)		~~Define~~ Explain the terms 'straight departure' and 'turning departure'. **_Source:_ ICAO Doc 8168, Volume I, Part I, Section 3, Chapter 2, 2.1 General; 2.2 Straight Departures; 2.3 Turning (excluding maximum speeds)**	X		X			X	X	
~~LO (02)~~		~~State the responsibility of the operator when unable to utilise the published departure procedures.~~	~~X~~		~~X~~			~~X~~	~~X~~	
_010 06 03 03_		**_Omnidirectional departures_**								
(01)		Explain when the 'omnidirectional method' is used for departure.	X		X			X	X	
~~LO (02)~~		~~Describe the solutions when an omnidirectional procedure is not possible.~~	~~X~~		~~X~~			~~X~~	~~X~~	
_010 06 03 04_		**_~~Published information~~ Intentionally left blank_**								
~~LO (01)~~		~~State the conditions for the publication of a SID and/or RNAV route.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO (02)~~		~~Describe how omnidirectional departures are expressed in the appropriate publication.~~	~~X~~		~~X~~			~~X~~	~~X~~	
_010 06 03 05_		**_~~Area Navigation (~~RNAV~~)~~ departure procedures and RNP-based departures_**								
~~LO (01)~~		~~Explain the relationship between RNAV/RNP-based departure procedures and those for approaches.~~	~~X~~		~~X~~			~~X~~	~~X~~	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
010 06 04 00		**Approach procedures — ICAO Doc 8168, Volume I**								
010 06 04 01		***General criteria***								
(01)		State the g~~G~~eneral criteria (except the table 'Speeds for procedure calculations') of ~~the~~ approach procedure design: — instrument approach areas; — accuracy of fixes; — fixes formed by intersections; — intersection fix-tolerance factors; — other fix-tolerance factors; ~~— approach area splays;~~ — descent gradient. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 1**	X		X			X		
(02)		Name the five possible segments of an instrument approach procedure. **Source: ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 1, 1.2.2 Segments of the approach procedure**	X		X			X	X	
(03)		~~Give~~ State the reasons for establishing aircraft categories for the approach. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 1, 1.3 Categories of aircraft**	X		X			X	X	
(04)		State the maximum angle between the final approach track and the extended RWY centre line to still consider a non-precision approach as being a 'straight-in approach'. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 1, 1.2.3 Types of approach**	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(05)		State the minimum obstacle clearance (MOC) provided by the minimum sector altitudes (MSAs) established for an aerodrome. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 2, 12.3 Minimum sector altitudes (MSA)/terminal arrival altitudes (TAA)**	X		X			X	X	
~~LO (06)~~		~~Describe the point of origin, shape, size and subdivisions of the area used for MSAs.~~	~~X~~		~~X~~			~~X~~	~~X~~	
(07)	X	State that a pilot shall apply wind corrections when carrying out an instrument approach procedure.	X		X			X	X	
(08)		~~Name~~ State the most significant ~~performance~~ factor influencing the conduct of instrument approach procedures. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 1, 1.2.1 External factors influencing the approach procedure**	X		X			X	X	
(09)		Explain why a pilot should not descend below obstacle clearance altitude/height (OCA/H~~s~~), which are established for: — precision approach procedures; — non-precision approach procedures; — visual (circling) procedures; — APV approach procedures. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 1, 1.5 Obstacle clearance altitude/height (OCA/H)**	X		X			X	X	
(10)		Describe in general terms the relevant factors for the calculation of operational minima. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4,**	X		X			X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Chapter 1, 1.6 Factors affecting operational minima								
(11)		Translate the following acronyms into plain language: DA, DH, OCA, OCH, MDA, MDH, MOC, DA/H, OCA/H, MDA/H. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 1**	X		X			X	X	
(12)		Explain the relationship between the terms: DA, DH, OCA, OCH, MDA, MDH, MOC, DA/H, OCA/H, and MDA/H. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 1**	X		X			X	X	
010 06 04 02		***Approach procedure design***								
(01)		Describe how the vertical cross section for each of the five approach segments is broken down into the various areas. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 1**	X		X			X	X	
(02)		State within which area of the cross section the ~~M~~minimum ~~O~~obstacle ~~C~~clearance (MOC) is provided for the whole width of the area. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 2**	X		X			X	X	
(03)		Define the terms 'IAF', 'IF', 'FAF', 'FAP', 'MAPt' and 'TP'. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 1 Definitions, abbreviations and acronyms and units of measurement**	X		X			X	X	
~~LO (04)~~		~~Name the area within which the plotted point of an intersection fix may lie.~~	~~X~~		~~X~~			~~X~~		

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (05)~~		~~Explain by which factors the dimensions of an intersection fix are determined.~~	~~X~~		~~X~~			~~X~~		
(06)	X	State the accuracy of facilities providing track (VHF omnidirectional radio range (VOR), instrument landing system (ILS), non-directional beacon (NDB)). ***Source:* ICAO Doc 8168, Volume I, Part I, Section 2, Chapter 2, Table I-2-2-1. System use accuracy (2 SD) of facility providing track guidance and facility not providing track guidance**	X		X			X	X	
~~LO (07)~~		~~Describe the 'other fix tolerance factors':~~ ~~surveillance radar (Terminal Area Radar (TAR)), En Route Surveillance Radar (RSR), DME, 75 MHz marker beacon, fixes overhead a station (VOR, NDB).~~	~~X~~		~~X~~			~~X~~		
~~LO (08)~~		~~Describe the basic information relating to approach-area splays.~~	~~X~~		~~X~~			~~X~~	~~X~~	
(09)		State the optimum descent gradient (preferred for a precision approach) in degrees and per cent. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 1, 1.9 Descent gradient**	X		X			X	X	
010 06 04 03		***Arrival and approach segments***								
(01)		Name the five standard segments of an instrument approach~~APP~~ procedure and state the beginning and end for each of them. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 1, 1.2 Instrument approach procedure**	X		X			X	X	
(02)		Describe where an arrival~~ARR~~ route normally ends. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4,**	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Chapter 2 Arrival segment								
~~LO (03)~~		~~State whether or not omnidirectional or sector arrivals can be provided.~~	~~X~~		~~X~~			~~X~~	~~X~~	
(04)		Explain the main task of the initial approach~~APP~~ segment.	X		X			X	X	
(05)		Describe the maximum angle of interception between the initial approach~~APP~~ segment and the intermediate approach~~APP~~ segment (provided at the intermediate fix) for a precision approach and a non-precision approach. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 3 Initial approach segment**	X		X			X	X	
(06)		Describe the main task of the intermediate approach~~APP~~ segment. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 4 Intermediate approach segment**	X		X			X	X	
(07)		State the main task of the final approach~~APP~~ segment. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 5 Final approach segment**	X		X			X	X	
(08)		Name the two possible aims of a final approach~~APP~~. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 5 Final approach segment**	X		X			X	X	
(09)		Explain the term 'final approach point' in case of an ILS approach. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 5 Final approach segment**	X		X			X	X	
(10)		State what happens if an ILS glide path (GP) becomes inoperative during the approach~~APP~~. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4,**	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Chapter 5 Final approach segment								
010 06 04 04		***Missed approach***								
(01)		Name the three phases of a missed approach procedure and describe their geometric limits. ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 6 Missed approach segment**	X		X			X	X	
(02)		~~Describe~~ State the main task of a missed approach procedure. ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 6 Missed approach segment**	X		X			X	X	
~~LO (03)~~		~~State at which height/altitude the missed approach is assured to be initiated.~~	~~X~~		~~X~~			~~X~~	~~X~~	
(04)		Define the term 'missed approach point (MAPt)'. ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 1 Definitions, abbreviations and acronyms and units of measurement**	X		X			X	X	
(05)		Describe how an MAPt may be established in an approach procedure. ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 1 Definitions, abbreviations and acronyms and units of measurement**	X		X			X	X	
(06)		State the pilot's ~~reaction~~ action if, upon reaching the MAPt, the required visual reference is not established. ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 6 Missed approach segment**	X		X			X	X	
(07)		Describe what a pilot is expected to do in the event a missed approach is initiated prior to arriving at the MAPt.	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 6 Missed approach segment**								
(08)		State whether the pilot is obliged to cross the MAPt at the height (HGT)/altitude (ALT) required by the procedure or whether they are allowed to cross the MAPt at a~~n~~ HGT/ALT~~altitude/height~~ greater than that required by the procedure. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 6 Missed approach segment**	X		X			X	X	
010 06 04 05		***Visual manoeuvring (circling) in the vicinity of the aerodrome (AD)***								
(01)		Describe what is meant by 'visual manoeuvring (circling)'. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 7 Visual manoeuvring (circling) area**	X		X			X	X	
(02)		Describe how a prominent obstacle in the visual manoeuvring (circling) area outside the final approach and missed approach area has to be considered for the visual circling. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 7 Visual manoeuvring (circling) area**	X		X			X	X	
(03)		State for which category of aircraft the obstacle clearance altitude/height (OCA/H) within an established visual manoeuvring (circling) area is determined. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 7 Visual manoeuvring (circling) area**	X		X			X	X	
(04)		Describe how a~~n~~ the minimum descent altitude/height (MDA/H) is specified for visual manoeuvring (circling) if the OCA/H is known.	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		Source: **ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 7 Visual manoeuvring (circling) area**								
(05)		State the conditions to be fulfilled before descending below MDA/H in a visual manoeuvring (circling) approach. ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 7, Visual manoeuvring (circling) area**	X		X			X	X	
(06)		~~Describe~~ Explain why there can be no single procedure designed that will cater for conducting a circling approach in every situation. ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 7 Visual manoeuvring (circling) area**	X		X			X	X	
(07)		State how the pilot is expected to behave after initial visual contact during a visual manoeuvring (circling). ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 7 Visual manoeuvring (circling) area**	X		X			X	X	
(08)		Describe what the pilot is expected to do if visual reference is lost while circling to land from an instrument approach. ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 4, Chapter 7 Visual manoeuvring (circling) area**	X		X			X	X	
010 06 04 06		***~~Area Navigation (RNAV)~~ approach procedures based on VOR/distance-measuring equipment (DME)***								
(01)		Describe the provisions that must be fulfilled before carrying out VOR/DME RNAV approaches. ***Source:*** **ICAO Doc 8168, Volume I, Part II, Section 3, Chapter 3**	X		X			X	X	
(02)		Explain the disadvantages of the VOR/DME RNAV system compared to a DME/DME RNAV approach.	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		Source: **ICAO Doc 8168, Volume I, Part II, Section 3, Chapter 3**								
(03)		List the factors the navigational accuracy of the VOR/DME RNAV system depends on. ***Source:*** **ICAO Doc 8168, Volume I, Part II, Section 3, Chapter 3**	X		X			X	X	
(04)		State whether the VOR/DME ~~/~~RNAV approach is a precision or a non-precision procedure. ***Source:*** **ICAO Doc 8168, Volume I, Part II, Section 3, Chapter 3**	X		X			X	X	
~~***010 06 04 07***~~		~~***Use of FMS/RNAV equipment to follow conventional non-precision approach procedures***~~								
~~LO (01)~~		~~State the provisions for flying the conventional non-precision approach procedures using FMS/RNAV equipment.~~	~~X~~		~~X~~			~~X~~		
010 06 05 00		**Holding procedures - ICAO Doc 8168, Volume I**								
010 06 05 01		***Entry and holding***								
(01)		Explain why deviations from the in-flight procedures of a holding established in accordance with ICAO Doc 8168 are dangerous. ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 6**	X		X			X	X	
(02)		State that if for any reason~~s~~ a pilot is unable to conform to the procedures for normal conditions laid down for any particular holding pattern, ~~they~~ this pilot should advise ATC as early as possible. ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 6, Chapter 1**	X		X			X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (03)~~		~~Describe how right-turn holdings can be transferred to left-turn holding patterns.~~	~~X~~		~~X~~			~~X~~	~~X~~	
(04)		Describe the shape and terminology associated with the holding pattern. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 6, Chapter 1**	X		X			X	X	
(05)		State the bank angle and rate of turn to be used whilst flying in a holding pattern. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 6, Chapter 1**	X		X			X	X	
(06)		Explain why a ~~pilots~~ pilot in a holding pattern should attempt to maintain tracks and how this can be achieved. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 6, Chapter 1**	X		X			X	X	
(07)		Describe where outbound timing begins in a holding pattern. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 6, Chapter 1**	X		X			X	X	
(08)		State where the outbound leg in a holding terminates if the outbound leg is based on DME. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 6, Chapter 1**	X		X			X	X	
(09)		Describe the three heading entry sectors for entries into a holding pattern. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 6, Chapter 1**	X		X			X	X	
(10)		Define the terms 'parallel entry', 'offset entry' and 'direct entry'.	X		X			X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **ICAO Doc 8168, Volume I, Part I, Section 6, Chapter 1**								
(11)		Determine the correct entry procedure for a given holding pattern. ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 6, Chapter 1**	X		X			X	X	
(12)		State the still air time for flying the outbound entry heading with or without DME. ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 6, Chapter 1**	X		X			X	X	
(13)		Describe what the pilot is expected to do when clearance is received specifying the time of departure from the holding point. ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 6, Chapter 1**	X		X			X	X	
010 06 05 02		***Obstacle clearance ~~(except table)~~***								
(01)	X	Describe the layout of the basic holding area, entry area and buffer area of a holding pattern. ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 6, Chapter 2**	X		X			X	X	
(02)	X	State which obstacle clearance is provided by a minimum permissible holding level referring to the holding area, the buffer area (general only) and over high terrain or in mountainous areas. ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 6, Chapter 2**	X		X			X	X	
010 06 06 00		**Altimeter-setting procedures - ICAO Doc 8168, Volume I**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
010 06 06 01		***Basic requirements and procedures***								
(01)		Describe the two main objectives of altimeter settings. ***Source:*** **ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 1**	X	X	X	X	X	X	X	
(02)		Define the terms ‘QNH’ and ‘QFE’. ***Source:*** **ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 2**	X	X	X	X	X	X	X	
(03)		Describe the different terms for ALT~~altitude~~ or flight levels (FLs) respectively which are the references during climb or descent to change the altimeter settings from QNH to 1013.2 hPa and vice versa. ***Source:*** **ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 2**	X	X	X	X	X	X	X	
(04)		Define the term ‘f~~F~~light l~~L~~evel (FL)’. ***Source:*** **ICAO Doc 8168, Volume I, Part I, Section 1 Definitions, abbreviations and acronyms and units of measurement**	X	X	X	X	X	X	X	
(05)		State where FL~~flight level~~ zero shall be located. ***Source:*** **ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 2**	X	X	X	X	X	X	X	
(06)		State the interval by which consecutive FLs~~flight levels~~ shall be separated. ***Source:*** **ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 2**	X	X	X	X	X	X	X	
(07)		Describe how FLs~~flight levels~~ are defined~~ numbered~~. ***Source:*** **ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 2**	X	X	X	X	X	X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(08)		Define the term 't~~T~~ransition a~~A~~ltitude (TA)'. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 1 Definitions, abbreviations and acronyms and units of measurement**	X	X	X	X	X	X	X	
(09)		State how TAs~~Transition Altitudes~~ shall normally be specified. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 2**	X	X	X	X	X	X	X	
(10)		Explain how the HGT~~height~~ of the TA~~Transition Altitude~~ is calculated and expressed in practice. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 2**	X	X	X	X	X	X	X	
(11)		State where TAs~~Transition Altitudes~~ shall be published. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 2**	X	X	X	X	X	X	X	
(12)		Define the term 't~~T~~ransition l~~L~~evel (TRL)'. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 1 Definitions, abbreviations and acronyms and units of measurement**	X	X	X	X	X	X	X	
(13)		State when the TRL~~Transition Level~~ is normally passed on to the aircraft. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 2**	X	X	X	X	X	X	X	
(14)		State how the vertical position of the aircraft shall be expressed at or below the TA~~Transition Altitude~~ and TRL~~Transition Level~~. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 1,**	X	X	X	X	X	X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Chapter 2								
(15)		Define the term ‘t~~T~~ransition l~~L~~ayer’. ***Source:* ICAO Doc 8168, Volume I, Part I, Section 1 Definitions, abbreviations and acronyms and units of measurement**	X	X	X	X	X	X	X	
(16)		Describe when the vertical position of an aircraft passing through the transition layer shall be expressed in terms of FLs~~flight levels~~ and when in terms of ALT~~altitude~~. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 2**	X	X	X	X	X	X	X	
(17)		State when the QNH altimeter setting shall be made available to departing aircraft. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 2**	X	X	X	X	X	X	X	
(18)		Explain when the vertical separation of an aircraft during en-route flight shall be assessed in terms of ALT~~altitude~~ and when in terms of FLs~~flight levels~~. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 3**	X	X	X	X	X	X	X	
(19)		Explain when, in air–ground communications during an en-route flight, the vertical position of an aircraft shall be expressed in terms of ALT~~altitude~~ and when in terms of FLs ~~flight levels~~. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 3**	X	X	X	X	X	X	X	
(20)		Describe why QNH altimeter-setting reports should be provided from sufficient locations.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		***Source:* ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 2**								
(21)		State how a QNH altimeter setting shall be made available to aircraft approaching a controlled aerodrome (AD) for landing. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 2**	X	X	X	X	X	X	X	
(22)		State under which circumstances the vertical position of an aircraft above the TRL~~transition level~~ may be referenced in ~~to~~ ALT~~altitudes~~. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 2**	X	X	X	X	X	X	X	
010 06 06 02		***Procedures for operators and pilots***								
~~LO (01)~~		~~State the three requirements that selected altitudes or selected flight levels should have.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~LO (02)~~		~~Describe a pre-flight operational test in case of QNH setting and in case of QFE setting including indication (error) tolerances referred to the different test ranges.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(03)		State on which setting at least one altimeter shall be set prior to take-off. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 3**	X	X	X	X	X	X	X	
(04)		State where during the climb the altimeter setting shall be changed from QNH to 1013.2 hPa. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 3**	X	X	X	X	X	X	X	
(05)		Describe when a pilot of an aircraft intending to land at an	X	X	X	X	X	X	X	

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		AD shall obtain the TRL~~transition level~~. **_Source:_ ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 3**								
(06)		Describe when a pilot of an aircraft intending to land at an AD shall obtain the actual QNH altimeter setting. **_Source:_ ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 3**	X	X	X	X	X	X	X	
(07)		State where the altimeter settings shall be changed from 1013.2 hPa to QNH during descent for landing. **_Source:_ ICAO Doc 8168, Volume I, Part III, Section 1, Chapter 3**	X	X	X	X	X	X	X	
010 06 07 00		**~~Simultaneous operation on p~~Parallel or near-parallel instrument RWYs~~runways~~—ICAO Doc 8168, Volume I**								
010 06 07 01		***Simultaneous operation on parallel or near-parallel instrument RWYs***								
(01)	X	Describe the difference between independent and dependent parallel approaches. **_Source:_ ICAO Doc 8168, Volume I, Part III, Section 2, Chapter 1**	X	X	X	X	X	X	X	
02)		Describe the following different operations: — simultaneous instrument departures; — segregated parallel approaches/departures; — semi-mixed and mixed operations. **_Source:_ ICAO Doc 8168, Volume I, Part III, Section 2, Chapter 1**	X	X	X	X	X	X	X	
(03)		~~Know about~~ Describe 'normal operating zone (NOZ)' and 'no transgression zone (NTZ)'.	X	X	X	X	X	X		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		~~Name~~ State the aircraft avionics equipment requirements for conducting parallel instrument approaches. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 2, Chapter 1**	X	X	X	X	X	X		
(05)		State ~~under which circumstances parallel instrument approaches may be conducted.~~ where guidance material may be located for simultaneous operations on parallel or near-parallel instrument runways. ***Source:* ICAO Doc 8168**	X	X	X	X	X	X		
(06)		State the radar requirements for simultaneous, independent, and parallel instrument approaches, and how weather conditions effect these. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 2, Chapter 1**	X	X	X	X	X	X		
(07)		State the maximum angle of interception for an ILS localiser course (CRS) or microwave landing system (MLS) final approach~~APP~~ track in case of simultaneous, independent, and parallel instrument approaches. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 2, Chapter 1**	X	X	X	X	X	X		
(08)		Describe the special conditions for tracks on missed approach procedures and departures in case of simultaneous~~,~~ or parallel operations. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 2, Chapter 1**	X	X	X	X	X	X		
010 06 08 00		**Secondary surveillance radar (transponder) operating procedures — ICAO Doc 8168, Volume I**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
010 06 08 01		***Operation of transponders***								
(01)		State when and where the pilot shall operate the transponder. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 3, Chapter 1**	X	X	X	X	X	X	X	
(02)		State the modes and codes that the pilot shall operate in the absence of any ATC directions or regional air navigation agreements. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 3, Chapter 1**	X	X	X	X	X	X	X	
(03)		~~Indicate~~ State when the pilot shall operate Mode C. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 3, Chapter 1**	X	X	X	X	X	X		
(04)		State when the pilot shall 'SQUAWK IDENT'. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 3, Chapter 1**	X	X	X	X	X	X	X	
(05)		State the transponder ~~mode and~~ code to indicate: — a state of emergency; — a COM~~communication~~ failure; — unlawful interference. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 3, Chapter 1**	X	X	X	X	X	X	X	
(06)		Describe the consequences of a transponder failure in flight. **Source: ICAO Doc 8168, Volume I, Part III, Section 3, Chapter 1**	X	X	X	X	X	X	X	
(07)		State the primary action of the pilot in the case of an unserviceable transponder before departure when no repair	X	X	X	X	X	X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		or replacement at the given AD~~aerodrome~~ is possible. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 3, Chapter 1**								
(08)		State when the pilot shall operate Mode S. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 3, Chapter 1**							X	
010 06 08 02		***Operation of airborne collision avoidance system (ACAS) equipment***								
(01)		Describe the main reason for using ACAS. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 3, Chapter 3, 3.1 ACAS overview**	X	X	X	X	X	X	X	
(02)		~~Indicate~~ State whether the ‘use of ACAS indications’ described in ICAO Doc 8168 is absolutely mandatory. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 3, Chapter 3, 3.2 Use of ACAS indications**	X	X	X	X	X	X		
(03)		Explain the pilots’ reaction required to allow ACAS to fulfil its role of assisting pilots in the avoidance of potential collisions. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 3, Chapter 3, 3.2 Use of ACAS indications**	X	X	X	X	X	X		
(04)		Explain why pilots shall not manoeuvre their aircraft in response to t~~T~~raffic a~~A~~dvisories (TAs) only. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 3, Chapter 3, 3.2 Use of ACAS indications**	X	X	X	X	X	X		
(05)		Explain the significance of ~~Traffic Advisories~~ TAs in view of possible r~~R~~esolution a~~A~~dvisories (RAs). ***Source:* ICAO Doc 8168, Volume I, Part III, Section 3,**	X	X	X	X	X	X		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Chapter 3, 3.2 Use of ACAS indications								
(06)		State why a pilot should follow RAs~~Resolution Advisories~~ immediately. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 3, Chapter 3, 3.2 Use of ACAS indications**	X	X	X	X	X	X		
(07)		List the reasons which may force a pilot to disregard an RA~~Resolution Advisory~~. ***Source:*: ICAO Doc 8168, Volume I, Part III, Section 3, Chapter 3, 3.2 Use of ACAS indications**	X	X	X	X	X	X		
~~LO (08)~~		~~Decide how a pilot shall react if there is a conflict between Resolution Advisories in case of an ACAS/ACAS coordinated encounter Resolution Advisories.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(09)		Explain the importance of instructing ATC immediately that an RA~~Resolution Advisory~~ has been followed. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 3, Chapter 3, 3.2 Use of ACAS indications**	X	X	X	X	X	X		
(10)		Explain the duties of a pilot with regard to ~~as regards~~ ~~far as~~ ATC ~~is concerned~~ when an RA~~Resolution Advisory~~ situation is resolved. ***Source:* ICAO Doc 8168, Volume I, Part III, Section 3, Chapter 3, 3.2 Use of ACAS indications**	X	X	X	X	X	X		
010 06 09 00		**REGULATION (EU) No 965/2012 ON AIR OPERATIONS**								
010 06 09 01		***Regulation structure***								
(01)		Describe the subject matter and scope of that Regulation. ***Source:* Regulation (EU) No 965/2012 Article 1, Subject**	X	X	X	X	X	X	X	

FOR INFORMATION ONLY

Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
		matter and scope								
(02)	X	State that Regulation (EU) No 965/2012 covers all types of commercial and non-commercial operations.	X	X	X	X	X	X	X	
010 06 09 02		***Definitions (Annex I)***								
(01)		Recall the definitions in the Regulation not already given in ICAO PAN-OPS. ***Source:*** **Regulation (EU) No 965/2012 Article 2, Definitions**	X	X	X		X	X		
010 06 09 03		***Part-SPA (Annex V), Part-NCC (Annex VI) and Part-NCO (Annex VII)***								
(01)		Describe the structure of these Parts.	X	X	X	X	X			
(02)	X	Explain the main content of these Parts, except the operational procedures.	X	X	X	X	X			
010 07 00 00		**AIR TRAFFIC SERVICES (ATS) AND AIR TRAFFIC MANAGEMENT (ATM)**								
010 07 01 00		**ICAO Annex 11 — Air Traffic Services**								
010 07 01 01		***Definitions***								
(01)	X	Recall the definitions given in ICAO Annex 11. ***Source*****: ICAO Annex 11, Chapter 1 Definitions**	X	X	X	X	X	X		
010 07 01 02		**General**								
(01)	X	~~Name~~ State the objectives of ~~Air Traffic Services (~~ATS~~)~~. **Source: ICAO Annex 11, Chapter 2, 2.2 Objectives of ATS**	X	X	X	X	X	X		
(02)	X	Describe the three basic types of ATS~~Air Traffic Services~~. ***Source:*** **ICAO Annex 11 ,Chapter 2, 2.3 Divisions of the air traffic services**	X	X	X	X	X	X		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)	X	Describe the three basic types of ATC~~Air Traffic Control~~ services ~~(ATC)~~. ***Source:* ICAO Annex 11, Chapter 2, 2.3 Divisions of the air traffic services**	X	X	X	X	X	X		
~~LO (04)~~		~~Indicate when aerodrome control towers shall provide an accurate time check to pilots.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(05)		State on which frequencies a pilot can expect ~~ATS~~ ATC to contact them in case of an emergency. ***Source:* ICAO Annex 11, Chapter 2, 2.25 In-flight contingencies**	X	X	X	X	X	X		
(06)		~~Understand~~ Describe the procedure for the transfer of an aircraft from one ATC unit to another. ***Source:* ICAO Annex 11, Chapter 3, 3.6.1 Transfer of responsibility for control**	X	X	X	X	X			
010 07 01 03		***Airspace***								
(01)		Describe the purpose for establishing flight information regions (FIRs) including upper flight information regions (UIRs). ***Source:* ICAO Annex 11, Chapter 2: 2.10; 2.11**	X	X	X	X	X	X		
(02)		~~Understand~~ Describe the various rules and services that apply to the various classes of airspace. ***Source:* ICAO Annex 11, Chapter 2, 2.6 Classification of airspaces and Annex 11, Appendix 4**	X	X	X	X	X	X	X	
(03)		Explain which airspace shall be included in an FIR or UIR.	X	X	X	X	X	X		
(04)		State the designation for those portions of the airspace where flight information service (FIS) and alerting services shall be provided.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **ICAO Annex 11, Chapter 2, 2.5 Designation of the portions of the airspace and controlled aerodromes where air traffic services will be provided**								
(05)		State the designations for those portions of the airspace where ATC services shall be provided. ***Source:*** **ICAO Annex 11, Chapter 2, 2.5 Designation of the portions of the airspace and controlled aerodromes where air traffic services will be provided**	X	X	X	X	X	X		
(06)		~~Indicate~~ Identify whether or not control areas (CTAs) and control zones (CTRs) designated within an FIR shall form part of that FIR. ***Source:*** **ICAO Annex 11, Chapter 2, 2.5 Designation of the portions of the airspace and controlled aerodromes where air traffic services will be provided**	X	X	X	X	X	X		
(07)		~~Name~~ State the lower limit of a CTA as far as ICAO ~~s~~Standards are concerned. ***Source:*** **ICAO Annex 11, Chapter 2, 2.11.3 Control areas**	X	X	X	X	X	X		
(08)		State whether or not the lower limit of a CTA has to be established uniformly. ***Source:*** **ICAO Annex 11, Chapter 2, 2.11.3 Control areas**	X	X	X	X	X	X		
(09)		Explain why a UIR or u~~U~~pper CTA should be delineated to include the u~~U~~pper a~~A~~irspace within the lateral limits of a number of lower FIRs or CTAs. ***Source:*** **ICAO Annex 11, Chapter 2, 2.11.4 Flight information regions or control areas in the upper airspace**	X	X	X	X	X	X		
(10)		Describe in general the lateral limits of CTRs. ***Source:*** **ICAO Annex 11, Chapter 2, 2.11.5 Control zones**	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(11)		State the minimum extension (in NM) of the lateral limits of a CTR. ***Source:* ICAO Annex 11, Chapter 2, 2.11.5 Control zones**	X	X	X	X	X	X		
(12)		State the upper limits of a CTR located within the lateral limits of a CTA. ***Source:* ICAO Annex 11, Chapter 2, 2.11.5 Control zones**	X	X	X	X	X	X		
010 07 01 04		***Air t~~T~~raffic c~~C~~ontrol (ATC) services***								
(01)		Name all classes of airspace in which ATC services shall be provided. ***Source:* ICAO Annex 11, Chapter 3, 3.1 Application**	X	X	X	X	X	X		
(02)		Name the ATS units providing ATC services (area control service, approach control service, aerodrome control service). ***Source:* ICAO Annex 11, Chapter 3, 3.2 Provision of air traffic control service**	X	X	X	X	X	X	X	
(03)		Describe which unit(s) may be assigned with the task to provide specified services on the apron. ***Source:* ICAO Annex 11, Chapter 3, 3.2 Provision of air traffic control service**	X	X	X	X	X	X	X	
(04)		~~Name~~ State the purpose of clearances issued by an ATC unit. ***Source:* ICAO Annex 11, Chapter 3, 3.3 Operation of air traffic control service**	X	X	X	X	X	X	X	
~~LO (05)~~		~~Describe the aim of clearances issued by ATC with regard to IFR, VFR or special VFR flights, and refer to the different airspaces.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(06)		List the various (five possible) parts of an ATC clearance.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		***Source:* ICAO Annex 11, Chapter 3, 3.7.1 Contents of clearances**								
~~LO (07)~~		~~Describe the various aspects of clearance coordination.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (08)~~		~~State how ATC shall react when it becomes apparent that traffic, additional to that already accepted, cannot be accommodated within a given period of time at a particular location or in a particular area, or can only be accommodated at a given rate.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(09)		Explain why the movement of persons, vehicles and towed aircraft on the manoeuvring area of an AD shall be controlled by the ~~AD~~ aerodrome control tower (TWR) (as necessary). ***Source:* ICAO Annex 11, Chapter 3, 3.8 Control of persons and vehicles at aerodromes, 3.8.1**	X	X	X	X	X	X		
010 07 01 05		***Flight ~~i~~Information ~~s~~Service (FIS)***								
(01)	X	State for which aircraft FIS shall be provided. ***Source:* ICAO Annex 11, Chapter 4, 4.1 Application**	X	X	X	X	X	X		
(02)	X	State whether or not FIS shall include the provision of pertinent significant meteorological information (SIGMET) and air meteorological information report (AIRMET) information. ***Source:* ICAO Annex 11, Chapter 4, 4.2 Scope of flight information service**	X	X	X	X	X	X		
(03)	X	State which information FIS shall include in addition to SIGMET and AIRMET information. ***Source:* ICAO Annex 11, Chapter 4, 4.2 Scope of flight information service**	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)	X	Indicate which other information the FIS shall include in addition to the special information given in Annex~~NNEX~~ 11. **Source: ICAO Annex 11, Chapter 4, 4.2 Scope of flight information service, 4.2.2 Note 2 and Attachment B**	X	X	X	X	X	X		
~~LO (05)~~		~~Name the three major types of operational FIS broadcasts.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(06)	X	~~Give~~ State the meaning of the acronym 'ATIS' in plain language. **Source: ICAO Annex 11, Chapter 4, 4.3.4 Voice-automatic terminal information service (Voice-ATIS) broadcasts**	X	X	X	X	X	X		
~~LO (07)~~		~~Show that you are acquainted with the basic conditions for transmitting an ATIS as indicated in ANNEX 11.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (08)~~		~~Mention the four possible ATIS messages.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(09)		List the basic information concerning automatic terminal information service (ATIS) broadcasts (e.g. frequencies used, number of ADs included, updating, identification, acknowledgment of receipt, language and channels, ALT-setting). **Source: ICAO Annex 11, Chapter 4, 4.3.4 Voice-automatic terminal information service (Voice-ATIS) broadcasts**	X	X	X	X	X	X		
(10)		~~Understand~~ State the content of an ATIS message ~~and the factors involved~~. **Source: ICAO Annex 11, Chapter 4, 4.3.7 ATIS for arriving and departing aircraft**	X	X	X	X	X			
(11)		State the reasons and circumstances when an ATIS message	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		shall be updated. ***Source:* ICAO Annex 11, Chapter 4, 4.3.6 Automatic terminal information service (voice and/or data link)**								
010 07 01 06		***Alerting service***								
(01)		Indicate who provides the alerting service. ***Source:* ICAO Annex 11, Chapter 2, 2.10 Establishment and designation of the units providing air traffic services**	X	X	X	X	X			
(02)		State who is responsible for initiating the appropriate emergency phase. ***Source:* ICAO Annex 11, Chapter 5 Alerting service**	X	X	X	X	X			
(03)		Indicate the aircraft to which alerting service shall be provided. ***Source:*: ICAO Annex 11, Chapter 5 Alerting service**	X	X	X	X	X			
(04)		Name the unit which shall be notified by the responsible ATS unit immediately when an aircraft is considered to be in a state of emergency. ***Source:* ICAO Annex 11, Chapter 5 Alerting service**	X	X	X	X	X			
(05)		Name the three stages of emergency and describe the basic conditions for each kind of emergency. ***Source:* ICAO Annex 11, Chapter 5 Alerting service**	X	X	X	X	X			
(06)	X	~~Demonstrate knowledge of~~ State the meaning of the expressions 'INCERFA', 'ALERFA' and 'DETRESFA'. ***Source:* ICAO Annex 11, Chapter 5 Alerting service**	X	X	X	X	X			
(07)	X	~~Describe the limiting conditions for the information of~~ State the information to be provided to those aircraft that operate in the vicinity of an aircraft that is either ~~being~~ in a	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		state of emergency or unlawful interference. ***Source:*** **ICAO Annex 11, Chapter 5 Alerting service**								
010 07 01 07		***Principles governing required navigation performance (RNP) and air traffic service (ATS) route designators***								
(01)		State the meaning of the expression~~s~~ RNP ~~4, RNP 1, etc~~. ***Source:*** **ICAO Annex 11, Chapter 1, Definitions**	X	X	X	X	X			
(02)		State the factors that RNP is based on. ***Source:*** **ICAO Annex 11, Chapter 1, Definitions (Navigation specification)**	X	X	X	X	X			
(03)	X	Describe the reason for establishing a system of route designators and navigation specifications.~~Required Navigation Performance (RNP)~~. ***Source:*** **ICAO Annex 11, Appendix 1, 1. Designators for ATS routes and navigation specifications**	X	X	X	X	X			
(04)		State whether or not a prescribed RNP type is considered an integral part of the ATS route designator. ***Source:*** **ICAO Annex 11, Appendix 1, 1. Designators for ATS routes and navigation specifications**	X	X	X	X	X			
(05)		~~Demonstrate general knowledge of~~ Explain the composition of an ATS route designator. ***Source:*** **ICAO Annex 11, Appendix 1, 2. Composition of designator (not to the extent of memorising the codes in 2.2.1)**	X	X	X	X	X			
010 07 02 00		**ICAO Doc~~ument~~ 4444 — Air Traffic Management**								
010 07 02 01		***Foreword (Scope and purpose)***								
~~LO (01)~~		~~Explain in plain language the meaning of the acronym~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~'PANS-ATM'.~~								
~~LO (02)~~		~~State whether or not the procedures prescribed in ICAO Doc 4444 are directed exclusively to ATS services personnel.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (03)~~		~~Describe the relationship between ICAO Doc 4444 and other documents.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(04)		State ~~whether or not a clearance issued by an~~ which ATS ~~ATC~~ unit~~s~~ provides clearances to do, and do not, ~~does~~ include the prevention of collision with terrain, ~~and if there is an exception to this, name the exception.~~ ***Source:* ICAO Doc 4444, Foreword, 2 Scope and purpose, 2.1**	X	X	X	X	X	X	X	
010 07 02 02		***Definitions***								
(01)	X	Recall all definitions given in ICAO Doc 4444 except the following: accepting unit/controller, AD taxi circuit, aeronautical fixed service (AFS), aeronautical fixed station, air-taxiing, allocation, approach funnel, assignment, data convention, data processing, discrete code, D-value, flight status, ground effect, receiving unit/controller, sending unit/controller, transfer of control point, transferring unit/controller, unmanned free balloon. ***Source:* ICAO Doc 4444, Chapter 1 Definitions**	X	X	X	X	X	X		
010 07 02 03		***ATS system capacity and a~~A~~ir t~~T~~raffic f~~F~~low m~~M~~anagement (ATFM)***								
(01)	X	Explain when and where ATFM services shall be implemented. ***Source:* ICAO Doc 4444, Chapter 3, 3.2 Air traffic flow**	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		management, 3.2.1 General								
010 07 02 04		***General provisions for a~~A~~ir t~~T~~raffic s~~S~~ervices (ATS)***								
(01)	X	Describe who is responsible for the provision of flight information and alerting service within an ~~Flight Information Region (~~FIR~~)~~, within controlled airspace and at controlled ADs~~aerodromes~~. ***Source:*** **ICAO Doc 4444, Chapter 4, 4.2 Responsibility for the provision of flight information service and alerting service**	X	X	X	X	X	X		
010 07 02 05		***ATC clearances***								
~~LO (01)~~		~~Explain 'the sole scope and purpose' of an ATC clearance.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(02)		State which information the issue of an ATC clearance is based on. ***Source:*** **ICAO Doc 4444, Chapter 4, 4.5 Air traffic control clearances, 4.5.1 Scope and purpose**	X	X	X	X	X	X	X	
(03)		Describe what a PIC should do if an ATC clearance is not suitable. ***Source:*** **ICAO Doc 4444, Chapter 4, 4.5 Air traffic control clearances, 4.5.1 Scope and purpose**	X	X	X	X	X	X	X	
(04)		~~Indicate~~ State who bears the responsibility for adhering to the applicable rules and regulations whilst flying under the control of an ATC unit. ***Source:*** **ICAO Doc 4444, Chapter 4, 4.5 Air traffic control clearances, 4.5.1 Scope and purpose**	X	X	X	X	X	X	X	
(05)	X	~~Name~~ State the two primary purposes of clearances issued by ATC units.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		***Source:* ICAO Doc 4444, Chapter 4, 4.5 Air traffic control clearances, 4.5.1 Scope and purpose**								
(06)		State why clearances must be issued 'early enough' to en-route aircraft. ***Source:* ICAO Doc 4444, Chapter 4, 4.5 Air traffic control clearances, 4.5.1 Scope and purpose**	X	X	X	X	X	X		
(07)		Explain what is meant by the expression 'clearance limit'. ***Source:* ICAO Doc 4444, Chapter 4, 4.5.7 Description of air traffic control clearances, 4.5.7.1 Clearance limit**	X	X	X	X	X	X	X	
(08)		Explain the meaning of the phrases 'cleared via flight planned route', 'cleared via (designation) departure' and 'cleared via (designation) arrival' in an ATC clearance. ***Source:* ICAO Doc 4444, Chapter 4, 4.5.7 Description of air traffic control clearances, 4.5.7.2 Route of flight**	X	X	X	X	X	X	X	
(09)		List which items of an ATC clearance shall always be read back by the flight crew. ***Source:* ICAO Doc 4444, Chapter 4, 4.5.7.5 Readback of clearances**	X	X	X	X	X	X	X	
010 07 02 06		***Horizontal speed control instructions***								
(01)		Explain the reason for speed control by ATC. **Source: ICAO Doc 4444, Chapter 4, 4.6 Horizontal speed control instructions, 4.6.1 General**	X	X	X	X	X	X	X	
(02)	X	Define the maximum speed changes that ATC may impose. ***Source:* ICAO Doc 4444, Chapter 4, 4.6.3 Descending and arriving aircraft**	X	X	X	X	X	X	X	
(03)		State within ~~which~~ what distance from the THR~~threshold~~ the PIC ~~must~~ should not expect any kind of speed control.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		***Source:* ICAO Doc 4444, Chapter 4, 4.6.3 Descending and arriving aircraft**								
010 07 02 07		***Change from IFR to VFR flight***								
(01)		Explain how the change from IFR to VFR can be initiated by the PIC. ***Source:* ICAO Doc 4444, Chapter 4, 4.8 Change from IFR to VFR flight**	X		X			X	X	
(02)		~~Indicate~~ Describe the expected reaction of the appropriate ATC unit upon a request to change from IFR to VFR. ***Source:* ICAO Doc 4444, Chapter 4, 4.8 Change from IFR to VFR flight**	X		X			X	X	
010 07 02 08		***Wake turbulence***								
(01)		State the wake-turbulence categories of aircraft. ***Source:* ICAO Doc 4444, Chapter 4, 4.9.1 Wake turbulence categories of aircraft**	X	X	X	X	X	X		
(02)		State the wake-turbulence separation minima. ***Sourcez:* ICAO Doc 4444, Chapter 5, 5.8 Time-based wake turbulence longitudinal separation minima** **ICAO Doc 4444, Chapter 8, 8.7.3.4 (table of distance-based wake turbulence separation minima) and 8.7.3.4.1 (appropriate conditions for application)**	X	X	X	X	X	X		
(03)		Describe how a 'heavy' aircraft shall indicate this in the initial radio-telephony contact with ATS. ***Source:* ICAO Doc 4444, Chapter 4, 4.9.2 Indication of heavy wake turbulence category**	X	X	X	X	X	X		
010 07 02 09		***Altimeter-setting procedures***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Define the following terms: — TRL~~transition level~~; — transition layer; and — TA~~transition altitude~~. — **Source: ICAO Doc 4444, Chapter 1, Definitions**	X	X	X	X	X	X	X	
(02)		~~Indicate~~ Describe how the vertical position of an aircraft in the vicinity of an AD~~aerodrome~~ shall be expressed at or below the TA~~transition altitude~~, at or above the TRL~~transition level~~, and while climbing or descending through the transition layer. ***Source:* ICAO Doc 4444, Chapter 4, 4.10.1 Expression of vertical position of aircraft**	X	X	X	X	X	X	X	
(03)		Describe when the HGT~~height~~ of an aircraft using QFE during an NDB approach is referred to the landing THR~~threshold~~ instead of the AD~~aerodrome~~ elevation. ***Source:* ICAO Doc 4444, Chapter 4, 4.10.1 Expression of vertical position of aircraft**	X	X	X	X	X	X	X	
(04)		~~Indicate~~ State how far altimeter settings provided to aircraft shall be rounded up or down. ***Source:* ICAO Doc 4444, Chapter 4, 4.10.4 Provision of altimeter setting information**	X	X	X	X	X	X	X	
(05)		~~Define~~ Describe the expression 'lowest usable FL~~flight level~~'. ***Source:* ICAO Doc 4444, Chapter 4, 4.10.4 Provision of altimeter setting information**	X	X	X	X	X	X	X	
(06)		Determine how the vertical position of an aircraft on an en-route flight is expressed at or above the lowest usable FL ~~flight level~~ and below the lowest usable FL~~flight level~~. ***Source:* ICAO Doc 4444, Chapter 4, 4.10.1 Expression of**	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		vertical position of aircraft								
(07)		State who establishes the TRL~~transition level~~ to be used in the vicinity of an AD~~aerodrome~~. ***Source:*** **ICAO Doc 4444, Chapter 4, 4.10.2 Determination of the transition level**	X	X	X	X	X	X	X	
(08)		Decide how and when a flight crew member shall be informed about the TRL~~transition level~~. ***Source:*** **ICAO Doc 4444, Chapter 4, 4.10.4 Provision of altimeter setting information**	X	X	X	X	X	X	X	
(09)		State whether or not the pilot can request ~~the~~ TRL~~transition level~~ to be included in the approach clearance. ***Source:*** **ICAO Doc 4444, Chapter 4, 4.10.4 Provision of altimeter setting information**	X	X	X	X	X	X	X	
~~LO (10)~~		~~State in what kind of clearance the QNH altimeter setting shall be included.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
010 07 02 10		***Position reporting***								
(01)		Describe when position reports shall be made by an aircraft flying on routes defined by designated significant points. ***Source:*** **ICAO Doc 4444, Chapter 4, 4.11.1 Transmission of position reports**	X	X	X	X	X	X	X	
(02)		List the six items that are normally included in a voice position report. ***Source:*** **ICAO Doc 4444, Chapter 4, 4.11.2 Contents of voice position reports, 4.11.1.1**	X	X	X	X	X	X	X	
(03)	X	~~Name~~ State the requirements for using a simplified position report with FL~~flight level~~, next position (and time-over) and ensuing significant points omitted.	X	X	X	X	X	X	X	

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		***Source:* ICAO Doc 4444, Chapter 4, 4.11.2 Contents of voice position reports**								
(04)		~~Name~~ State the item of a position report which must be forwarded to ATC with the initial call after changing to a new frequency. ***Source:* ICAO Doc 4444, Chapter 4, 4.11.2 Contents of voice position reports**	X	X	X	X	X	X	X	
(05)		Indicate the item of a position report which may be omitted if secondary surveillance radar (SSR) Mode C is used. ***Source:* ICAO Doc 4444, Chapter 4, 4.11.2 Contents of voice position reports**	X	X	X	X	X	X	X	
(06)		Explain in which circumstances the indicated airspeed should be included in a position report. ***Source:* ICAO Doc 4444, Chapter 4, 4.11.2 Contents of voice position reports**	X	X	X	X	X	X		
(07)		Explain the meaning of the acronym 'ADS'.	X	X	X	X	X	X		
~~LO (08)~~		~~State to which unit an ADS report shall be made.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (09)~~		~~Describe how ADS reports shall be made.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(10)		Describe which expression shall precede the level figures in a position report if the level is reported in relation to 1013.2 hPa (standard pressure). ***Sourcez:* ICAO Doc 4444, Chapter 4, 4.5.7.5 Readback of clearances** **ICAO Doc 4444, Chapter 4, 4.11.2 Contents of voice position reports**	X	X	X	X	X	X		
010 07 02 11		***Reporting of operational and meteorological information***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		List the occasions when special air reports shall be made. ***Source:*** **ICAO Doc 4444, Chapter 4, 4.12.3 Contents of special air-reports 4.12.3.1 (a to k inclusive)**	X	X	X	X	X	X		
010 07 02 12		***Separation methods and minima***								
(01)		Explain the general provisions for the separation of controlled air traffic. ***Source:*** **ICAO Doc 4444, Chapter 5, 5.2.1 General and 5.2.2 Degraded aircraft performance**	X		X			X	X	
(02)	X	Name the different kinds of separation used in aviation. ***Source:*** **ICAO Doc 4444, Chapter 5** **ICAO Annex 11 Chapter 3, 3.5.2**	X		X			X	X	
(03)		~~Understand~~ State the difference between the type of separation provided within the various classes of airspace and the various types of flight. ***Source:*** **ICAO Doc 4444, Chapter 5, 5.2 Provisions for the separation of controlled traffic**	X		X			X	X	
(04)		State who is responsible for the avoidance of collision with other aircraft when operating in VMC. ***Source:*** **ICAO Doc 4444, Chapter 5, 5.9 Clearances to fly maintaining own separation while in VMC**	X		X			X	X	
~~LO (05)~~		~~State the ICAO documents in which details of current separation minima are prescribed.~~	~~X~~		~~X~~			~~X~~	~~X~~	
(06)		Describe how vertical separation is obtained. ***Source:*** **ICAO Doc 4444, Chapter 5, 5.3.1 Vertical separation application**	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(07)		State the required vertical separation minimum. ***Source:* ICAO Doc 4444, Chapter 5, 5.3.2 Vertical separation minimum**	X		X			X	X	
(08)		Describe how the cruising levels of aircraft flying to the same destination and in the expected approach sequence are correlated with each other. **Source: ICAO Doc 4444, Chapter 5, 5.3.3 Assignment of cruising levels for controlled flights**	X		X			X	X	
(09)		Name the conditions that must be adhered to when two aircraft are cleared to maintain a specified vertical separation between them during climb or descent. **Source: ICAO Doc 4444, Chapter 5, 5.3.4 Vertical separation during climb or descent**	X		X			X	X	
(10)		~~List~~ State the two main methods for horizontal separation. ***Source:* ICAO Doc 4444, Chapter 5**	X		X			X	X	
(11)		Describe how lateral separation of aircraft at the same level may be obtained. ***Source:* ICAO Doc 4444, Chapter 5, 5.4.1 Lateral separation, 5.4.1.1.2**	X		X			X	X	
(12)		Explain the term 'geographical separation'. ***Source:* ICAO Doc 4444, Chapter 5, 5.4.1 Lateral separation**	X		X			X	X	
(13)		Describe track separation between aircraft using the same navigation aid or method. ***Source:* ICAO Doc 4444, Chapter 5, 5.4.1.2 Lateral separation criteria and minima, 5.4.1.2.1.2**	X		X			X	X	
(14)		Describe the three basic means for the establishment of longitudinal separation.	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **ICAO Doc 4444, Chapter 5, 5.4.2**								
~~LO (15)~~		~~Describe the circumstances under which a reduction in separation minima may be allowed.~~	~~X~~		~~X~~			~~X~~	~~X~~	
(16)		Indicate the minimum standard horizontal radar separation in NM. ***Source:*** **ICAO Doc 4444, Chapter 5**	X		X			X	X	
(17)		Describe the method of the Mach number technique. ***Source:*** **ICAO Doc 4444, Chapter 5, 5.4.2.4 Longitudinal separation minima with mach number technique based on time**	X	X						
~~LO (18)~~		~~State the wake-turbulence radar separation for aircraft in the APP and DEP phases of a flight when an aircraft is operating directly behind another aircraft at the same ALT or less than 300 m (1 000 ft) below.~~	~~X~~		~~X~~			~~X~~	~~X~~	
010 07 02 13		***Separation in the vicinity of aerodromes (ADs)***								
(01)		~~Define~~ Describe the expression 'e~~E~~ssential l~~L~~ocal t~~T~~raffic'. ***Source:*** **ICAO Doc 4444, Chapter 6, 6.2 Essential local traffic**	X	X	X	X	X	X		
(02)		State which possible decision the PIC may choose to take if ~~departing aircraft are expedited by suggesting a~~ they are~~he is required~~ asked to accept take-off in a direction which is not 'into the wind'. ***Source:*** **ICAO Doc 4444, Chapter 6, 6.3.3 Departure sequence**	X	X	X	X	X	X		
(03)		State the condition to enable ATC to initiate a visual approach for an IFR flight. ***Source:*** **ICAO Doc 4444, Chapter 6, 6.5.3 Visual approach,**	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		6.5.3.1								
(04)		~~Indicate~~ State whether or not separation shall be provided by ATC between an aircraft executing a visual approach and other arriving or departing aircraft. ***Source:* ICAO Doc 4444, Chapter 6, 6.5.3 Visual approach, 6.5.3.4**	X	X	X	X	X	X	X	
(05)		State in which case, when the flight crew are not familiar with the instrument approach procedure being carried out, only the final approach track has to be ~~forwarded~~ given to them by ATC. ***Source:* ICAO Doc 4444, Chapter 6, 6.5.4 Instrument approach**	X	X	X	X	X	X	X	
(06)		Describe which FL~~flight level~~ should be assigned to an aircraft first arriving over a holding fix for landing. ***Source:* ICAO Doc 4444, Chapter 6, 6.5.5 Holding**	X	X	X	X	X	X	X	
(07)		~~Talk about~~ State ~~the~~ which kinds of priority ~~that shall~~ can be ~~given~~ applied to aircraft for ~~a~~ landing. ***Source:* ICAO Doc 4444, Chapter 6, 6.5.6 Approach sequence, 6.5.6.1 General**	X	X	X	X	X	X	X	
(08)		~~Understand~~ Describe the situation when a pilot of an aircraft in an approach sequence indicates their intention to hold for weather improvements. ***Source:* ICAO Doc 4444, Chapter 6, 6.5.6 Approach sequence, 6.5.6.1 General**	X	X	X	X	X	X	X	
(09)		Explain the term ‘e~~E~~xpected a~~A~~pproach t~~T~~ime’ and the procedures for its use. ***Source:* ICAO Doc 4444, Chapter 6, 6.5.7 Expected**	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		approach time								
(10)		State the reasons which could probably lead to the decision to use another take-off or landing direction than the one into the wind. ***Source:*** **ICAO Doc 4444, Chapter 7, 7.2 Selection of runway-in-use**	X	X	X	X	X	X	X	
(11)		~~Name~~ State the possible consequences for a PIC if the 'RWY-in-use' is not considered suitable for the operation involved. ***Source:*** **ICAO Doc 4444, Chapter 7**	X	X	X	X	X	X	X	
010 07 02 14		***Miscellaneous separation procedures***								
~~LO (01)~~		~~Be familiar with the separation of aircraft holding flight.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~LO (02)~~		~~Be familiar with the minimum separation between departing aircraft.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(03)		~~Be familiar~~ State ~~with~~ the minimum separation between departing and arriving aircraft. ***Source:*** **ICAO Doc 4444, Chapter 5, 5.7 Separation of departing aircraft from arriving aircraft**	X	X	X	X	X	X	X	
(04)		~~Be familiar~~ State ~~with~~ the non-radar wake-turbulence longitudinal separation minima. ***Source:*** **ICAO Doc 4444, Chapter 5 and 6**	X	X	X	X	X	X	X	
(05)		~~Know about~~ Describe the consequences of a clearance to 'maintain own separation' while in VMC. ***Source:*** **ICAO Doc 4444, Chapter 5, 5.8 Time-based wake turbulence longitudinal separation minima, 5.8.1** **ICAO Doc 4444, Chapter 6, 6.5.3 Visual approach**	X	X	X	X	X	X	X	
(06)		Give a brief description of 'essential traffic' and 'essential	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		traffic information'. ***Source:* ICAO Doc 4444, Chapter 5, 5.10 Essential traffic information**								
(07)		Describe the circumstances under which a reduction in separation minima may be allowed. ***Source:* ICAO Doc 4444, Chapter 6, 6.1 Reduction in separation minima in the vicinity of aerodromes**	X	X	X	X	X	X	X	
010 07 02 15		***Arriving and departing aircraft***								
(01)		List the elements of information which shall be transmitted to an aircraft as early as practicable possible if an approach for landing is intended. ***Source:* ICAO Doc 4444, Chapter 6, 6.6 Information for arriving aircraft**	X	X	X	X	X	X	X	
(02)		List the elements of information to be transmitted to an aircraft at the commencement of final approach. ***Source:* ICAO Doc 4444, Chapter 6, 6.6 Information for arriving aircraft**	X	X	X	X	X	X	X	
(03)		List the elements of information to be transmitted to an aircraft during final approach. ***Source:* ICAO Doc 4444, Chapter 6, 6.6 Information for arriving aircraft**	X	X	X	X	X	X	X	
(04)		~~Acquaint yourself with all the information regarding arriving and/or departing aircraft~~ State the prerequisites for operating on parallel or near-parallel RWYs~~runways, including knowledge about NTZ and NOZ and~~ the ~~various~~ different combinations of parallel arrivals ~~and/~~or departures. ***Source:* ICAO Doc 4444, Chapter 6, 6.7 Operations on**	X	X	X	X	X	X		

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		parallel or near-parallel runways								
(05)		State the sequence of priority between aircraft landing (or in the final stage of an approach to land) and aircraft intending to depart. ***Source:* ICAO Doc 4444, Chapter 7, 7.8 Order of priority for arriving and departing aircraft**	X	X	X	X	X	X	X	
~~LO (06)~~		~~Explain the factors that influence the approach sequence.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(07)		State the significant changes in the meteorological conditions in the take-off or climb-out area that shall be transmitted without delay to a departing aircraft. ***Source:* ICAO Doc 4444, Chapter 6, 6.4.1 Meteorological conditions**	X	X	X	X	X	X	X	
~~LO (08)~~		~~Describe what information shall be forwarded to a departing aircraft as far as visual or non-visual aids are concerned.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(09)		State the significant changes that shall be transmitted as early as practicable possible to an arriving aircraft, particularly changes in the meteorological conditions. ***Source:* ICAO Doc 4444, Chapter 6, 6.6 Information for arriving aircraft**	X	X	X	X	X	X	X	
010 07 02 16		***Procedures for aerodrome (AD) control service***								
~~LO (01)~~		~~Describe the general tasks of the Aerodrome Control Tower (TWR) when issuing information and clearances to aircraft under its control.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~LO (02)~~		~~List for which aircraft and their given positions or flight situations the TWR shall prevent collisions.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)		Name the operational failure or irregularity of AD equipment which shall be reported to the TWR immediately. ***Source:* ICAO Doc 4444, Chapter 7, 7.1.3 Failure or irregularity of aids and equipment**	X	X	X	X	X	X	X	
(04)		~~State~~ Explain that, after a given period of time, the TWR shall report to the area control centre (ACC) or flight information centre (FIC) if an aircraft does not land as expected. ***Source:* ICAO Doc 4444, Chapter 7, 7.1.2 Alerting service provided by aerodrome control towers**	X	X	X	X	X	X	X	
(05)		Describe the procedures to be observed by the TWR whenever VFR operations are suspended. **Source: ICAO Doc 4444, Chapter 7, 7.13 Suspension of visual flight rules operations**	X	X	X	X	X	X	X	
(06)		Explain the term 'RWY-in-use' and its selection. ***Source:* ICAO Doc 4444, Chapter 7, 7.2 Selection of runway-in-use**	X	X	X	X	X	X		
(07)		List the information the TWR should give to an aircraft: — prior to taxiing for take-off; — prior to take-off; — prior to entering the traffic circuit. ***Source:* ICAO Doc 4444, Chapter 7, 7.4.1.2 Aerodrome and meteorological information**	X	X	X	X	X	X		
(08)		Explain that a report of surface wind direction given to a pilot by the TWR is magnetic. ***Source:* ICAO Doc 4444, Chapter 11, 11.4.3.2 Messages**	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		containing meteorological information								
(09)		Explain the exact meaning of the expression '~~runway~~ RWY vacated'. ***Source:* ICAO Doc 4444, Chapter 7, 7.10.3.4**	X	X	X	X	X	X		
010 07 02 17		***Radar services***								
~~LO (01)~~		~~State to what extent the use of radar in air traffic services may be limited.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~LO (02)~~		~~State what radar-derived information shall be available for display to the controller as a minimum.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(03)		~~Name~~ State the ~~two~~ basic identification procedures used with radar. ***Source:* ICAO Doc 4444, Chapter 8, 8.6.2.3 SSR and/or MLAT identification procedures and Chapter 8, 8.6.2.4 PSR identification procedures**	X	X	X	X	X	X	X	
~~LO~~ (04)		~~Define~~ Describe the term 'PSR'. ***Source:* ICAO Doc 4444, Chapter 1 Definitions**	X	X	X	X	X	X	X	
(05)		Describe the circumstances under which an aircraft provided with radar service should be informed of its position. ***Source:* ICAO Doc 4444, Chapter 8, 8.6.4 Position information**	X	X	X	X	X	X	X	
(06)		List the possible forms of position information passed on to the aircraft by radar services. ***Source:* ICAO Doc 4444, Chapter 8, 8.6.4 Position information**	X	X	X	X	X	X	X	
(07)		Define the term 'radar vectoring'.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		***Source:* ICAO Doc 4444, Chapter 8, 8.6.5 Vectoring**								
~~LO~~ (08)		State the aims of radar vectoring as shown in ICAO Doc 4444. ***Source:* ICAO Doc 4444, Chapter 8, 8.6.5 Vectoring**	X	X	X	X	X	X	X	
(09)		~~State~~ Describe how radar vectoring shall be achieved. ***Source:* ICAO Doc 4444, Chapter 8, 8.6.5 Vectoring**	X	X	X	X	X	X	X	
(10)		Describe the information which shall be given to an aircraft when radar vectoring is terminated and the pilot is instructed to resume own navigation. ***Source:* ICAO Doc 4444, Chapter 8, 8.6.5 Vectoring**	X	X	X	X	X	X	X	
(11)		Explain the procedures for the conduct of s~~S~~urveillance r~~R~~adar a~~A~~pproaches (SRA). ***Source:* ICAO Doc 4444, Chapter 8, 8.9.7.1 Surveillance radar approach**	X	X	X	X	X	X	X	
(12)		Describe what kind of action (concerning the transponder) the pilot is expected to perform in case of emergency if they have previously been directed by ATC to operate the transponder on a specific code. ***Source:* ICAO Doc 4444, Chapter 8, 8.8.1 Emergencies**	X	X	X	X	X	X	X	
010 07 02 18		***Air traffic advisory service***								
(01)		Describe the objective and basic principles of the air traffic advisory service. ***Source:* ICAO Doc 4444, Chapter 9, 9.1.4.1 Objective and basic principles**	X	X	X	X	X	X		
(02)		State to which aircraft air traffic advisory service ~~shall~~ may be provided.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **ICAO Doc 4444, Chapter 9, 9.1.4.1 Objective and basic principles**								
(03)		Explain ~~why~~ the difference between ~~air traffic advisory service does not deliver 'clearances' but only '~~advisory information~~'.~~ and clearances, stating which ATS units are responsible for their issue. ***Source:*** **ICAO Doc 4444, Chapter 9, 9.1.4.1.3**	X	X	X	X	X	X		
010 07 02 19		***Procedures related to emergencies, communication (COM) failure and contingencies***								
(01)		State the mode and code of SSR equipment a pilot might operate in a (general) state of emergency or (specifically) in case the aircraft is subject to unlawful interference. ***Source:*** **ICAO Doc 4444, Chapter 15, 15.1 Emergency procedures**	X	X	X	X	X	X	X	
(02)		State the special rights an aircraft in a state of emergency can expect from ATC. ***Source:*** **ICAO Doc 4444, Chapter 15, 15.1.1 General; 15.1.2 Priority; 15.1.3 Unlawful interference and aircraft bomb threat**	X	X	X	X	X	X	X	
(03)		Describe the expected action of aircraft after receiving a broadcast from ATS concerning the emergency descent of an aircraft. ***Source:*** **ICAO Doc 4444, Chapter 15, 15.1.4 Emergency descent**	X	X	X	X	X	X	X	
(04)		State how it can be ascertained, in case of a failure of two-way COM~~communication~~, whether the aircraft is able to receive transmissions from the ATS unit. ***Source:*** **ICAO Doc 4444, Chapter 15, 15.3 Air-ground**	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		communications failure								
~~LO (05)~~		~~Explain the assumption based on which separation shall be maintained if an aircraft is known to experience a COM failure in VMC or in IMC.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(06)		State on which frequencies appropriate information, for an aircraft encountering two-way COM failure, shall be sent by ATS. ***Source:* ICAO Doc 4444, Chapter 15, 15.3.5**	X	X	X	X	X	X	X	
~~LO (07)~~		~~Describe the expected actions of an ATS unit after having been informed that an aircraft is being intercepted in or outside its area of responsibility.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(08)		State what is meant by the expression 'strayed aircraft' and 'unidentified aircraft'. ***Source:* ICAO Doc 4444, Chapter 15, 15.5.1 Strayed or unidentified aircraft**	X	X	X	X	X	X	X	
(09)		Explain the ~~minimum level~~ the reasons for fuel-dumping and state the minimum level ~~the reasons for this~~. ***Source:* ICAO Doc 4444, Chapter 15, 15.5.3 Fuel dumping**	X	X	X	X	X	X		
(10)		Explain the possible request of ATC to an aircraft to change its radio-telephone (RTF) call sign. ***Source:* ICAO Doc 4444, Chapter 15, 15.7.6 Change of radiotelephony call sign for aircraft**	X	X	X	X	X	X		
010 07 02 20		***Miscellaneous procedures***								
(01)		Explain the meaning of 'AIRPROX'. ***Sourcez:* ICAO Doc 4444, Chapter 1, Definitions** **ICAO Doc 4444, Chapter 16, 16.3 Air traffic incident report**	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		Determine the task of an air traffic incident report. ***Source:*** **ICAO Doc 4444, Chapter 16, 16.3 Air traffic incident report**	X	X	X	X	X	X		
010 08 00 00		**AERONAUTICAL INFORMATION SERVICE (AIS)**								
010 08 01 00		**Introduction**								
010 08 01 00		**Introduction to ICAO Annex 15 — Aeronautical Information Service (AIS)**								
(01)		State, in general terms, the objective of an AIS ~~the Aeronautical Information Service~~.	X	X	X	X	X	X		
010 08 02 00		**Definitions of ICAO Annex 15**								
010 08 02 01		***Definitions of ICAO Annex 15***								
(01)		Recall the following definitions: a~~A~~eronautical i~~I~~nformation c~~C~~ircular (AIC), a~~A~~eronautical i~~I~~nformation p~~P~~ublication (AIP), AIP amendment, AIP supplement, aeronautical information regulation and control (AIRAC), danger area, integrated aeronautical information package, international airport, international NOTAM office (NOF), manoeuvring area, movement area, NOTAM, p~~P~~re-flight i~~I~~nformation b~~B~~ulletin (PIB), prohibited area, restricted area, SNOWTAM, ASHTAM. ***Source:*** **ICAO Annex 15, Chapter 1, 1.1 Definitions**	X	X	X	X	X	X	X	
010 08 03 00		**General**								
010 08 03 01		***General — AIS responsibilities and functions***								
(01)		State during which period of time AIS~~aeronautical~~	X	X	X	X	X	X		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~information service~~ shall be available with reference to an aircraft flying in the area of responsibility of an AIS, provided a 24-hour service is not available. **_Source:_ ICAO Annex 15, Chapter 2, 2.2 AIS responsibilities and functions**								
(02)		~~Name (~~List, in general~~),~~ the kind of aeronautical information/data which an AIS service shall make available in a suitable form to flight crew~~s~~. **Source: ICAO Annex 15, Chapter 2, 2.2 AIS responsibilities and functions**	X	X	X	X	X	X		
(03)		Summarise the duties of AIS~~aeronautical information service~~ concerning aeronautical information data for the territory of ~~the~~ a particular state. **_Source:_** **ICAO Annex 15, Chapter 2, 2.2 AIS responsibilities and functions** **ICAO Annex 15, Chapter 2, 2.3 Exchange of aeronautical data and aeronautical information**	X	X	X	X	X	X		
~~LO (04)~~		~~Understand the principles of WGS 84.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
010 08 04 00		**Integrated aeronautical information package**								
~~(01)~~		~~Name the different elements that make up an integrated aeronautical information package.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
_010 08 04 01_		**_Aeronautical ~~i~~Information ~~p~~Publication (AIP)_**								
(01)		State the primary purpose of the AIP. **_Source:_ ICAO Annex 15, Chapter 4, Notes 1 and 2**	X	X	X	X	X	X		
(02)		Name the different parts of the AIP.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		***Source:* ICAO Annex 15, Chapter 4, 4.1 Contents**								
(03)		State ~~in which~~ the main parts of the AIP where the following information can be found: — differences from the ICAO Standards, Recommended Practices and Procedures; — location indicators, AIS~~aeronautical information services~~, minimum flight ALT~~altitude~~, meteorological information for aircraft in flight (VOLMET) service, SIGMET service; — general rules and procedures (especially general rules, VFR, IFR, ALT-setting procedure, interception of civil aircraft, unlawful interference, air traffic incidents); — ATS airspace (especially FIR, UIR, TMA); — ATS routes (especially lower ATS routes, upper ATS routes, area navigation routes); — AD~~aerodrome~~ data including aprons, taxiways (TWYs) and check locations/positions data; — navigation warnings (especially prohibited, restricted and danger areas); — aircraft instruments, equipment and flight documents; — AD surface movement guidance and control system and markings; — RWY physical characteristics, declared distances, approach (APP) and RWY lighting; — AD radio navigation and landing aids; — charts related to an AD;	X	X	X	X	X	X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— entry, transit and departure of aircraft, passengers, crew and cargo, and the significance of this information to flight crew. ***Source:* ICAO Annex 15, Appendix 1**								
(04)		State how permanent changes to the AIP shall be published. ***Source:*** **ICAO Annex 15, Chapter 4, 4.3 Specifications for AIP Amendments** **ICAO Annex 15, Chapter 4, 4.5 Distribution**	X	X	X	X	X	X		
(05)		Explain what kind of information shall be published in the form of AIP ~~s~~Supplements. ***Source:* ICAO Annex 15, Chapter 4, 4.4 Specifications for AIP Supplements**	X	X	X	X	X	X		
~~LO (06)~~		~~Describe how conspicuousness of AIP Supplement pages is achieved.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
010 08 04 02		***Notices to airmen (NOTAMs)***								
(01)		Describe how information shall be published which in principle would belong to NOTAMs but includes extensive text ~~and/~~or graphics. ***Source:* ICAO Annex 15, Chapter 5, 5.1.1 and Notes 1 and 2**	X	X	X	X	X	X	X	
(02)		Summarise the essential information which leads to the issu~~ance~~e of a NOTAM. ***Source:* ICAO Annex 15, Chapter 5, 5.1.1.1**	X	X	X	X	X	X	X	
(03)		State to whom NOTAMs shall be distributed. ***Source:* ICAO Annex 15, Chapter 5, 5.3.1**	X	X	X	X	X	X		
(04)		Explain how information regarding snow, ice and standing	X	X	X	X	X	X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		water on AD pavements shall be reported. ***Source:*** **ICAO Annex 15, Appendix 2 Instructions for the completion of the SNOWTAM format**								
(05)		Describe the means by which NOTAMs shall be distributed. ***Source:*** **ICAO Annex 15, 5.2 General specifications** **ICAO Annex 15, 5.3 Distribution** **ICAO Annex 15, Appendix 5**	X	X	X	X	X	X		
(06)		Define and s~~S~~tate which information an ASHTAM may contain. ***Source:*** **ICAO Annex 15, Appendix 3. ASHTAM format**	X	X	X	X	X	X		
010 08 04 03		***Aeronautical i~~I~~nformation r~~R~~egulation and c~~C~~ontrol (AIRAC)***								
(01)	X	List the circumstances under which the information concerned shall or should be distributed as AIRAC. ***Source:*** **ICAO Annex 15, Chapter 6** **ICAO Annex 15, Appendix 4 Information to be notified by AIRAC**	X	X	X	X	X	X	X	
~~LO (02)~~		~~State the sequence in which AIRACs shall be issued and state how many days before the effective date the information shall be distributed by AIS.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
010 08 04 04		***Aeronautical i~~I~~nformation c~~C~~irculars (AICs)***								
(01)	X	Describe the ~~reasons for the publication of~~ type of information that may be published in AICs. ***Source:*** **ICAO Annex 15, Chapter 7, 7.1 Origination**	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(02)		Explain the organisation ~~and standard colour codes~~ of AICs. ***Source:* ICAO Annex 15, Chapter 7, 7.2 General specifications**	X	X	X	X	X	X		
~~LO (03)~~		~~Explain the normal publication cycle of AICs.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
010 08 04 05		***Pre-flight and post-flight information/data***								
~~LO (01)~~		~~List (in general) which details shall be included in the aeronautical information provided for pre-flight planning purposes at the appropriate ADs.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(02)		Summarise, in addition to the elements of the integrated AIP and maps/charts, the additional current information relating to the AD of departure that shall be provided as pre-flight information. ***Source:* ICAO Annex 15, Chapter 8, 8.1 Pre-flight information**	X	X	X	X	X	X		
(03)		Describe how a recapitulation of current NOTAM and other information of urgent character shall be made available to flight crews. ***Source:* ICAO Annex 15, Chapter 8, 8.1 Pre-flight information**	X	X	X	X	X	X	X	
(04)		State which post-flight information from aircrews shall be submitted to AIS for distribution as required by the circumstances. ***Source:* ICAO Annex 15, Chapter 8, 8.3 Post-flight information**	X	X	X	X	X	X		
010 08 05 00		**ATM service providers**								
(01)		State that Commission Implementing Regulation (EU) No 1035/2011 provides:	X		X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		— general requirements for the provision of air navigation services; — specific requirements for the provision of air traffic services; — specific requirements for the provision of meteorological services; — specific requirements for the provision of aeronautical information services; — specific requirements for the provision of communication, navigation or surveillance services.								
010 09 00 00		**AERODROMES (ICAO Annex 14, Volume I — Aerodrome Design and Operations, and Regulation (EU) No 139/2014)**								
010 09 01 00		**General**								
010 09 01 01		***General — AD reference code***								
~~LO (01)~~		~~Recognise all definitions of ICAO Annex 14 **except** the following:~~ ~~accuracy, cyclic redundancy check, data quality, effective intensity, ellipsoid height (geodetic height), geodetic datum, geoid, geoid undulation, integrity (aeronautical data), light failure, lighting system reliability, orthometric height, station declination, usability factor, Reference code.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(02)		Describe~~, in general terms,~~ the intent of the AD reference code and state the functions of the two code elements. ***Source:*** **ICAO Annex 14, Volume 1, Chapter 1, 1.6 Reference Code**	X	X	X	X	X	X		
010 09 02 00		**Aerodrome (AD) data**								

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
010 09 02 01		***Aerodrome (AD) reference point***								
(01)		Describe where the AD~~aerodrome~~ reference point shall be located and where it shall normally remain. ***Source:* ICAO Annex 14, Volume 1, Chapter 2, 2.2 Aerodrome reference point**	X	X	X	X	X	X	X	
010 09 02 02		***Pavement strengths***								
(01)		Explain the terms pavement classification number (PCN) and aircraft classification number (ACN), and describe their mutual dependence. ***Source:* ICAO Annex 14, Volume 1, Chapter 2, 2.6 Strength of pavements**	X	X	X	X	X	X		
(02)		Describe how the bearing strength for an aircraft with an apron mass equal to or less than 5 700 kg shall be reported. ***Source:* ICAO Annex 14, Volume 1, Chapter 2, 2.6 Strength of pavements**	X	X	X	X	X	X		
010 09 02 03		***Declared distances***								
(01)		~~List the four most important declared RWY distances and indicate where you can find guidance on their calculation in~~ State that ICAO Annex 14 provides guidance on the calculation of declared distances (TORA, TODA, ASDA, LDA).	X	X	X	X	X	X		
(02)		Recall the definitions for the four main declared distances. ***Source:* ICAO Annex 14, Volume 1, Chapter 1, 1.1 Definitions**	X	X	X	X	X	X		
010 09 02 04		***Condition of the movement area and related facilities***								
(01)		~~Understand~~ State the purpose of informing AIS and ATS units about the condition of the movement area and related	X	X	X	X	X	X		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		facilities. ***Source:* ICAO Annex 14, Volume 1, Chapter 2, 2.9 Condition of the movement area and related facilities**								
(02)		List the matters of operational significance or affecting aircraft performance which should be reported to AIS and ATS units to be transmitted to aircraft involved. ***Source:* ICAO Annex 14, Volume 1, Chapter 2, 2.9 Condition of the movement area and related facilities**	X	X	X	X	X	X		
(03)		Describe the ~~four~~ three different types of water deposit on RWYs~~runways~~. ***Source:* ICAO Annex 14, Volume 1, Chapter 2, 2.9 Condition of the movement area and related facilities**	X	X	X	X	X	X		
(04)		~~Name~~ Explain the ~~four defined states~~ different types of frozen water on the RWY and their impact on aircraft braking performance. ***Source:* ICAO Annex 14, Volume 1, Chapter 2, 2.9 Condition of the movement area and related facilities**	X	X	X	X	X	X		
(05)		~~Understand~~ Describe the five levels of braking action including the associated coefficients and codes. ***Source:* ICAO Annex 14, Volume 1, Annex A, 6. Assessing the surface friction characteristics of snow-, slush-, ice- and frost-covered paved surfaces**	X	X	X	X	X			
010 09 03 00		**Physical characteristics**								
010 09 03 01		***Runways (RWYs)***								
(01)		Describe where a THR~~threshold~~ should normally be located. ***Source:* ICAO Annex 14, Volume 1, Chapter 3, 3.1.5 and 3.1.6 Location of threshold**	X	X	X	X	X	X		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		~~Acquaint yourself with~~ Describe the general considerations concerning RWYs~~runways~~ associated with a stopway (SWY) or clearway (CWY). **_Source:_ ICAO Annex 14, Volume 1, Chapter 3, 3.1.9 Runways with stopways or clearways**	X	X	X	X	X	X	X	
~~LO (03)~~		~~State where in Annex 14 you can find detailed information about the required runway width dependent upon code number and code letter.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
010 09 03 02		***Runway (RWY) strips***								
(01)		Explain the term '~~RWY~~runway strip'. **_Source:_ ICAO Annex 14, Volume 1, Chapter 3, 3.4 General, 3.4.1**	X	X	X	X	X	X	X	
010 09 03 03		***Runway-end safety area***								
(01)		Explain the term 'runway~~RWY~~ end safety area'. **_Source:_ ICAO Annex 14, Volume 1, Chapter 3, 3.5 Runway end safety area 3.5.1 and 3.5.2**	X	X	X	X	X	X	X	
010 09 03 04		***Clearway (CWY)***								
(01)		Explain the term '~~CWY~~clearway'. **_Source:_ ICAO Annex 14, Volume 1, Chapter 3, 3.6 Clearways**	X	X	X	X	X	X	X	
010 09 03 05		***Stopway (SWY)***								
(01)		Explain the term '~~SWY~~stopway'. **_Source:_ ICAO Annex 14, Volume 1, Chapter 3, 3.7 Stopways**	X	X	X	X	X	X	X	
~~***010 09 03 06***~~		~~***Radio-altimeter operating area***~~ ***Intentionally left blank***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (01)~~		~~Describe where a radio-altimeter operating area should be established and how far it should extend laterally and longitudinally.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
010 09 03 07		***Taxiways (TWYs)***								
~~LO (01)~~		~~Describe the condition which must be fulfilled to maintain the required clearance between the outer main wheels of an aircraft and the edge of the taxiway.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(02)		Describe the reasons and the requirements for rapid-exit TWYs~~taxiways~~. ***Source:* ICAO Annex 14, Volume 1, Chapter 3, 3.9 Taxiways – Rapid-exit taxiways**	X	X	X	X	X	X		
(03)		~~State~~ Explain ~~the reason for a~~ TWY~~taxiway~~ widening in curves. ***Source:* ICAO Annex 14, Volume 1, Chapter 3, 3.9.5 Taxiways curves**	X	X	X	X	X	X		
(04)		Explain when and where holding bays should be provided. ***Source:* ICAO Annex 14, Volume 1, Chapter 3, 3.12**	X	X	X	X	X	X		
(05)		Describe where RWY~~runway-~~holding positions shall be established. ***Source:* ICAO Annex 14, Volume 1, Chapter 3, 3.12**	X	X	X	X	X	X	X	
(06)		~~Define~~ Describe the term 'road-holding position'. ***Source:* ICAO Annex 14, Volume 1, Chapter 3, 3.12**	X	X	X	X	X	X		
(07)		Describe where intermediate TWY~~taxiway-~~holding positions should be established. ***Source:* ICAO Annex 14, Volume 1, Chapter 3, 3.12**	X	X	X	X	X	X		
010 09 04 00		**Visual aids for navigation**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
010 09 04 01		***Indicators and signalling devices***								
(01)		Describe the wind-direction indicators with which ADs shall be equipped. ***Source:*** **ICAO Annex 14, Volume 1, Chapter 5, 5.1.1 Wind direction indicator (Application, Location and Characteristics**)	X	X	X	X	X	X	X	
~~LO~~ (02)		Describe a landing-direction indicator. ***Source:*** **ICAO Annex 14, Volume 1, Chapter 5, 5.1.2 Landing direction indicator**	X	X	X	X	X	X		
(03)		Explain the capabilities of a signalling lamp.	X	X	X	X	X	X	X	
(04)	X	State which characteristics a signal area should have. ***Source:*** **ICAO Annex 14, Volume 1, Chapter 5, 5.1.4 Signal panels and signal area, 5.1.4.1 to 5.1.4.3**	X	X	X	X	X	X	X	
(05)	X	Interpret all indications and signals that may be used in a signals area. ***Source:*** **Commission Implementing Regulation (EU) No 923/2012 (SERA) s— Appendix 1 Signals, 3.2 Visual ground signals**	X	X	X	X	X	X	X	
010 09 04 02		***Markings***								
(01)		Name the colours used for the various markings (RWY, TWY, aircraft stands, apron safety lines). ***Source:*** **ICAO Annex 14, Volume 1, Chapter 5, 5.2 Markings**	X	X	X	X	X	X	X	
(02)		State where a RWY designation marking shall be provided and describe the different layout~~show it is designed~~ (excluding dimensions).	X	X	X	X	X	X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **ICAO Annex 14, Volume 1, Chapter 5, 5.2 Markings**								
(03)		Describe the application and general characteristics ~~characteristics~~ (excluding dimensions) of: — RWY-centre-line markings; — THR markings; — touchdown-zone (TDZ) markings; — RWY-side-stripe markings; — TWY-centre-line markings; — RWY~~runway~~-holding position markings; — intermediate holding position markings; — aircraft-stand markings; — apron safety lines; — road-holding position markings; — mandatory instruction markings; — information marking. ***Source:*** **ICAO Annex 14, Volume 1, Chapter 5, 5.2 Markings**	X	X	X	X	X	X	X	
010 09 04 03		***Lights***								
(01)		Describe the mechanical safety considerations regarding elevated approach lights and elevated RWY, SWY~~stopway~~ and TWY~~taxiway~~ lights. ***Source:*** **ICAO Annex 14, Volume 1, Chapter 5, 5.3.1.4 to 5.3.1.8 (Elevated approach lights, elevated lights and surface lights)**	X	X	X	X	X	X	X	
~~LO (02)~~		~~Describe the relationship of the intensity of RWY lighting, the approach-lighting system and the use of a separate~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~intensity control for different lighting systems.~~								
(03)		List the conditions for the installation of an ~~AD~~ aerodrome beacon (ABN) and describe its general characteristics. ***Source:* ICAO Annex 14, Volume 1, Chapter 5, 5.3.3 Aeronautical beacons**	X	X	X	X	X	X	X	
(04)		~~Name~~Describe the different kinds of operations for which a simple approach~~APP~~ lighting system shall be used. ***Source:* ICAO Annex 14, Volume 1, Chapter 5, 5.3.4 Approach lighting systems**	X	X	X	X	X	X	X	
(05)		Describe the basic installations of a simple approach~~APP~~ lighting system including the dimensions and distances normally used. ***Source:* ICAO Annex 14, Volume 1, Chapter 5, 5.3.4.2**	X	X	X	X	X	X	X	
(06)		Describe the principle of a precision approach~~APP~~ category I lighting system including information such as location and characteristics. ~~*Remark: This includes the 'Calvert' system with additional crossbars.*~~ ***Source:*** **ICAO Annex 14, Volume 1, Chapter 5, 5.3.4.10** **ICAO Annex 14, Volume 1, Chapter 5, 5.3.4.14**	X	X	X	X	X	X	X	
(07)		Describe the principle of a precision approach~~APP~~ category II and III lighting system including information such as location and characteristics, especially the inner 300 m of the system. ***Source*:** **ICAO Annex 14, Volume 1, Chapter 5, 5.3.4.22**	X					X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		ICAO Annex 14, Volume 1, Chapter 5, 5.3.4.30 **ICAO Annex 14, Volume 1, Chapter 5, 5.3.4.31**								
(08)		Describe the wing bars of the precision approach path indicator (PAPI) and the abbreviated precision approach path indicator (APAPI). Interpret what the pilot will see during the approach using PAPI. ***Source:* ICAO Annex 14, Volume 1, Chapter 5, 5.3.5.24 to 5.3.5.27 PAPA and APAPI**	X	X	X	X	X	X	X	
~~LO (09)~~		~~Interpret what the pilot will see during approach using PAPI, APAPI, T-VASIS and AT-VASIS.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(10)		Interpret what the pilot will see during approach using helicopter approach path indicator (HAPI). ***Source:* ICAO Annex 14, Volume II, Chapter 5, 5.3.6 Visual approach slope indicator**			X	X	X	X	X	
(11)		Explain the application and characteristics (as applicable, but limited to colour, intensity, direction and whether fixed or flashing) of: — RWY-edge lights; — RWY-THR~~threshold~~ and wing-bar lights; — RWY-end lights; — RWY-centre-line lights; — RWY-lead-in lights; — RWY-TDZ~~touchdown-zone~~ lights; — SWY~~stopway~~ lights; — TWY~~taxiway~~-centre-line lights; — TWY~~taxiway~~-edge lights; — stop bars;	X	X	X	X	X	X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— intermediate holding position lights; — RWY-guard lights; — road-holding position lights. ***Source:* ICAO Annex 14, Volume 1, Chapter 5**								
(11)		~~Understand~~ State the timescale within which aeronautical ground lights shall be made available to arriving aircraft. ***Source:* ICAO Doc 4444, Section 7.15 Aeronautical ground lights**	X	X	X	X	X	X	X	
010 09 04 04		***Signs***								
~~LO (01)~~		~~State the general purpose for installing signs.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(02)		Explain which signs are the only ones on the movement area utilising red. ***Source:* ICAO Annex 14, Volume 1, Chapter 5.4 Signs**	X	X	X	X	X	X	X	
(03)		List the provisions for illuminating signs. ***Source:* ICAO Annex 14, Volume 1, Chapter 5.4 Signs**	X	X	X	X	X	X	X	
~~LO (04)~~		~~State the purpose for installing mandatory instruction signs.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(05)		Name the kind of signs which shall be included in ~~the~~ mandatory instruction signs. ***Source:* ICAO Annex 14, Volume 1, Chapter 5.4 Signs**	X	X	X	X	X	X	X	
(06)		Name the colours used for mandatory instruction signs. ***Source:* ICAO Annex 14, Volume 1, Chapter 5.4 Signs**	X	X	X	X	X	X	X	
(07)		Describe by which sign a pattern 'A' RWY~~runway~~-holding position (i.e. at an intersection of a TWY~~taxiway~~ and a non-instrument, non-precision approach or take-off RWY) marking shall be supplemented. ***Source:* ICAO Annex 14, Volume 1, Chapter 5.4 Signs**	X	X	X	X	X	X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(08)		Describe by which sign a pattern 'B' RWY~~runway~~ -holding position (i.e. at an intersection of a TWY~~taxiway~~ and a precision approach RWY) marking shall be supplemented. ***Source:* ICAO Annex 14, Volume 1, Chapter 5.4 Signs**	X	X	X	X	X	X	X	
(09)		Describe the location of: — a RWY designation sign at a TWY~~taxiway~~/RWY intersection; — a 'NO ENTRY' sign; — a RWY-holding position sign. ***Source:* ICAO Annex 14, Volume 1, Chapter 5.4 Signs**	X	X	X	X	X	X	X	
(10)		~~Name the~~ State which sign with which it shall be indicated that a taxiing aircraft is about to infringe an obstacle limitation surface or to interfere with the operation of radio navigation aids (e.g. ILS/MLS critical/sensitive area). ***Source:* ICAO Annex 14, Volume 1, Chapter 5.4 Signs**	X	X	X	X	X	X	X	
(11)		Describe the various possible inscriptions on RWY designation signs and on holding position signs. ***Source:* ICAO Annex 14, Volume 1, Chapter 5.4 Signs**	X	X	X	X	X	X	X	
~~(12)~~		~~Describe the inscription on an intermediate holding position sign on a TWYtaxiway.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~LO (13)~~		~~State when information signs shall be provided.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(14)		Describe the colours used in connection with information signs. ***Source:* ICAO Annex 14, Volume 1, Chapter 5.4 Signs**	X	X	X	X	X	X	X	
(15)		Describe the possible inscriptions on information signs. ***Source:* ICAO Annex 14, Volume 1, Chapter 5.4 Signs**	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(16)		Explain the application, location and characteristics of aircraft stand identification signs. ***Source:* ICAO Annex 14, Volume 1, Chapter 5.4 Signs**	X	X	X	X	X	X	X	
(17)		Explain the application, location and characteristics of road-holding position signs. ***Source:* ICAO Annex 14, Volume 1, Chapter 5.4 Signs**	X	X	X	X	X	X	X	
010 09 04 05		***Markers***								
(01)		Explain why markers located near a RWY~~runway~~ or TWY~~taxiway~~ shall be HGT limited. ~~to their height.~~ ***Source:* ICAO Annex 14, Volume 1, Chapter 5.5 Markers**	X	X	X	X	X	X	X	
(02)		Explain the application and characteristics (excluding dimensions) of: — unpaved RWY-edge markers; — TWY-edge markers; — TWY-centre-line markers; — unpaved TWY-edge markers; — boundary markers; — SWY~~stopway~~-edge markers. ***Source:* ICAO Annex 14, Volume 1, Chapter 5.5 Markers**	X	X	X	X	X	X	X	
010 09 05 00		**Visual aids for denoting obstacles**								
010 09 05 01		***Marking of objects***								
(01)		State how fixed or mobile objects shall be marked if colouring is not practicable. ***Source:* ICAO Annex 14, Volume 1, Chapter 6, 6.2.3.1 Marking**	X	X	X	X	X	X		

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		Describe marking by colours (fixed or mobile objects). ***Source***: **ICAO Annex 14, Volume 1, Chapter 6, 6.2.2 Mobile objects: 6.2.2.1, 6.2.2.2; 6.2.2.3; 6.2.2.4;** **ICAO Annex 14, Volume 1, Chapter 6, 6.2.3 Fixed objects: 6.2.3.1; 6.2.3.2; 6.2.3.3**	X	X	X	X	X	X		
(03)		Explain the use of markers for the marking of objects, overhead wires, cables, etc. ***Source:* ICAO Annex 14, Volume 1, Chapter 6, 6.2.5 Overhead wires, cables, etc., and supporting towers**	X	X	X	X	X	X		
(04)		Explain the use of flags for the marking of objects. ***Source:* ICAO Annex 14, Volume 1, Chapter 6, 6.2.3 Fixed objects: 6.2.3.5; 6.2.3.6; 6.2.3.7**	X	X	X	X	X	X		
010 09 05 02		***Lighting of objects***								
(01)		Name the different types of lights to indicate the presence of objects which must be lighted. ***Source:* ICAO Annex 14, Volume 1, Chapter 6, 6.2 Marking and/or lighting of objects: 6.2.1.1**	X	X	X	X	X	X		
~~LO (02)~~		~~State the time period(s) of the 24 hours of a day during which high-intensity lights are intended for use.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(03)		Describe (in general terms) the location of obstacle lights.	X	X	X	X	X	X		
(04)		Describe (in general and for normal circumstances) the colour and sequence of low-intensity obstacle lights, medium-intensity obstacle lights and high-intensity obstacle lights. ***Source:* ICAO Annex 14, Volume 1, Chapter 6: Table 6-1. Characteristics of obstacle lights**	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(05)		State ~~where you can find~~ that information about lights to be displayed by aircraft is provided in ICAO Annex 2 (Rules of the Air) and SERA.	X	X	X	X	X	X		
010 09 06 00		**Visual aids for denoting restricted use of areas**								
010 09 06 01		***Visual aids for denoting restricted use of areas on RWYs and TWYs***								
(01)		Describe the colours and meaning of 'closed markings' on RWYs and TWYs~~taxiways~~. ***Source:* ICAO Annex 14, Volume 1, Chapter 7, 7.1 Closed runways and taxiways, or parts thereof**	X	X	X	X	X	X		
(02)		State how the pilot of an aircraft moving on the surface of a TWY~~taxiway~~, holding bay or apron shall be warned that the shoulders of these surfaces are 'non-load-bearing'. ***Source:* ICAO Annex 14, Volume 1, Chapter 7, 7.2 Non-load-bearing surfaces**	X	X	X	X	X	X		
(03)		Describe the pre-THR~~threshold~~ marking (including colours) when the surface before the THR~~threshold~~ is not suitable for normal use by aircraft. ***Source:* ICAO Annex 14, Volume 1, Chapter 7, 7.3 Pre-threshold area**	X	X	X	X	X	X		
010 09 07 00		**Aerodromes (AD) operational services, equipment and installations**								
010 09 07 01		***Rescue and f~~F~~irefighting (RFF)***								
(01)		~~Name~~ State the principal objective of ~~a~~ RFF~~rescue and firefighting~~ services. ***Source:* ICAO Annex 14, Volume 1, Chapter 9, 9.2 Rescue and firefighting**	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
~~LO (02)~~		~~List the most important factors bearing on effective rescue in a survivable aircraft accident.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(03)		Explain the basic information the AD category (for RFF~~rescue and firefighting~~) depends upon. ***Source:* ICAO Annex 14, Volume 1, Chapter 9, 9.2 Rescue and firefighting**	X	X	X	X	X	X		
(04)		Describe what is meant by the term 'response time', and state its normal and maximum limits. ***Source:* ICAO Annex 14, Volume 1, Chapter 9, 9.2 Rescue and firefighting**	X	X	X	X	X	X		
~~LO (05)~~		~~State the reasons for emergency-access roads and for satellite fire-fighting stations.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
010 09 07 02		***Apron management service***								
~~LO (01)~~		~~Describe the reason for providing a special apron management service and state what has to be observed if the AD control tower is not participating in the apron management service.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(02)		State who has a right-of-way against vehicles operating on an apron. ***Source:* ICAO Annex 14, Volume 1, Chapter 9, 9.5 Apron management service**	X	X	X	X	X	X		
010 09 07 03		***Ground-servicing of aircraft***								
(01)		Describe the necessary actions during the ground-servicing of an aircraft with regard to the possible event of a fuel fire. ***Source:* ICAO Annex 14, Volume 1, Chapter 9, 9.6 Ground servicing of aircraft**	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
010 09 08 00		**Attachment A to ICAO Annex 14, Volume 1 — Supplementary Guidance Material**								
010 09 08 01		***Declared distances***								
(01)		List the four types of 'declared distances' on a RWY~~runway~~ and also the appropriate abbreviations. ***Source:* ICAO Annex 14, Volume 1, Attachment A, 3. Calculation of declared distances: 3.1**	X	X	X	X	X	X		
(02)		Explain the circumstances which lead to the situation that the four declared distances on a RWY~~runway~~ are equal to the length of the RWY~~runway~~. ***Source:* ICAO Annex 14, Volume 1, Attachment A, 3. Calculation of declared distances: 3.2**	X	X	X	X	X	X		
(03)		Describe the influence of a CWY~~clearway~~, SWY~~stopway~~ ~~and/~~or displaced THR~~threshold~~ upon the four 'declared distances'. ***Source:* ICAO Annex 14, Volume 1, Attachment A, 3. Calculation of declared distances: 3.3; 3.4; 3.5**	X	X	X	X	X	X		
010 09 08 02		***~~Radio-altimeter operating areas~~ Intentionally left blank***								
~~LO (01)~~		~~Describe the purpose of a radio-altimeter operating area.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (02)~~		~~Describe the physical characteristics of a radio-altimeter operating area.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (03)~~		~~Describe the dimensions of a radio-altimeter operating area.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (04)~~		~~Describe the position of a radio-altimeter operating area.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
010 09 08 03		***Approach lighting systems***								
(01)		Name the two main groups of approach lighting systems.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **ICAO Annex 14, Volume 1, Attachment A, 12.1 Types and characteristics**								
(02)		Describe the two different versions of a simple approach lighting system.	X	X	X	X	X	X	X	
(03)		Describe the two different basic versions of precision approach lighting systems for CAT I.	X	X	X	X	X	X	X	
(04)		Describe the diagram of the inner 300 m of the precision approach lighting system in the case of CAT II and III.	X							
(05)		Describe how the arrangement of an approach lighting system and the location of the appropriate THR~~threshold~~ are interrelated~~ between each other~~.	X	X	X	X	X	X	X	
010 10 00 00		**FACILITATION (ICAO Annex 9)**								
010 10 01 00		**General**								
010 10 01 01		***~~Foreword~~ Intentionally left blank***								
~~LO (01)~~		~~Explain the aim of ANNEX 9 as indicated in the Foreword.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
010 10 01 02		***~~Definitions (ICAO Annex 9)~~ Intentionally left blank***								
~~LO (01)~~		~~Understand the definitions.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
010 10 02 00		**Entry and departure of aircraft**								
010 10 02 01		***General d~~D~~eclaration***								
(01)		Describe the purpose and use of aircraft documents — as regards ~~far as the~~ 'g~~G~~eneral d~~D~~eclaration' ~~is concerned~~. ***Source:*** **ICAO Annex 9, Chapter 2, Entry and departure of aircraft, Section B Documents — requirements and use and Section D Disinsection of aircraft**	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~(02)~~		~~State whether or not a ‘General Declaration’ will be required by a Contracting State under normal circumstances.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~(03)~~		~~State the kind of information concerning crew members whenever a ‘General Declaration’ is required by a Contracting State.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
010 10 02 02		***Entry and departure of crew***								
(01)		Explain entry requirements for crew. ***Source:* ICAO Annex 9, Chapter 3, K. Entry procedures and responsibilities, N. Identification and entry of crew and other aircraft operators’ personnel**	X	X	X	X	X			
(02)		Explain the reasons for the use of c~~C~~rew m~~M~~ember c~~C~~ertificates (CMC) for ~~flight crews and cabin attendants~~ crew members engaged in i~~I~~nternational a~~A~~ir t~~T~~ransport. ***Source:* ICAO Annex 9, Chapter 3, N. Identification and entry of crew and other aircraft operators’ personnel**	X	X	X	X	X			
(03)		Explain in which cases Contracting States ~~shall~~ should accept the CMC as an identity document instead of a passport or visa. ***Source:* ICAO Annex 9, Chapter 3, N. Identification and entry of crew and other aircraft operators’ personnel**	X	X	X	X	X			
~~LO (04)~~		~~State whether the entry privileges for crews of scheduled international air services can be extended to other flight crews of aircraft operated for remuneration or hire but not engaged in scheduled International Air Services.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
010 10 02 03		***Entry and departure of passengers and baggage***								
(01)		Explain the entry requirements for passengers and their	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		baggage. ***Source:*** **ICAO Annex 9, Chapter 3, Entry and departure of persons and their baggage:** **A. General;** **B. Documents required for travel;** **F. Entry/re-entry visas; P. Emergency assistance/entry visas in cases of force majeure**								
(02)		Explain the requirements and documentation for unaccompanied baggage. ***Source:*** **ICAO Annex 9, Chapter 3, M. Disposition of baggage separated from its owner** **ICAO Annex 9, Chapter 4, C. Release and clearance of export and import cargo**	X	X	X	X	X			
(03)		~~Be familiar with~~ Identify the documentation required for the departure and entry of passengers and their baggage. ***Source:*** **ICAO Annex 9, Chapter 3. Entry and departure of persons and their baggage**	X	X	X	X	X			
(04)		~~Be familiar with~~Explain the arrangements in the event of a passenger being declared an inadmissible person. ***Source:*** **ICAO Annex 9, Chapter 5, INADMISSIBLE PERSONS AND DEPORTEES: A. General; B. Inadmissible persons**	X	X	X	X	X			
(05)		Describe the pilot's authority towards unruly passengers. ***Source:*** **ICAO Annex 9, Chapter 6, E. Unruly passengers**	X	X	X	X	X			
010 10 02 04		***Entry and departure of cargo***								
(01)		Explain the entry requirements for cargo.								
~~LO (02)~~		~~Be familiar with the documentation required for the entry~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~and departure of cargo.~~								
010 11 00 00		**SEARCH AND RESCUE (SAR)**								
010 11 01 00		**Essential ~~Search and Rescue (SAR)~~ definitions ~~in ICAO Annex 12~~**								
010 11 01 01		***Essential SAR definitions — ICAO Annex 12***								
(01)		Recall the definition of ~~Define~~ the following terms: alert phase, distress phase, emergency phase, operator, PIC~~pilot-in-command~~, rescue coordination centre, State of R~~r~~egistry, uncertainty phase. ***Source:*** **ICAO Annex 12, Chapter 1 Definitions**	X	X	X	X	X			
010 11 02 00		**SAR—Organisation**								
010 11 02 01		***SAR — Organisation — Establishment and provision***								
(01)		Describe how ICAO Contracting States shall arrange for the establishment and prompt provisions of SAR services. ***Source:*** **ICAO Annex 12, Chapter 2**	X	X	X	X	X			
(02)		Explain the establishment of SAR ~~Regions~~ by Contracting States. ***Source:*** **ICAO Annex 12, Chapter 2**	X	X	X	X	X			
(03)		Describe the areas within which SAR services shall be established by Contracting States. ***Source:*** **ICAO Annex 12, Chapter 2**	X	X	X	X	X			
(04)		State the period of time per day within which SAR services shall be available. ***Source:*** **ICAO Annex 12, Chapter 2**	X	X	X	X	X			
(05)		Describe for which areas rescue coordination centres shall	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		be established. ***Source:*** **ICAO Annex 12, Chapter 2**								
010 11 03 00		**Operating procedures for non-SAR crews**								
010 11 03 01		***Operating procedures for non-SAR crews — PIC***								
(01)		Explain the SAR operating procedures for the PIC~~pilot-in-command~~ who arrives first at the scene of an accident. ***Source:*** **ICAO Annex 12, Chapter 5, 5.6 Procedures at the scene of an accident**	X	X	X	X	X			
(02)		Explain the SAR operating procedures for the PIC~~pilot-in-command~~ intercepting a distress transmission. ***Source:*** **ICAO Annex 12, Chapter 5, 5.6 Procedures at the scene of an accident**	X	X	X	X	X			
010 11 04 00		**Search and rescue signals**								
010 11 04 01		***Search and rescue signals — Survivors***								
(01)		Explain the 'ground–air visual signal code' for use by survivors. ***Source:*** **ICAO Annex 12, Chapter 5.8 Search and rescue signalsand Appendix**	X	X	X	X	X			
(02)		~~Explain the signals to be used for~~ Recognise the SAR 'air–ground signals' for use by survivors. ***Source:*** **ICAO Annex 12, Chapter 5.8 Search and rescue signals and Appendix**	X	X	X	X	X			
010 12 00 00		**SECURITY — Safeguarding International Civil Aviation against Acts of Unlawful Interference (ICAO Annex 17)**								
010 12 01 00		**Essential definitions of ICAO Annex 17**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
010 12 01 01		***Essential definitions of ICAO Annex 17***								
(01)		Recall the definition of~~Define~~ the following terms: airside, aircraft security check, screening, security, security control, security-restricted area, unidentified baggage. ***Source:*** **ICAO Annex 17, Chapter 1 Definitions**	X	X	X	X	X			
010 12 02 00		**General principles**								
010 12 02 01		***General principles — Objectives of security***								
(01)		State the objectives of security. ***Source:*** **ICAO Annex 17, Chapter 2, 2.1 Objectives**	X	X	X	X	X			
~~LO (02)~~		~~Explain where further information in addition to ICAO Annex 17 concerning aviation security is available.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
010 12 03 00		~~**Organisation**~~ **Intentionally left blank**								
~~LO (01)~~		~~Understand the required activities expected at each airport serving international civil aviation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
010 12 04 00		**Preventive security measures**								
010 12 04 01		***Preventive security measures***								
(01)		Describe the objects not allowed (for reasons of aviation security) on board an aircraft that is engaged in international civil aviation. ***Source:*** **ICAO Annex 17, Chapter 4, 4.1 Objective**	X	X	X	X	X			
~~LO (02)~~		~~Explain what each Contracting State is supposed to do concerning originating passengers and their cabin baggage prior to boarding an aircraft engaged in international civil aviation operations.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)		State what each Contracting State is supposed to do if passengers subjected to security control have mixed after a security screening point. ***Source:* ICAO Annex 17, Chapter 4, 4.4 Measures relating to passengers and their cabin baggage**	X	X	X	X	X			
~~LO (04)~~		~~Explain what has to be done at airports serving international civil aviation to protect cargo, baggage, mail stores and operator supplies against an act of unlawful interference.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(05)		Explain what has to be done when passengers, who are obliged to travel because of judicial or administrative proceedings, are supposed to board an aircraft. ***Source:* ICAO Annex 17, Chapter 4, 4.7 Measures relating to special categories of passengers**	X	X	X	X	X			
(06)		~~Understand~~ Explain what has to be considered if law enforcement officers carry weapons on board. ***Source:* ICAO Annex 17, Chapter 4, 4.7 Measures relating to special categories of passengers**	X	X	X	X	X			
~~LO (07)~~		~~Describe what is meant by 'access control' at an aerodrome.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
010 12 05 00		**Management of response to acts of unlawful interference**								
010 12 05 01		***Management of response to acts of unlawful interference***								
(01)		Describe the assistance each Contracting State shall provide to an aircraft subjected to an act of unlawful seizure. ***Source:* ICAO Annex 17, Chapter 5, 5.2 Response**	X	X	X	X	X			
(02)		State the circumstances which could prevent a Contracting State ~~to detain~~ from detaining an aircraft on the ground after being subjected to an act of unlawful seizure.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		***Source:* ICAO Annex 17, Chapter 5, 5.2 Response**								
010 12 06 00		**Operators' security programme**								
010 12 06 01		***Operators' security programme — Principles***								
(01)		~~Understand~~ Describe the principles of the written operator's security programme each Contracting State requires from operators. ***Source:* ICAO Annex 17, Chapter 3, 3.3 Aircraft operators**	X	X	X	X	X			
010 12 07 00		**Security procedures in other documents, i.e. ICAO Annex 2, ~~ICAO Annex~~ 6, ~~ICAO Annex~~ 14, ICAO Doc 4444, Regulation (EU) No 965/2012 and CS-ADR-DSN**								
010 12 07 01		***ICAO Annex 2 — Rules of the Air~~,~~ Attachment B — Unlawful interference***								
(01)		Describe what the PIC should do, in a situation if unlawful interference, unless considerations ~~on~~ aboard the aircraft dictate otherwise. ***Source:* ICAO Annex 2, Chapter 3, 3.7 Unlawful interference**	X	X	X	X	X			
(02)		Describe what the PIC, of an aircraft subjected to unlawful interference, should do if: — the aircraft must depart from its assigned track; — the aircraft must depart from its assigned cruising level; — the aircraft is unable to notify an ATS unit of the unlawful interference. ***Source:* ICAO Annex 2, Attachment B 'Unlawful interference'**	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)		Describe what the PIC should attempt to do with regard to broadcast warnings and the ~~to decide at which~~ level at which to proceed, in a situation of unlawful interference, ~~the crew is proceeding~~ if no applicable regional procedures for in-flight contingencies have been established. ***Source:* ICAO Annex 2, Attachment B 'Unlawful interference'**	X	X	X	X	X			
010 12 07 02		***ICAO Annex 6 — Operation of Aircraft, Chapter 13 — Security***								
(01)		Describe the special considerations referring to flight crew compartment doors with regard to aviation security. ***Source:* ICAO Annex 6, Chapter 13, 13.2 Security of the flight crew compartment**	X	X	X	X	X			
~~LO (02)~~		~~Explain what an operator shall do to minimise the consequences of acts of unlawful interference.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~Explain what an operator shall do to have appropriate employees available who can contribute to the prevention of acts of sabotage or other forms of unlawful interference.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
010 12 07 03		***ICAO Annex 14 — Aerodromes, Chapter 3 — Physical characteristics***								
(01)		Describe what minimum distance an isolated aircraft parking position (after the aircraft has been subjected to unlawful interference) should have from other parking positions, buildings or public areas. ***Source:* ICAO Annex 14, Volume I, Chapter 3, 3.14 Isolated aircraft parking position**	X	X	X	X	X			
010 12 07 04		***ICAO Doc 4444 — Air Traffic Management***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Describe the considerations that must take place with regard to a taxi clearance in case an aircraft is known or believed to have been subjected to unlawful interference. ***Source:* ICAO Doc 4444, Chapter 15, 15.1.3 Unlawful interference and aircraft bomb threat**	X	X	X	X	X			
010 13 00 00		**AIRCRAFT ACCIDENT AND INCIDENT INVESTIGATION**								
010 13 01 00		**Essential definitions of ICAO Annex 13**								
010 13 01 01		**Definitions and descriptions**								
(01)		~~Define~~ Recall the definition of the following terms: accident, aircraft, flight recorder, incident, investigation, maximum mass, operator, serious incident, serious injury, State of Design, State of Manufacture, State of Occurrence, State of the Operator, State of Registry. ***Source:* ICAO Annex 13, Chapter 1 Definitions**	X	X	X	X	X			
(02)		~~Define~~ Explain the difference between 'serious incident' and 'accident'. ***Source:* ICAO Annex 13, Chapter 1 Definitions and Attachment C 'List of examples of serious incidents'**	X	X	X	X	X			
(03)		Determine whether a certain occurrence has to be defined as a serious incident or as an accident. ***Source:* ICAO Annex 13, Chapter 1 Definitions and Attachment C 'List of examples of serious incidents'**	X	X	X	X	X			
(04)		Recognise the description of an accident or incident. ***Source:* ICAO Annex 13, Chapter 1 Definitions**	X	X	X	X	X			
~~**010 13 02 00**~~		~~**Applicability of ICAO Annex 13**~~								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (01)~~		~~Describe the geographical limits, if any, within which the specifications given in Annex 13 apply.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~010 13 03 00~~ **010 13 02 00**		**~~ICAO~~ Accident and incident investigation**								
010 13 02 01		**Objectives and procedures**								
(01)		State the objective(s) of the investigation of an accident or incident according to ICAO Annex 13. ***Source:*** **ICAO Annex 13, Chapter 3, 3.1 Objective of the investigation**	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(02)		~~Understand~~ Describe the general procedures for the investigation of an accident or incident according to ICAO Annex 13. ~~and relevant EU regulations.~~ ***Source:*** **ICAO Annex 13, Chapter 4, 4.1** **ICAO Annex 13, Chapter 5, 5.1 to 5.4.1**	X	X	X	X	X			
~~010 13 04 00~~ **010 13 03 00**		**Accident and incident investigation in EU regulations ~~accordance with EU documents~~**								
010 13 03 01		**Occurrences**								
(01)		~~Be familiar with Council Directive 94/56/EC of 21 November 1994 establishing the fundamental principles governing the investigation of civil aviation accidents and incidents.~~ Identify an occurrence as being either an accident, incident or serious incident in Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation. ***Source:*** **Regulation (EU) No 996/2010, Article 2(1), (7)**	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		and (16) and Annex 'List of examples of serious incidents'								
(02)		~~Be familiar with~~ ~~Council Directive 2003/42/EC of the European Parliament and of the Council of 13 June 2003 on occurrence reporting in civil aviation.~~ ~~State~~ Describe the relationship between Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and Regulation (EU) No 376/2014 of the European Parliament and of the Council of 3 April 2014 on the reporting, analysis and follow-up of occurrences in civil aviation. ***Source:*** **Regulation (EU) No 376/2014, p. L122/18 (3) and p. L122/21 (28);** **Regulation (EU) No 996/2010**	X	X	X	X	X			
~~LO~~ (03)		~~Be familiar with the differences between the procedures for accident and incident investigation in EU regulations compared to ICAO Annex 13.~~ State the subject matter and scope of Regulation (EU) No 376/2014 (Article 3). ***Source:*** **Regulation (EU) No 376/2014, Article 3**	X	X	X	X	X			
(04)		Identify occurrences that ~~have to~~ must be reported (Regulation (EU) No 376/2014, Article 4). ***Source:*** **Regulation (EU) No 376/2014, Article 4**	X	X	X	X	X			
(05)		Identify occurrences that should be voluntarily reported (Regulation (EU) No 376/2014, Article 5). ***Source:*** **Regulation (EU) No 376/2014, Article 5**	X	X	X	X	X			
(06)		~~Discuss the collection, storage and analysis of occurrence information~~ Describe how information from occurrences	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		is collected, stored and analysed (Regulation (EU) No 376/2014, Articles 6, 8, 13 and 14). ***Source:* Regulation (EU) No 376/2014, Articles 6, 8, 13 and 14**								

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Appendix to Annex I to ED Decision 2018/001/R

'Acceptable Means of Compliance (AMCs) and Guidance Material (GM) to Part-FCL Amendment 4'

Appendix

'SUBJECT 021 — AIRCRAFT GENERAL KNOWLEDGE — AIRFRAME, SYSTEMS AND POWER PLANT'

to

AMC1 FCL.310; FCL.515(b); FCL.615(b)

'Theoretical knowledge examinations'

of Annex I

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SUBJECT 021 — AIRCRAFT GENERAL KNOWLEDGE — AIRFRAME ~~AND~~, SYSTEMS~~, ELECTRICS,~~ AND POWER PLANT ~~AND EMERGENCY EQUIPMENT~~

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
020 00 00 00		**AIRCRAFT GENERAL KNOWLEDGE**								
021 00 00 00		**AIRCRAFT GENERAL KNOWLEDGE — AIRFRAME AND SYSTEMS, ~~ELECTRICS~~, POWER PLANT, ~~EMERGENCY EQUIPMENT~~**								
021 01 00 00		**SYSTEM DESIGN, LOADS, STRESSES, MAINTENANCE**								
021 01 01 00		**System design**								
021 01 01 01		***Design concepts***								
(01)	X	Describe the following structural design philosophy: — safe life; — fail-safe (multiple load paths); — damage-tolerant.	X	X	X	X	X			
(02)		~~Describe the following system design philosophy:~~ — ~~Rredundancy.~~ Explain the purpose of redundancy in aircraft design.	X	X	X	X	X			
021 01 01 02		***Level of certification***								
~~LO (01)~~		~~Explain and state the safety objectives associated with failure conditions (AMC 25.1309, Fig. 2).~~	~~X~~							
~~LO (02)~~		~~Explain the relationship between the probability of a failure and the severity of the failure effects.~~	~~X~~		~~X~~	~~X~~				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(03)	X	Explain why some systems are duplicated or triplicated.	X	X	X	X	X			
(04)	X	Explain that all aircraft are certified according to specifications determined by the competent authority, and that these certification specifications cover aspects such as design, material quality and build quality.	X	X	X	X	X			
(05)	X	State that the certification specifications for aeroplanes issued by EASA are: — CS-23 for Normal, Utility, Aerobatic and Commuter Aeroplanes; — CS-25 for Large Aeroplanes.	X	X						
(06)	X	State that the certification specifications for rotorcraft issued by EASA are: — CS-27 for Small Rotorcraft; — CS-29 for Large Rotorcraft.			X	X	X			
021 01 02 00		**Loads and stresses**								
021 01 02 01		***Stress, strain and loads***								
~~LO (01)~~		~~Explain the following terms:~~ — ~~stress,~~ — ~~strain,~~ — ~~tension,~~ — ~~compression,~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— ~~buckling,~~ — ~~bending,~~ — ~~torsion,~~ — ~~static loads,~~ — ~~dynamic loads,~~ — ~~cyclic loads,~~ — ~~elastic and plastic deformation.~~								
		~~*Remark: Stress is the internal force per unit area inside a structural part as a result of external loads. Strain is the deformation caused by the action of stress on a material. It is normally given as the change in dimension expressed in a percentage of the original dimensions of the object.*~~								
~~LO (02)~~		~~Describe the relationship between stress and strain for a metal.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(01)		Explain how stress and strain are always present in an aircraft structure both when parked and during manoeuvring. *Remark: Stress is the internal force per unit area inside a structural part as a result of external loads. Strain is the deformation caused by the action of stress on a material.*	X	X	X	X	X			
		~~*It is normally given as the change in dimension expressed in a percentage of the original dimensions of the object.*~~								
(02)		Describe the following types of loads that an aircraft may be subjected to, when they occur, and how a pilot may affect their	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		magnitude: — static loads; — dynamic loads; — cyclic loads.								
(03)		Describe the areas typically prone to stress that should be given particular attention during a pre-flight inspection, and highlight the limited visual cues of any deformation that may be evident.	X	X	X	X	X			
021 01 03 00		**Fatigue and corrosion**								
021 01 03 01		***Describe and explain fatigue and corrosion***								
~~LO (01)~~		~~Describe the phenomenon of fatigue.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~Explain the relationship between the magnitude of the alternating stress and the number of cycles (S/N diagram or Wöhler curve).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~Explain the implication of stress-concentration factor.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(04)		Describe the effects of corrosion and how it can be visually identified by a pilot during the pre-flight inspection.	X	X	X	X	X			
(05)		Describe the operating environments where the risk of corrosion is increased and how to minimise the effects of the environmental factors.	X	X	X	X	X			
(06)		Explain that aircraft have highly corrosive fluids on board as part of their systems and equipment.	X	X	X	X	X			
(07)		Explain fatigue, how it affects the useful life of an aircraft, and the	X	X	X	X	X			

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		effect of the following factors on the development of fatigue: — corrosion; — number of cycles; — type of flight manoeuvres; — stress level; — level and quality of maintenance.								
021 01 04 00		**~~Corrosion~~ Intentionally left blank**								
~~LO (01)~~		~~Describe the following types of corrosion:~~ — ~~oxidation,~~ — ~~electrolytic.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~Describe the interaction between fatigue and corrosion (stress corrosion).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
021 01 05 00		**Maintenance**								
021 01 05 01		***Maintenance methods: hard-time and on-condition monitoring***								
(01)		Explain the following terms: — hard-time or fixed-time maintenance; — on-condition maintenance~~.~~; — condition monitoring.	X	X	X	X	X			
021 02 00 00		**AIRFRAME**								
021 02 01 00		**~~Construction and a~~ Attachment methods**								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
021 02 01 01		***Attachment methods and detecting the development of faulty attachments***								
~~LO (01)~~		~~Describe the principles of the following construction methods:~~ — ~~Mmonocoque;~~ — ~~semi-monocoque;~~ — ~~cantilever;~~ — ~~sandwich, including honey comb;~~ — ~~truss.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(02)		Describe the following attachment methods used for aircraft parts and components: — riveting; — welding; — bolting; — pinning; — adhesives (bonding); — screwing.	X	X	X	X	X			
~~LO (03)~~		~~State that sandwich structural parts need additional provisions to carry concentrated loads.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(04)		Explain how the development of a faulty attachment between aircraft parts or components can be detected by a pilot during the pre-flight inspection.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
021 02 02 00		**Materials**								
021 02 02 01		***Composite and other materials***								
~~LO (01)~~		~~Explain the following material properties:~~ — ~~elasticity,~~ — ~~plasticity,~~ — ~~stiffness,~~ — ~~strength,~~ — ~~strength-to-density ratio.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~Compare the above properties as they apply to aluminium alloys, magnesium alloys, titanium alloys, steel and composites.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~Explain the need to use alloys rather than pure metals.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(04)	X	Explain the principle of a composite material, and give examples of typical non-metallic materials used on aircraft: — carbon; — glass; — aramid; — resin or filler.	X	X	X	X	X			
~~LO (05)~~		~~Describe the function of the following components:~~ — ~~Mmatrix, resin or filler;~~ — ~~fibres.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(06)	X	State the advantages and disadvantages of composite materials compared with metal alloys by considering the following: — strength-to-weight ratio; — capability to tailor the strength to the direction of the load; — stiffness; — electrical conductivity (lightning); — resistance to fatigue and corrosion; — resistance to ~~corrosion and~~ cost~~.~~; — discovering damage during a pre-flight inspection.	X	X	X	X	X			
~~LO (07)~~		~~State that the following are composite-fibre materials:~~ — ~~Ccarbon,~~ — ~~glass,~~ — ~~aramid (Kevlar).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(08)		State that several types of materials are used on aircraft and that they are chosen based on type of structure or component and the required/desired material properties.	X	X	X	X	X			
021 02 03 00		**Aeroplane: wings, tail surfaces and control surfaces**								
021 02 03 01		***Design ~~and construction~~***								
~~LO (01)~~		~~Describe the following types of construction:~~ — ~~Ccantilever,~~ — ~~non-cantilever (braced).~~	~~X~~	~~X~~						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(02)		Describe the following types of design and explain their advantages and disadvantages: — high-mounted wing; — low-mounted wing; — low- or mid-set tailplane; — T-tail.	X	X						
021 02 03 02		***Structural components***								
(01)		Describe the function of the following structural components: — spar and its components (web and girder or cap); — rib; — stringer; — skin; — torsion box.	X	X						
021 02 03 03		***Loads, stresses and aeroelastic vibrations (~~'~~flutter~~'~~)***								
(01)		Describe the vertical and horizontal loads on the ground and during normal flight.	X	X						
(02)		~~Describe the loads in flight for symmetrical and asymmetrical conditions, considering both vertical and horizontal loads and loads due to engine failure.~~ Describe the vertical and horizontal loads during asymmetric flight following an engine failure for a multi-engine aeroplane, and how	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		a pilot may potentially overstress the structure during the failure scenario.								
(03)		~~Describe~~ Explain the principle of flutter~~, flutter damping~~ and resonance for the wing and control surfaces.	X	X						
(04)		Explain the following countermeasures used to achieve ~~significance on~~ stress relief and reduce resonance ~~flutter of the following~~: — chord-wise and span-wise position of masses (e.g. engines, fuel, ~~and~~ balance masses for wing and control balance masses); — torsional stiffness; — bending flexibility~~.~~; — fuel-balancing procedures during flight (automatic or applied by the pilot).	X	X						
~~LO (05)~~		~~Describe the following design configurations:~~ — ~~Cconventional (low- or mid-set) tailplane;~~ — ~~T-tail.~~	~~X~~	~~X~~						
021 02 04 00		**Fuselage, landing gear, doors, floor, windscreen and windows**								
021 02 04 01		***Construction, functions, loads***								
(01)	X	Describe the following types of fuselage construction: — monocoque,	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— semi-monocoque.								
(02)		Describe the construction and the function of the following structural components of a fuselage: — frames; — bulkhead; — pressure bulkhead; — stiffeners, stringers, longerons; — skin, doublers; — floor suspension (crossbeams); — floor panels; — firewall.	X	X	X	X	X			
(03)		Describe the loads on the fuselage due to pressurisation.	X	X						
(04)		Describe the following loads on a main landing gear: — touch-down loads (vertical and horizontal); — taxi loads on bogie gear (turns).	X	X						
(05)		Describe the structural danger of a nose-wheel landing with respect to: — fuselage loads; — nose-wheel strut loads.	X	X						
(06)		Describe the structural danger of a tail strike with respect to: — fuselage and aft bulkhead damage (pressurisation).	X	X						

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(07)		Describe the door and hatch construction for pressurised and unpressurised aeroplanes including: — door and frame (plug type); — hinge location; — locking mechanism.	X	X						
(08)	X	Explain the advantages and disadvantages of the following fuselage cross sections: — circular; — double bubble ~~(two types);~~ — oval; — rectangular.	X	X						
(09)		~~State that~~ Explain why flight-deck windows are constructed with different layers.	X	X						
(10)		Explain the function of window heating for structural purposes.	X	X						
(11)		Explain the implication of a direct-vision window (see CS-25.773(b)(3)).	X	X						
(12)		~~State~~ Explain the need for an eye-reference position.	X	X						
(13)		Explain the function of floor venting (blow-out panels).	X	X						
(14)		Describe the construction and fitting of sliding doors.			X	X	X			
021 02 05 00		**Helicopter: structural aspects of flight controls ~~structural aspects~~**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
021 02 05 01		***Design and construction***								
(01)		List the functions of flight controls.			X	X	X			
~~LO (02)~~		~~Describe and explain the different flight control design concepts for conventional, tandem, coaxial, side by side, NOTAR and Fenestron-equipped helicopters.~~			~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~Explain the advantages, disadvantages and limitations of the respective designs above.~~			~~X~~	~~X~~	~~X~~			
~~LO (04)~~		~~Explain the function of the synchronised elevator.~~			~~X~~	~~X~~	~~X~~			
~~LO (05)~~		~~Describe the construction methods and alignment of vertical and horizontal stabilisers.~~ Explain why vertical and horizontal stabilisers may have different shapes and alignments.			X	X	X			
021 02 05 02		***Structural components and materials***								
~~(01)~~		~~Name the main components of flight and control surfaces.~~			~~X~~	~~X~~	~~X~~			
(02)		Describe the fatigue life and methods of checking for serviceability of flight ~~and~~ control surface components and materials.			X	X	X			
021 02 05 03		***Loads, stresses and aeroelastic vibrations***								
~~LO (01)~~		~~Describe and explain where the main stresses are applied to components.~~			~~X~~	~~X~~	~~X~~			
(02)		Describe the dangers and stresses regarding safety and serviceability in flight when the manufacturer's design envelope is			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		exceeded.								
~~LO (03)~~		~~Explain the procedure for:~~ — ~~Sstatic chord-wise balancing;~~ — ~~static span-wise balancing;~~ — ~~blade alignment;~~ — ~~dynamic chord-wise balancing;~~ — ~~dynamic span-wise balancing.~~			~~X~~	~~X~~	~~X~~			
(04)		~~Explain the process of blade tracking including:~~ — ~~Tthe pre-track method of blade tracking;~~ — ~~the use of delta incidence numbers;~~ — ~~aircraft configuration whilst carrying out tracking;~~ — ~~factors affecting blade flying profile;~~ — ~~ground tracking and in-flight trend analysis;~~ — ~~use of pitch-link and blade trim tab adjustments;~~ — ~~tracking techniques, including stroboscopic and electronic.~~ Explain that blade tracking is important both to minimise vibration and to help ensure uniformity of flow through the disc.			X	X	X			
(05)		Describe the early indications and vibrations which are likely to be experienced when the main-rotor blades and tail rotor are out of balance and/or tracking, including the possible early indications due to possible fatigue and overload.			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(06)		Explain how a vibration harmonic can be set up in other components which can lead to their early failure.			X	X	X			
(07)		~~Describe~~ State the three planes of vibration measurement, i.e. vertical, lateral, fore and aft.			X	X	X			
021 02 06 00		**Structural limitations**								
021 02 06 01		***Maximum structural masses***								
(01)		Define and explain the following maximum structural masses: — maximum ramp mass; — maximum take-off mass; — maximum zero-fuel mass; — maximum landing mass. *Remark: These limitations may also be found in the relevant part of ~~S~~subjects 031 ‘Mass and balance’, 032 ‘Performance (aeroplane)’ and 034 ‘Performance (helicopter)’.*	X	X						
(02)		Explain that airframe life is limited by fatigue, created by alternating stress and the number of load cycles.	X	X						
(03)		Explain the maximum structural masses: — maximum take-off mass.			X	X	X			
(04)		Explain that airframe life is limited by fatigue, created by load cycles.			X	X	X			
021 03 00 00		**HYDRAULICS**								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
021 03 01 00		**Hydromechanics: basic principles**								
021 03 01 01		***Concepts and basic principles***								
(01)	X	Explain the concept and basic principles of hydromechanics including: — hydrostatic pressure; — Pascal's law; — the relationship between pressure, force and area; — transmission of power: multiplication of force, decrease of displacement.	X	X	X	X	X			
021 03 02 00		**Hydraulic systems**								
021 03 02 01		***Hydraulic fluids: types, characteristics, limitations***								
(01)	X	List and explain the desirable properties of a hydraulic fluid with regard to: — thermal stability; — corrosiveness; — flashpoint and flammability; — volatility; — viscosity.	X	X	X	X	X			
(02)	X	State that hydraulic fluids are irritating for skin and eyes.	X	X	X	X	X			
(03)		List the two different types of hydraulic fluids:	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		— Ssynthetic~~,~~; — mineral.								
(04)		State that different types of hydraulic fluids cannot be mixed.	X	X	X	X	X			
(05)	BK	State that at the pressures being considered, hydraulic fluid is considered incompressible.	X	X	X	X	X			
021 03 02 02		***System components: design, operation, degraded modes of operation, indications and warnings***								
(01)		Explain the working principle of a hydraulic system.	X	X	X	X	X			
(02)		Describe the difference in the principle of operation between a constant pressure system and a system pressurised only on specific demand ~~(open-centre)~~.	X	X	X	X	X			
(03)		State the differences in the principle of operation between a passive hydraulic system (without a pressure pump) and an active hydraulic system (with a pressure pump).	X	X	X	X	X			
(04)	X	List the main advantages and disadvantages of system actuation by hydraulic or purely mechanical means with respect to: — weight~~,~~; — size~~,~~; — force.	X	X	X	X	X			
(05)		List the main ~~users~~ uses of hydraulic systems.	X	X	X	X	X			
(06)		State that hydraulic systems can be classified as either high	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		pressure (typically 3000 psi or higher) ~~and~~ or low pressure (typically up to 2000 psi).								
(07)		~~State that the normal hydraulic pressure of most large transport aircraft is 3 000 psi.~~ State that a high-pressure hydraulic system is typically operating at 3 000 psi but on some aircraft a hydraulic pressure of 4 000 to 5 000 psi may also be used.	X	X	X	X	X			
(08)		~~Explain the working principle of a low-pressure (0–2000 psi) open centred system using an off loading valve and an RPM dependent pump.~~ Explain the working principle of a low-pressure (0–2000 psi) system.	X	X	X	X	X			
(09)		Explain the advantages and disadvantages of a high-pressure system over a low-pressure system.	X	X	X	X	X			
(10)		Describe the working principle and functions of pressure pumps including: — constant pressure pump (swash plate or cam plate); — pressure pump whose output is dependent on pump revolutions per minute (RPM) (gear type).	X	X	X	X	X			
(11)		~~State that for an aeroplane, the power sources of a hydraulic pressure pump can be:~~ Explain the following different sources of hydraulic pressure, their typical application and potential operational limitations:	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— manual; — engine gearbox; — electrical; — air (pneumatic and ram-air turbine); — hydraulic (power transfer unit) or reversible motor pumps; — accessory.								
(12)		~~State that for a helicopter, the power sources of a hydraulic pressure pump can be:~~ Explain the following different sources of hydraulic pressure, their typical application and potential operational limitations: — manual~~,~~; — engine~~,~~; — gearbox~~,~~; — electrical.			X	X	X			
(13)		Describe the working principle and functions of the following hydraulic system components: — reservoir (pressurised and unpressurised); — accumulators; — case drain lines and fluid cooler return lines; — piston actuators (single and double acting); — hydraulic motors; — filters;	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— non-return (check) valves; — relief valves; — restrictor valves; — elector valves (linear and basic rotary selectors, two and four ports); — bypass valves; — shuttle valves; — fire shut-off valves; — priority valves; — fuse valves; — pressure and return pipes.								
(14)		Explain ~~why~~ the function of the demand pump installed on many transport aeroplanes ~~have 'demand' hydraulic pumps~~.	X	X						
(15)		Explain how redundancy is obtained by giving examples.	X	X	X	X	X			
(16)		~~Interpret the hydraulic system schematic appended to these LOs (to be introduced at a later date).~~ Interpret a typical hydraulic system schematic to the level of detail as found in an aircraft flight crew operating manual (FCOM).	X	X	X	X	X			
(17)		Explain the implication of a high system demand.	X	X	X	X	X			
~~LO (18)~~		~~Explain the implication of a system internal leakage including hydraulic lock of piston actuators.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(19)		List and describe the instruments and alerts for monitoring a hydraulic system.	X	X	X	X	X			
(20)		State the indications and explain the implications of the following malfunctions: — system leak or low level; — low pressure; — high temperature.	X	X	X	X	X			
021 04 00 00		**LANDING GEAR, WHEELS, TYRES, BRAKES**								
021 04 01 00		**Landing gear**								
021 04 01 01		***Types***								
(01)	X	Name, for an aeroplane, the following different landing-gear configurations: — nose wheel~~,~~; — tail wheel.	X	X						
(02)	X	Name, for a helicopter, the following different landing-gear configurations: — nose wheel~~,~~; — tail wheel~~,~~; — skids.			X	X	X			
021 04 01 02		***System components, design, operation, indications and warnings, on-ground/in-flight protections, emergency extension systems***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)		Explain the function of the following components of a landing gear: — oleo leg/shock strut; — axles; — bogies and bogie beam; — drag struts; — side stays/struts; — torsion links; — locks (over centre); — gear doors ~~and retraction mechanisms (normal and emergency operation)~~.	X	X						
(02)		Explain the function of the following components of a landing gear: — oleo leg/shock strut; — axles; — drag struts; — side stays/struts; — torsion links; — locks (over centre); — gear doors ~~and retraction mechanisms (normal and emergency operation)~~.			X	X	X			
(03)		Name the different components of a landing gear, using the diagram appended to these LOs.	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(04)		~~Describe the sequence of events of the landing gear during normal operation.~~ Describe the sequence of events during normal operation of the landing gear.	X	X	X	X	X			
(05)		State how landing-gear position indication and alerting is implemented.	X	X	X	X	X			
(06)		Describe the various protection devices to avoid inadvertent gear retraction on the ground and explain the implications of taking off with one or more protection devices in place: — ground lock (pins); — protection devices in the gear-retraction mechanism.	X	X	X	X	X			
(07)		Explain the speed limitations for gear operation (VLO (maximum landing gear operating speed) and VLE (maximum landing gear extended speed)).	X	X	X	X	X			
(08)		Describe the sequence for emergency gear extension: — unlocking; — operating; — down-locking.	X	X	X	X	X			
(09)		Describe some methods for emergency gear extension including: — gravity/free fall; — air or nitrogen pressure;	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— manually/mechanically.								
021 04 02 00		**Nose-wheel steering~~: design, operation~~**								
021 04 02 01		***Design, operation***								
(01)		Explain the operating principle of nose-wheel steering.	X	X	X	X	X			
(02)		Explain, for a helicopter, the functioning of differential braking with free-castoring nose wheel.			X	X	X			
(03)		Describe, for an aeroplane, the functioning of the following systems: — differential braking with free-castoring nose wheel; — tiller or hand wheel steering; — rudder pedal nose-wheel steering.	X	X						
(04)		Explain the centring mechanism of the nose wheel.	X	X	X	X	X			
(05)		Define the term 'shimmy' and the possible consequences of shimmy for the nose- and the main-wheel system and explain the purpose of a shimmy damper to reduce the severity of shimmy.	X	X	~~X~~	~~X~~	~~X~~			
(06)		Explain the purpose of main-wheel (body) steering.	X	X						
021 04 03 00		**Brakes**								
021 04 03 01		***Types and materials***								
(01)		Describe the basic operating principle of a ~~disk~~ disc brake.	X	X	X	X	X			
(02)		State the different materials used in a disc brake (steel, carbon).	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(03)		~~Describe their characteristics, advantages and disadvantages such as:~~ Describe the characteristics, advantages and disadvantages of steel or carbon brake discs with regard to: — weight; — temperature limits; — internal-friction coefficient; — wear.	X	X	X	X	X			
021 04 03 02		***System components, design, operation, indications and warnings***								
(01)		~~State~~ Explain the limitation of brake energy and describe the operational consequences.	X	X						
(02)		Explain how brakes are actuated: — hydraulically, — electrically.	X	X	X	X	X			
~~LO (03)~~ (04)		~~Identify the task of an auto-retract or in-flight brake system.~~ Explain the purpose of an in-flight wheel brake system.	X	X						
~~LO (05)~~		~~State that brakes can be torque-limited.~~	~~X~~	~~X~~						
(06)		Describe the function of a brake accumulator.	X	X	X	X	X			
(07)		Describe the function of the parking brake.	X	X	X	X	X			
(08)		Explain the function of brake-wear indicators.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(09)		Explain the reason for the brake-temperature indicator.	X	X						
~~LO (10)~~		~~State that the main power source for brakes in normal operation and for alternate operation for large transport aeroplanes is hydraulic.~~	~~X~~	~~X~~						
021 04 03 03		***Anti-skid***								
(01)		Describe the operating principle of ~~an~~ anti-skid where excessive ~~system where the~~ brake pressure applied is automatically reduced for optimum breaking performance ~~is based on maintaining the optimum wheel-slip value~~.	X	X						
(02)		~~Explain the purpose of the wheel-speed signal (tachometer) and of the aeroplane reference speed signal to the anti-skid computer, considering:~~ Explain that the anti-skid computer compares wheel speed to aeroplane reference speed to provide the following: — slip ratio for maximum braking performance; — locked-wheel prevention (protection against deep skid on one wheel); — touchdown protection (protection against brake-pressure application during touchdown); — hydroplane protection.	X	X						
(03)		Give examples of the impact of an anti-skid system on performance, and explain the implications of anti-skid system	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		failure.								
021 04 03 04		***Autobrake***								
(01)		Describe the operating principle of an autobrake system.	X	X						
(02)		~~State that~~ Explain why the anti-skid system must be available when using autobrakes.	X	X						
(03)		Explain the difference between the three ~~possible levels~~ modes of operation of an autobrake system: — OFF (system off or reset); — Armed~~/Disarm~~ (~~arm:~~ the system is ready to operate under certain conditions); — ~~Operative/Inoperative or~~ Activated/Deactivated (application of pressure on brakes).	X	X						
(04)		Describe how an autobrake system setting will either apply maximum braking (RTO or MAX) or result in a given rate of deceleration, where the amount of braking applied may be affected by: — the use of reverse thrust; — slippery runway.	X	X						
021 04 04 00		**Wheels, rims and tyres**								
021 04 04 01		***Types, structural components and materials, operational limitations, thermal plugs***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)	X	Describe the different types of tyres such as: — tubeless; — diagonal (cross ply); — radial (circumferential bias).	X	X	X	X	X			
(02)	X	Define the following terms: — ply rating; — tyre tread; — tyre creep; — retread (cover).	X	X	X	X	X			
(03)		Explain the function of thermal/fusible plugs.	X	X						
(04)		Explain ~~the~~ implications of and how to identify tread separation and wear or damage with associated increased risk of tyre burst.	X	X						
(05)		~~State that~~ Explain why the ground speed of tyres is limited.	X	X						
~~LO (06)~~ (06)		~~Describe material and basic construction of the rim of an aeroplane wheel.~~ Describe the following tyre checks a pilot will perform during the pre-flight inspection and identify probable causes: — cuts and damages; — flat spots.	X	X						
021 04 05 00		**Helicopter equipment**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
021 04 05 01		***Flotation devices***								
(01)		Explain flotation devices, ~~and~~ how they are operated and their limitations.			X	X	X			
(02)		Explain why ~~the~~ indicated airspeed (IAS) limitations before, during and after flotation-device deployment must be observed.			X	X	X			
021 05 00 00		**FLIGHT CONTROLS**								
021 05 01 00		**Aeroplane: primary flight controls**								
021 05 01 01		***Definition and control surfaces***								
		~~*Remark: The manual, irreversible and reversible flight control systems as discussed in 021 05 01 01, 05 01 02 and 05 01 03 are all considered to be mechanical flight control systems. Fly-by-wire flight control systems are discussed in 021 05 04 00.*~~								
(01)		Define a ‘primary flight control’.	X	X						
(02)		List the following primary flight control surfaces: — elevator; — aileron, roll spoilers, flaperon; — rudder.	X	X						
(03)		List the various means of control surface actuation including: — manual; — fully powered (irreversible);	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— partially powered (reversible).								
021 05 01 ~~01~~02		***Manual controls***								
(01)		Explain the basic principle of a fully manual control system.	X	X						
021 05 01 ~~02~~03		***Fully powered controls (irreversible)***								
(01)		Explain the basic principle of a fully powered control system.	X	X						
(02)		Explain the concept of irreversibility in a flight control system.	X	X						
(03)		Explain the need for a 'feel system' in a fully powered control system.	X	X						
(04)		Explain the operating principle of a stabiliser trim system in a fully powered control system.	X	X						
(05)		Explain the operating principle of rudder and aileron trim in a fully powered control system.	X	X						
021 05 01 ~~03~~04		***Partially powered controls (reversible)***								
(01)		Explain the basic principle of a partially powered control system.	X	X						
(02)		Explain why a 'feel system' is not necessary in a partially powered control system.	X	X						
021 05 01		***System components, design, operation, indications and warnings,***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~04~~05		***degraded modes of operation, jamming***								
(01)		List and describe the function of the following components of a flight control system: — actuators; — control valves; — cables ~~or electrical wiring~~; — electrical wiring; — control surface position sensors.	X	X						
(02)		Explain how redundancy is obtained in primary flight control systems of large transport aeroplanes.	X	X						
(03)		Explain the danger of control jamming and the means of retaining sufficient control capability.	X	X						
(04)		Explain the methods of locking the controls on the ground and describe 'gust or control lock' warnings.	X	X						
(05)		Explain the concept of a rudder-deflection limitation (rudder limiter) system and the various means of implementation (rudder ratio changer, variable stops, blow-back).	X	X						
021 05 02 00		**Aeroplane: secondary flight controls**								
021 05 02 01		***System components, design, operation, degraded modes of operation, indications and warnings***								
(01)		Define a 'secondary flight control'.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(02)		List the following secondary flight control surfaces: — lift-augmentation devices (flaps and slats); — speed brakes; — flight and ground spoilers; — trimming devices such as trim tabs, trimmable horizontal stabiliser.	X	X						
(03)		Describe secondary flight control actuation methods and sources of actuating power.	X	X						
(04)		Explain the function of a mechanical lock when using hydraulic motors driving a screw jack.	X	X						
(05)		Describe the requirement for limiting flight speeds for the various secondary flight control surfaces.	X	X						
(06)		For lift-augmentation devices, explain the load-limiting (relief) protection devices and the functioning of an auto-retraction system.	X	X						
(07)		Explain how a flap/slat asymmetry protection device functions, and describe the implications of a flap/slat asymmetry situation.	X	X						
(08)		Describe the function of an auto-slat system.	X	X						
(09)		Explain the concept of control surface blow-back (aerodynamic forces overruling hydraulic forces).	X	X						
021 05 03 00		**Helicopter: flight controls**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
021 05 03 01		***Droop stops, control systems, trim systems, control stops***								
(01)		Explain the methods of locking the controls on the ground.			X	X	X			
(02)		Describe main-rotor droop stops and how ~~static~~ rotor flapping is restricted.			X	X	X			
~~LO (03)~~		~~Describe the need for linear and rotary control input/output.~~			~~X~~	~~X~~	~~X~~			
(04)		Explain the principle of phase lag and advance angle.			X	X	X			
(05)		Describe the following four axes of control operation, their operating principle and their associated cockpit controls: — collective control; — cyclic fore and aft (pitch axis); — cyclic lateral (roll axis); — yaw.			X	X	X			
(06)		Describe the swash plate or azimuth star control system including the following: — swash plate inputs; — the function of the non-rotating swash plate; — the function of the rotating swash plate; — how swash plate tilt is achieved; — swash plate pitch axis; — swash plate roll axis; — balancing of pitch/roll/collective inputs to the swash plate to			X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		equalise torsional loads on the blades.								
~~LO (07)~~ (08)		~~Describe the main-rotor spider control system including the following:~~ — ~~Tthe collective beam;~~ — ~~pitch/roll/collective inputs to the collective beam;~~ — ~~spider drive.~~ Describe the operation of the spider control system.			X	X	X			
~~LO (09)~~		~~Describe the need for control system interlinks, in particular:~~ — ~~Ccollective/yaw;~~ — ~~collective/throttle;~~ — ~~cyclic/stabilator;~~ — ~~interaction between cyclic controls and horizontal/stabilator.~~			~~X~~	~~X~~	~~X~~			
(10)		~~State the need for ‘feel systems’ in the hydraulic actuated flight control system.~~ State the need for artificial feel in a hydraulically actuated flight control system.			X	X	X			
(11)		Describe and explain the purpose of a trim system using the following terms: — force-trim switch; — force gradient; — parallel trim actuator;			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— cyclic 4-way trim switch; — interaction of trim system with an SAS/SCAS/ASS stability system; — trim-motor indicators.								
~~LO (12)~~		~~Describe the purpose of a cyclic beep-trim system that utilises parallel trim actuators to enable the pilot to control the aircraft.~~			~~X~~	~~X~~	~~X~~			
~~LO (13)~~		~~List and describe the different types of trim systems.~~			~~X~~	~~X~~	~~X~~			
~~LO (14)~~		~~Explain the basic components of a trim system, in particular:~~ — ~~force-trim switch;~~ — ~~force gradient;~~ — ~~parallel trim actuator;~~ — ~~cyclic 4-way trim switch;~~ — ~~interaction of trim system with an SAS/SCAS/ASS stability system;~~ — ~~trim-motor indicators.~~			~~X~~	~~X~~	~~X~~			
(15)		Describe the different types of control runs.			X	X	X			
(16)		Explain the use of control stops.			X	X	X			
021 05 04 00		**Aeroplane: f~~F~~ly-by-w~~W~~ire (FBW) control systems**								
021 05 04 01		***Composition, explanation of operation, modes of operation***								
(01)		Explain that an FBW flight control system is composed of the following:	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		— pilot's input command (control column/sidestick/rudder pedals ~~column~~); — electrical signalling paths, including: • pilot input to computer; • computer to flight control surfaces; • feedback from aircraft response to computer; — flight control computers; — actuators; — flight control surfaces.								
(02)		State the advantages and disadvantages of an FBW system in comparison with a conventional flight control system including: — weight; — pilot workload; — flight-envelope protection.	X	X						
(03)		Explain why an FBW system is always irreversible.	X	X						
(04)		~~State the existence of degraded modes of operation.~~ Explain the different modes of operation: — normal operation (e.g. normal law or normal mode); — downgraded operation (e.g. alternate law or secondary mode); — direct law.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(05)		Describe the implications of mode degradation in relation to pilot workload and flight-envelope protection.	X	X						
(06)		Describe the implications for pilot workload during flight in normal operation (normal law/normal mode) during the following scenarios: — an undetected system error activates the envelope protection; — aircraft departs from intended flight path; — aircraft does not respond as expected to control inputs.	X	X						
(07)		For aircraft using sidestick for manual control, describe the implications of: — dual control input made by the pilot; — the control takeover facility available to the pilot.	X	X						
(08)		Describe solutions or actions to regain control.	X	X						
021 05 05 00		**Helicopter: f~~F~~ly-by-w~~W~~ire (FBW) control systems**								
		To be introduced at a later date.			X	X	X			
021 06 00 00		**PNEUMATICS — PRESSURISATION AND AIR-CONDITIONING SYSTEMS**								
021 06 01 00		**Pneumatic/bleed-air supply**								
021 06 01 01		***Piston-engine air supply***								
(01)		~~State the method~~ Describe the following means of supplying air for	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		the pneumatic systems for piston-engine aircraft: — compressor; — vacuum pomp.								
(02)		State that an air supply is required for the following systems: — instrumentation~~,~~; — heating~~,~~; — de-icing.	X	X	X	X	X			
_021 06 01 02_		**_Gas turbine engine: bleed air supply_**								
(01)		State that the possible bleed-air sources for gas turbine engine aircraft are the following: — engine~~,~~; — auxiliary power unit (APU)~~,~~; — ground supply.	X	X	X	X	X			
(02)		State that for an aeroplane a bleed-air supply can be used for the following systems or components: — ~~anti-icing~~ ice protection;~~,~~ — engine air starter;~~,~~ — pressurisation of a hydraulic reservoir;~~,~~ — air-driven hydraulic pumps;~~,~~ — pressurisation and air conditioning.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(03)		State that for a helicopter a bleed-air supply can be used for the following systems or components: — anti-icing;~~,~~ — engine air starter;~~,~~ — pressurisation of a hydraulic reservoir.			X	X	X			
(04)		State that the bleed-air supply system can comprise the following: — pneumatic ducts;~~,~~ — isolation valve;~~,~~ — pressure-regulating valve;~~,~~ — engine bleed valve (HP/IP valves);~~,~~ — fan-air pre-cooler;~~,~~ — temperature and pressure sensors.	X	X	~~X~~	~~X~~	~~X~~			
(05)		~~Interpret the pneumatic system schematic appended to these LOs (to be introduced at a later date).~~ Interpret a basic pneumatic system schematic to the level of detail as found in an FCOM.	X	X	X	X	X			
(06)		Describe the cockpit indications for bleed air systems.	X	X	X	X	X			
(07)		~~State~~ Explain how the bleed air supply system is controlled and monitored.	X	X	X	X	X			
(08)		~~List~~ State the following ~~air~~ bleed-air malfunctions: — over-temperature;~~,~~	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— over-pressure;~~,~~ — low pressure;~~,~~ — overheat/duct leak;~~,~~ and describe the potential consequences.								
021 06 02 00		**Helicopter: air-conditioning systems**								
021 06 02 01		***Types, system components, design, operation, degraded modes of operation, indications and warnings***								
(01)		Describe the purpose of an air-conditioning system.			X	X	X			
(02)		Explain how an air-conditioning system is controlled.			X	X	X			
(03)		Describe the vapour cycle air-conditioning system including system components, design, operation, degraded modes of operation and system malfunction indications.			X	X	X			
(04)		Identify the following components from a diagram of an air-conditioning system and describe the operating principle and function: — air-cycle machine (pack, bootstrap system); — pack-cooling fan; — water separator; — mixing valves; — flow-control valves; — isolation valves;			X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— recirculation fans; — filters for recirculation; — temperature sensors.								
(05)		List and describe the controls, indications and warnings related to an air-conditioning system.			X	X	X			
021 06 03 00		**Aeroplane: pressurisation and air-conditioning system**								
021 06 03 01		***System components, design, operation, degraded modes of operation, indications and warnings***								
(01)		~~State~~ Explain that a pressurisation and an air-conditioning system of an aeroplane controls: — ventilation;~~,~~ — temperature;~~,~~ — pressure.	X	X						
(02)		~~State~~ Explain how ~~that in general~~ humidity is ~~not~~ controlled.	X	X						
(03)		Explain that the following components constitute a pressurisation system: — pneumatic system as the power source; — outflow valve; — outflow valve actuator; — pressure controller; — excessive differential pressure-relief valve;	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— negative differential pressure-relief valve.								
(04)		Explain that the following components constitute an air-conditioning system and describe their operating principles and function: — air-cycle machine (pack, bootstrap system); — pack-cooling fan; — water separator; — mixing valves; — flow-control valves (outflow valve); — isolation valves; — ram-air valve; — recirculation fans; — filters for recirculated air; — temperature sensors. *Remark: The bootstrap system is the only air-conditioning system considered for Part-FCL aeroplane examinations.*	X	X						
(05)		Describe the use of hot trim air.	X	X						
(06)		Define the following terms: — cabin altitude; — cabin vertical speed; — differential pressure;	X	X						

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL/ IR**	**ATPL**	**CPL**			
		— ground pressurisation.								
(07)		Describe the operating principle of a pressurisation system.	X	X						
(08)		Describe the emergency operation by manual setting of the outflow valve position.	X	X						
(09)		Describe the working principle of an electronic cabin-pressure controller.	X	X						
(10)		State how the maximum operating altitude is determined.	X	X						
(11)		~~State~~ Explain: — why the maximum allowed value of cabin altitude is limited; — a typical value of maximum differential pressure for large transport aeroplanes ~~(8 to 9 psi)~~; — the relation between cabin altitude, the maximum differential pressure and maximum aeroplane operating altitude.	X	X						
(12)		~~Identify the aural warning when cabin altitude exceeds 10 000 ft.~~ Explain the typical warning on a transport category aircraft when cabin altitude exceeds 10 000 ft.	X	X						
(13)		List and interpret typical ~~the~~ indications of the pressurisation system.	X	X						
(14)		Describe the main operational differences between a bleed-air-driven air-conditioning system and an electrically driven air-conditioning system as found on aircraft without engine bleed air	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		system.								
021 07 00 00		**ANTI-ICING AND DE-ICING SYSTEMS**								
021 07 01 00		**Types, ~~design,~~ operation, indications ~~and warnings, operational limitations~~**								
021 07 01 01		***Types, design, operation, indications and warnings, operational limitations***								
(01)		Explain the concepts of anti-icing and de-icing ~~and anti-icing~~.	X	X	X	X	X			
(02)		Name the components of an aircraft which can be protected from ice accretion.	X	X	X	X	X			
(03)		State that on some aeroplanes the tail does not have an ice-protection system.	X	X						
(04)		State the different types of anti-icing/de-icing systems and describe their operating principle: ~~(hot air, electrical, fluid)~~ — hot air; — electrical; — fluid.	X	X	X	X	X			
~~LO (05)~~		~~Describe the operating principle of these systems.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(06)		Describe the operating principle of the inflatable boot de-icing system.	X	X						
021 07 02 00		**Ice warning systems~~: types, operation, and indications~~**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
021 07 02 01		***Types, operation, and indications***								
(01)		Describe the different operating principles of the following ice detectors: — mechanical systems using air pressure; — electromechanical systems using resonance frequencies.	X	X						
(02)		Describe the principle of operation of ice warning systems.	X	X						
021 07 03 00		**Helicopter blade heating systems**								
021 07 03 01		***Limitations***								
(01)		Explain the limitations on blade heating and the fact that on some helicopters the heating does not heat all the main-rotor blades at the same time.			X	X	X			
021 08 00 00		**FUEL SYSTEM**								
021 08 01 00		**Piston engine**								
021 08 01 01		***Fuel: types, characteristics, limitations***								
(01)		State the types of fuel used by a piston engine ~~(diesel, AVGAS, MOGAS)~~ and their associated limitations: — diesel;~~,~~ — JET-A1 (for high-compression engines); — AVGAS;~~,~~ — MOGAS.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(02)		State the main characteristics of these fuels and give typical values regarding their flash points, freezing points and density.	X	X	X	X	X			
021 08 01 02		***Design, operation, system components, indications***								
(01)		State the tasks of the fuel system.	X	X	X	X	X			
(02)		Name the following main components of a fuel system, and state their location and their function. — lines; — boost pump; — pressure valves; — filter, strainer; — tanks (wing, tip, fuselage); — vent system; — sump; — drain; — fuel-quantity sensor; — fuel temperature sensor.	X	X	X	X	X			
(03)		Describe a gravity fuel feed system and a pressure feed fuel system.	X	X	X	X	X			
(04)		Describe the construction of the different types of fuel tanks and state their advantages and disadvantages: — drum tank;~~,~~	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— bladder tank;~~,~~ — integral tank.								
(05)		Explain the function of cross-feed.	X	X	X	X	X			
(06)		Define the term 'unusable fuel'.	X	X	X	X	X			
(07)		List the following parameters that are monitored for the fuel system: — fuel quantity (low-level warning); — fuel temperature.	X	X	X	X	X			
021 08 02 00		**Turbine engine**								
021 08 02 01		***Fuel: types, characteristics, limitations***								
(01)		State the types of fuel used by a gas turbine engine: ~~(JET-A, JET-A1, JET-B)~~ — JET-A;~~,~~ — JET-A1;~~,~~ — JET-B.	X	X	X	X	X			
(02)		State the main characteristics of these fuels and give typical values regarding their flash points, freezing points and density.	X	X	X	X	X			
(03)		State the existence of additives for freezing.	X	X	X	X	X			
021 08 02 02		***Design, operation, system components, indications***								
(01)		~~State the tasks~~ Explain the function of the fuel system:	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~LO (02)~~		~~Name the main components of a fuel system, and state their location and their function:~~ — lines; — centrifugal boost pump; — pressure valves; — fuel shut-off valve; — filter, strainer; — tanks (wing, tip, fuselage, tail); — bafflers/baffles; — sump; — vent system; — drain; — fuel-quantity sensor; — fuel-temperature sensor; — refuelling/defuelling system; — fuel dump/jettison system.	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(02)		Name the main components of the fuel system and state their location and their function: — trim fuel tanks; — bafflers; — refuelling/defuelling system;	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— fuel dump/jettison system. *Remark: For completion of list, please see 021 08 01 02 02.*								
(03)		~~Interpret the fuel-system schematic appended to these Los.~~ Interpret a typical fuel system schematic to the level of detail as found in an aircraft FCOM.	X	X	X	X	X			
(04)		Explain the limitations in the event of loss of booster pump fuel pressure.	X	X	X	X	X			
~~LO (05)~~		~~Describe the construction of the different types of fuel tanks and state their advantages and disadvantages:~~ — ~~drum tank,~~ — ~~bladder tank,~~ — ~~integral tank.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (06)~~		~~Explain the function of cross-feed and transfer.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (07)~~		~~Define the term 'unusable fuel'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (08)~~		Describe the use and purpose of drip sticks (manual magnetic indicators) (may also be known as dip stick or drop stick).	X	X	~~X~~	~~X~~	~~X~~			
(09)		Explain the considerations for fitting a fuel dump/jettison system and, if fitted, its function.	X	X	X	X	X			
~~LO (10)~~		~~List the following parameters that are monitored for the fuel system:~~ — ~~fuel quantity (low-level warning);~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— ~~fuel temperature.~~								
021 09 00 00		**ELECTRICS**								
		For any reference to the direction of current flow, the conventional current flow shall be used, i.e. from positive to negative.								
021 09 01 00		**General, definitions, basic applications: circuit breakers, logic circuits.**								
021 09 01 01		***Static electricity***								
(01)		Explain static electricity and describe the flying conditions where aircraft are most susceptible to build-up of static electricity.	X	X	X	X	X			
(02)		~~Describe a static discharger and explain its purpose.~~ Describe a static discharger and explain the following: — its purpose; — typical locations; — pilot's role of observing it during pre-flight inspection.	X	X	X	X	X			
(03)		Explain why an aircraft must first be grounded before refuelling/defuelling.	X	X	X	X	X			
(04)		Explain the reason for electrical bonding.	X	X	X	X	X			
021 09 01 02		***Direct current (DC)***								
(01)		~~State that a current can only flow in a closed circuit.~~	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		Explain the term 'direct current' (DC), and state that current can only flow in a closed circuit.								
(02)	X	Explain the basic principles of conductivity and give examples of conductors, semiconductors and insulators.	X	X	X	X	X			
(03)		~~State the operating principle of mechanical (toggle, rocker, push and pull), _hermos, time and proximity switches.~~ Describe the difference in use of the following mechanical switches and explain the difference in observing their state (e.g. ON/OFF) and why some switches are guarded: — toggle switch; — rocker switch; — pushbutton switch; — rotary switch.	X	X	X	X	X			
(04)		~~Define 'voltage', 'current and resistance', and state their unit of measurement.~~ Define voltage and current, and state their unit of measurement.	X	X	X	X	X			
(05)	X	Explain Ohm's law in qualitative terms.	X	X	X	X	X			
(06)	X	Explain the effect on total resistance when resistors are connected in series or in parallel.	X	X	X	X	X			
(07)	X	State that resistances can have a positive or a negative temperature coefficient (PTC/NTC) and state their use.	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(08)		~~Define ‘electrical work and power’ in qualitative terms and state the unit of measurement.~~ Define electrical power and state the unit of measurement.	X	X	X	X	X			
~~LO (09)~~		~~Define the term ‘electrical field’ and ‘magnetic field’ in qualitative terms and explain the difference with the aid of the Lorentz force (Electromotive Force (EMF)).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~(10)~~	~~X~~	~~Explain the term ‘capacitance’, and explain the use of a capacitor as a storage device.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
021 09 01 03		***Alternating current (AC)***								
(01)	X	~~Explain the term ‘alternating current’ (AC).~~ Explain the term ‘alternating current’ (AC), and compare its use to DC with regard to complexity.	X	X	X	X	X			
(02)		~~Define the term 'phase'.~~ Define the term ‘phase’, and explain the basic principle of single-phase and three-phase AC.	X	X	X	X	X			
(03)		~~Explain the principle of single-phase and three-phase AC and state its use in the aircraft.~~ State that aircraft can use single-phase or three-phase AC.	X	X	X	X	X			
(04)		~~Define ‘frequency’ in qualitative terms and state the unit of measurement.~~ Define frequency and state the unit of measurement.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~LO (05)~~		~~Explain the use of a particular frequency in aircraft.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(06)	X	Define 'phase shift' in qualitative terms.	X	X	X	X	X			
021 09 01 04		***~~Resistors, capacitors, inductance coil~~ Intentionally left blank***								
~~LO (01)~~		~~Describe the relation between voltage and current of an ohmic resistor in an AC/DC circuit.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~Describe the relation between voltage and current of a capacitor in an AC/DC circuit.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~Describe the relation between voltage and current of a coil in an AC/DC circuit.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
021 09 01 05		***~~Permanent magnets~~ Intentionally left blank***								
~~LO (01)~~		~~Explain the term 'magnetic flux'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~State the pattern and direction of the magnetic flux outside the magnetic poles and inside the magnet.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
021 09 01 06		***Electromagnetism***								
(01)		State that an electrical current produces a magnetic field ~~and define the direction of that field~~.	X	X	X	X	X			
(02)		Describe how the strength of the magnetic field changes with the magnitude of the current ~~if supported by a ferromagnetic core~~.	X	X	X	X	X			
(03)		Explain the purpose and the working principle of a solenoid.	X	X	X	X	X			
(04)		Explain the purpose and the working principle of a relay.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(05)		Explain the principle of electromagnetic induction and how two electrical components or systems may affect each ~~an~~other through this principle.	X	X	X	X	X			
~~LO (06)~~		~~List the parameters affecting the inductance of a coil.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (07)~~		~~List the parameters affecting the induced voltage in a coil.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
021 09 01 07		***Circuit ~~breakers~~ protection***								
(01)		Explain the ~~operating~~ working principle of a fuse and a circuit breaker.	X	X	X	X	X			
(02)		Explain how a fuse is rated.	X	X	X	X	X			
~~LO (03)~~		~~State the difference between a 'trip-free' and 'non-trip-free' circuit breaker.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(04)		~~List the following different types of circuit breakers:~~ Describe the principal difference between the following types of circuit breakers: — thermal circuit breaker sensing magnitude of current; — magnetic circuit breaker sensing direction of current.	X	X	X	X	X			
(05)		Describe how circuit breakers may be used to reset aircraft systems/computers in the event of system failure (when part of a described procedure).	X	X	X	X	X			
(06)		Explain a short circuit in practical terms using Ohm's Law, power and energy expressions highlighting the risk of fire due to power	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		transfer and extreme energy dissipation.								
(06)		Explain the risk of fire resulting from excessive heat in a circuit subjected to overcurrent.	X	X	X	X	X			
(07)		Explain that overcurrent situations may be transient.	X	X	X	X	X			
(08)		Explain the hazards of multiple resets of a circuit breaker or the use of incorrect fuse rating when replacing blown fuses.	X	X	X	X	X			
021 09 01 08		***Semiconductors and logic circuits***								
(01)		~~State the differences between semiconductor materials and conductors and explain how the conductivity of semiconductors can be altered.~~ Describe the effect of temperature on semiconductors with regard to function and longevity of the component.	X	X	X	X	X			
~~LO (02)~~		~~State the principal function of diodes, such as rectification and voltage limiting.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~State the principal function of transistors, such as switching and amplification.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(04)		~~Explain~~ Describe the following five basic logic functions, as used in aircraft FCOM documentation, and recognise their schematic symbols according to the ANSI/MIL standard: ~~AND, OR, NOT, NOR and NAND.~~ — AND,~~;~~ — OR,~~;~~	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		— NOT,~~;~~ — NOR,~~;~~ — NAND.								
~~LO (05)~~		~~Describe their associated symbols.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(06)		~~Interpret logic diagrams using a combination of these functions.~~ Interpret a typical logic circuit schematic to the level of detail as found in an aircraft FCOM.	X	X	X	X	X			
021 09 02 00		**Batteries**								
021 09 02 01		***Types, characteristics and limitations***								
(01)		State the function of an aircraft battery.	X	X	X	X	X			
(02)		Name the types of rechargeable batteries used in aircraft~~.~~: — lead-acid; — nickel-cadmium; — lithium-ion; — lithium-polymer.	X	X	X	X	X			
(03)		Compare ~~lead-acid and nickel-cadmium (Ni-Cd) batteries~~ the different battery types with respect to: ~~weight, voltage, load behaviour, self-discharge, charging characteristics, thermal runaway and storage life.~~ — load behaviour; — charging characteristics;	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— risk of thermal runaway.								
(04)		~~Explain the term 'cell voltage'.~~ Explain the term 'cell voltage' and describe how a battery may consist of several cells that combined provide the desirable voltage and capacity.	X	X	X	X	X			
~~LO (05)~~		~~State that a battery is composed of several cells.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(06)		Explain the difference between battery voltage and charging voltage.	X	X	X	X	X			
~~LO (07)~~		~~State the charging voltage that corresponds with different battery voltages.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(08)		Define the term 'capacity of batteries' and state the unit of measurement used.	X	X	X	X	X			
(09)		State the effect of temperature on battery capacity and performance.	X	X	X	X	X			
~~LO (10)~~		~~State the relationship between voltage and capacity when batteries are connected in series or in parallel.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(11)		State that in the case of loss of all generated power (battery power only) the remaining electrical power is time-limited.	X	X	X	X	X			
(12)		Explain how ~~particularly~~ lithium-type batteries pose a threat to aircraft safety and what affects this risk: — numbers of batteries aboard an aircraft including those	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		brought on board by passengers; — temperature, of both battery and environment; — physical condition of the battery; — battery charging.								
(13)		Describe how to contain a battery thermal runaway highlighting the following: — how one cell can affect the neighbouring cells; — challenges if it happens in an aircraft during flight.	X	X	X	X	X			
021 09 03 00		**Generation**								
		Remark: For standardisation purposes, the following standard expressions are used: — *DC generator: produces DC output;* — *DC alternator: produces AC, rectified by integrated rectifying unit, the output is DC;* — *DC alternator: producing a DC output by using a rectifier;* — *AC generator: produces AC output;* — *starter generator: integrated combination of a ~~DC~~ generator ~~with DC output~~ and a starter motor ~~using battery DC~~;* — *permanent magnet alternator/ generator: self-exciting AC generator. ~~produces AC output without field excitation using a permanent magnet~~*	X	X	X	X	X			
021 09 03 01		***DC generation***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)		Describe the basic working principle of a simple DC generator or DC alternator ~~and name its main components~~.	X	X	X	X	X			
~~LO (02)~~		~~State in qualitative terms how voltage depends on the number of windings, field strength, RPM and load.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~List the differences between a DC generator and a DC alternator with regard to voltage response at low RPM, power–weight ratio, and brush sparking.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(04)		Explain the principle of voltage control and why it is required.	X	X	X	X	X			
(05)		~~Explain why reverse current flow from the battery to the generator must be prevented.~~ Explain the purpose of reverse current protection from the battery/busbar to the alternator.	X	X	X	X	X			
(06)		Describe the basic operating principle of a starter generator and state its purpose.	X	X	X	X	X			
021 09 03 02		***AC generation***								
(01)		~~Describe the components of a three-phase AC generator and the operating principle.~~ Describe the working principle of a brushless three-phase AC generator.	X	X	X	X	X			
(02)		State that the generator field current is used to control voltage.	X	X	X	X	X			
(03)		~~State in qualitative terms the relation between frequency number~~	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~of pole pairs and RPM of a three-phase generator.~~ State the relationship between output frequency and the RPM of three-phase AC generator.								
(04)		Explain the term ~~'wild-frequency generator'~~ 'frequency wild generator'.	X	X	X	X	X			
~~LO (05)~~		~~Describe how a three-phase AC generator can be connected to the electrical system.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (06)~~		~~Describe the purpose and the working principle of a permanent magnet alternator/generator.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(07)		List the following different power sources that can be used for an aeroplane to drive an AC generator: — engine,~~;~~ — APU,~~;~~ — RAT,~~;~~ — hydraulic.	X	X						
(08)		List the following different power sources that can be used for a helicopter to drive an AC generator: — engine,~~;~~ — APU,~~;~~ — gearbox.			X	X	X			
021 09 03 03		***Constant s~~S~~peed d~~D~~rive (CSD) and i~~I~~ntegrated d~~D~~rive g~~G~~enerator***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		(IDG) systems~~.~~								
(01)		Describe the function ~~and the working principle~~ of a CSD.	X	X						
(02)		Explain the parameters of a CSD that are monitored.	X	X						
(03)		Describe the function ~~and the working principle~~ of an IDG.	X	X						
(04)		Explain the consequences of a mechanical disconnection during flight for a CSD and an IDG.	X	X						
(05)		Explain that a CSD/IDG has its own, independent oil system and how a leak from this may appear as an engine oil leak	X	X						
021 09 03 04		***Transformers, transformer rectifier units (TRUs), static inverters***								
(01)		State the function of a transformer ~~and its operating principle~~.	X	X	X	X	X			
(02)		~~State the function of a Transformer Rectifier Unit (TRU), its operating principle and the voltage output.~~ State the function of a TRU and its purpose, including type of output.	X	X	X	X	X			
(03)		~~State the function of static inverters, their operating principle and the voltage output.~~ State the function of a static inverter and its purpose, including type of output.	X	X	X	X	X			
021 09 04 00		**Distribution**								
021 09 04 01		***General***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)		Explain the function of a busbar ~~bus (bus bar)~~.	X	X	X	X	X			
(02)		Describe the function of the following buses: — ~~main bus,~~ — ~~tie bus,~~ — ~~essential bus,~~ — ~~emergency bus,~~ — ~~ground bus,~~ — ~~battery bus,~~ — ~~hot (battery) bus.~~, — AC bus; — DC bus; — emergency AC or DC bus; — essential AC or DC bus; — battery bus; — hot bus; — ground servicing ~~or~~ maintenance bus.	X	X	X	X	X			
(03)		State that the aircraft structure can be used as a part of the electrical circuit (common earth) and explain the implications for electrical bonding.	X	X	X	X	X			
(04)		Explain the function of external power.	X	X	X	X	X			
(05)		State that a priority sequence exists between the different sources	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		of electrical power on ground and in flight.								
(06)		~~Introduce~~ Explain the term 'load sharing'.	X	X	X	X	X			
~~LO (07)~~		~~Explain that load sharing is always achieved during parallel operations.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(08)		~~Introduce~~ Explain the term 'load shedding'.	X	X	X	X	X			
(09)		~~Explain that an AC load can be shed in case of generator overload.~~ Describe typical systems that can be shed in the event of a supply failure, such as passenger entertainment system and galley power.	X	X	X	X	X			
(10)		~~Interpret an electrical-system schematic (appended to these LOs).~~ ~~*Remark: The system described is a split system.*~~ Interpret a typical electrical system schematic to the level of detail as found in an aircraft FCOM.	X	X	X	X	X			
(11)		Explain the difference between a supply (e.g. generator) failure and a bus failure, and the operating consequences of either.	X	X	X	X	X			
021 09 04 02		***DC distribution***								
(01)		Describe a simple DC electrical system of a single-engine aircraft.	X	X	X	X	X			
(02)		Describe a DC electrical system of a multi-engine aircraft (CS-23/CS-27) including the distribution consequences of loss of generator(s) or bus failure.	X	X	X	X	X			
(03)		Describe the DC part of an electrical system of a transport aircraft (CS-25/CS-29) including the distribution consequences of loss of	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		DC supply or bus failure.								
(04)		Give examples of DC consumers.	X	X	X	X	X			
021 09 04 03		***AC distribution***								
(01)		~~Describe the AC electrical system of a transport aircraft for split and parallel operation.~~ Explain the difference in the principle of operation for a split AC electrical system and a parallel AC electrical system.	X	X	X	X	X			
(02)		~~Describe the distribution consequences of:~~ — ~~APU electrical supply and external power priority switching;~~ — ~~loss of (all) generator(s);~~ — ~~bus failure.~~ Describe the following distribution consequences: — power transfer between different power supplies; — power transfer in the event of a supply failure; — loss of all normal AC supplies.	X	X	X	X	X			
(03)		Give examples of AC consumers.	X	X	X	X	X			
(04)		Explain the conditions to be met for paralleling AC generators.	X	X	X	X	X			
(05)		~~Explain the terms 'real and reactive loads'.~~ State that volt-ampere (VA) is the unit for total power consumed in an AC system.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
~~(06)~~	~~X~~	~~State that the effect of real and reactive loads are compensated for in the case of paralleled AC generators.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
021 09 04 04		***Electrical load management and monitoring systems: automatic generators and bus switching during normal and failure operation, indications and warnings***								
(01)		Give examples of system control, monitoring and annunciators using the following terms: — generator control unit (GCU) for monitoring generator output and providing network protection; — exciter contactor/breaker/relay for control of generator exciter field; — generator contactor/breaker/relay for connecting the generator to the network; — bus-tie contactor/breaker/relay for connecting busbars together; — generator switch on the flight deck for manual control of exciter contactor; — IDG/CSD disconnect switch on the flight deck for mechanical disconnection of the generator; — bus-tie switch on the flight deck with AUTO and OFF positions only.	X	X	X	X	X			
(02)		~~Describe, for normal (on ground/in flight) and degraded modes of operation, the following functions of an electrical load~~	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~management system:~~ — ~~distribution,~~ — ~~monitoring,~~ — ~~protection (overloading, over/undervoltage, incorrect frequency).~~ Describe, for normal and degraded modes of operation, the following functions of an electrical load management system on ground and in flight using the terms in 021 09 04 04 (01): — distribution; — monitoring; — protection in the event of incorrect voltage; — protection in the event of incorrect frequency; — protection in the event of a differential fault.								
~~(03)~~		~~State which parameters are used to monitor an electrical system for parallel and split system operation.~~ ~~Explain the difference in monitoring required for a parallel AC system compared to a split AC system with regard to synchronising the output from the various supplies.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(04)		~~Describe how batteries are monitored.~~ Describe the requirement for monitoring the aircraft batteries.	X	X	X	X	X			
(05)		~~State that Ni-Cd batteries are monitored to avoid damage resulting from excessive temperature increase (thermal runaway).~~	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		Explain the importance of monitoring the temperature of nickel-cadmium and lithium-type batteries.								
(06)		Interpret various different ammeter indications of an ammeter which monitors the charge current of the battery.	X	X	X	X	X			
021 09 05 00		**Electrical motors**								
021 09 05 01		***General***								
(01)	X	State that the purpose of an electrical motor is to convert electrical energy into mechanical energy.	X	X	X	X	X			
(02)		State that because of the similarity in design, a generator and an electrical motor may be combined into a starter generator.	X	X	X	X	X			
(03)		Explain that the size of the engine determines how much energy is required for starting, and state the following: — small turbine engines may be able to use the battery for a very limited number of start attempts; — large turbine engines require one or more power sources, either external or on-board.								
021 09 05 02		***Operating principle***								
(01)		~~Explain the operating principle of an electric motor as being an electrical current carrying conductor inside a magnetic field that experiences a Lorentz/electromotive (EMF) force.~~ Describe how the torque of an electrical motor is determined by the supplied voltage and current and the resulting magnetic fields	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		within the engine.								
(02)	X	State that electrical motors can be either AC or DC ~~type~~.	X	X	X	X	X			
(03)		Explain the consequences of the following: — rotor seizure; — rotor runaway.	X	X	X	X	X			
021 09 05 03		***Components***								
(01)	X	Name the following components of an electrical motor ~~and explain their function~~: — rotor (rotating part of an electrical motor); — stator (stationary part of an electrical motor).	X	X	X	X	X			
021 10 00 00		**PISTON ENGINES**								
		Remark: This topic includes diesel ~~engines~~ and petrol engines.								
021 10 01 00		**General**								
021 10 01 01		***Types of internal-combustion engines: basic principles, definitions***								
(01)		Define the following terms and expressions: — ~~RPM~~rpm; — torque; — m~~M~~anifold a~~A~~bsolute p~~P~~ressure (MAP); — power output; — specific fuel consumption;	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— ~~mechanical efficiency, thermal efficiency, volumetric efficiency;~~ — compression ratio, clearance volume, swept (displaced) volume, total volume.								
~~LO (02)~~		~~Describe the influence of compression ratio on thermal efficiency.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
021 10 01 02		***Engine: design, operation, components ~~and materials~~***								
(01)		~~Describe the following main engine components and state their function.~~ Describe the basic operating principle of a piston engine: — crankcase~~,~~; — crankshaft~~,~~; — connecting rod~~,~~; — piston~~,~~; — piston pin~~,~~; — piston rings~~,~~; — cylinder~~,~~; — cylinder head~~,~~; — valves~~,~~; — valve springs~~,~~; — push rod~~,~~; — camshaft~~,~~; — rocker arm~~,~~;	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		— camshaft gear~~,~~; — bearings.								
~~LO (02)~~		~~State the materials used for the following engine components:~~ — ~~Ccrankcase,~~ — ~~crankshaft,~~ — ~~connecting rod,~~ — ~~piston,~~ — ~~piston pin,~~ — ~~cylinder,~~ — ~~cylinder head,~~ — ~~valves,~~ — ~~camshaft.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(03)		Name and identify the various types of engine design with regard to cylinder arrangement and their advantages/disadvantages~~, such as~~: — horizontally opposed~~,~~; — in line~~,~~; — radial~~,~~; — and working cycle (four stroke: petrol and diesel).	X	X	X	X	X			
~~LO (04)~~		~~Describe the gas-state changes, the valve positions and the ignition~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~timing during the four strokes of the theoretical piston-engine cycle.~~								
~~LO (05)~~		~~Explain the main differences between the theoretical (Otto cycle) and the practical four-stroke piston-engine cycles.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(06)		Describe the differences between petrol ~~engines~~ and diesel engines with respect to: — means of ignition; — maximum compression ratio; — regulating air or mixture supply to the cylinder; — ~~specific power output (kW/kg);~~ — ~~thermal efficiency;~~ — pollution from the exhaust.	X	X	X	X	X			
021 10 02 00		**Fuel**								
021 10 02 01		***Types, grades, characteristics, limitations***								
(01)		Name the type of fuel used for petrol engines including its colour (AVGAS); — 100 (green); — 100LL (blue).	X	X	X	X	X			
(02)		~~Name the types of fuel used for diesel engines (kerosene or diesel).~~ Name the type of fuel normally used for aviation diesel engines (JET-A1).	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(03)	X	Define the term ‘octane rating’.	X	X	X	X	X			
~~LO (04)~~		~~Describe the combustion process in a piston-engine cylinder for both petrol and diesel engines.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (05)~~		~~Define the term ‘flame front velocity’ and describe its variations depending on the fuel-air mixture for petrol engines.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(06)		Define the term ‘detonation’ and describe the causes and effects of detonation for both petrol and diesel engines.	X	X	X	X	X			
(07)		Define the term ‘pre-ignition’ and describe the causes and effects of pre-ignition for both petrol and diesel engines.	X	X	X	X	X			
(08)		Identify the conditions and power settings that promote detonation for petrol engines.	X	X	X	X	X			
(09)		Describe how detonation in petrol engines is recognised.	X	X	X	X	X			
~~LO (10)~~		~~Name the anti-detonation petrol fuel additive (tetraethyl lead).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(11)		Describe the method and occasions for checking the fuel for water content.	X	X	X	X	X			
(12)		State the typical value of fuel density for aviation gasoline and diesel fuel.	X	X	X	X	X			
(13)		Explain volatility, viscosity and vapour locking for petrol and diesel fuels.	X	X	X	X	X			
021 10 03 00		**Engine fuel pumps**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
021 10 03 01		***Engine-driven fuel pump***								
(01)		~~Describe~~ Explain the need for a separate engine-driven fuel pump.	X	X	X	X	X			
~~LO (02)~~		~~List the different types of engine-driven fuel pumps:~~ — ~~Ggear type,~~ — ~~vane type.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
021 10 04 00		**Carburettor/injection system**								
021 10 04 01		***Carburettor: design, operation, degraded modes of operation, indications and warnings***								
(01)		State the purpose of a carburettor.	X	X	X	X	X			
(02)		Describe the operating principle of the simple float chamber carburettor.	X	X	X	X	X			
~~LO (03)~~		~~Describe the method of achieving reliable idle operation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(04)		Describe the methods of obtaining mixture control over the whole operating engine power setting range (compensation jet, diffuser).	X	X	X	X	X			
(05)		Describe the methods of obtaining mixture control over the whole operating altitude range.	X	X	X	X	X			
(06)		Explain the purpose and the operating principle of an accelerator pump.	X	X	X	X	X			
(07)		Explain the purpose of power enrichment.	X	X	X	X	X			
(08)		Describe the function of the carburettor heat system.	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(09)		Explain the effect of carburettor heat on mixture ratio and power output.	X	X	X	X	X			
(10)		Explain the purpose and the operating principle of a primer pump.	X	X	X	X	X			
(11)		Discuss other methods for priming an engine (acceleration pumps).	X	X	X	X	X			
(12)		Explain the danger of carburettor fire, including corrective measures.	X	X	X	X	X			
021 10 04 02		***Injection: design, operation, degraded modes of operation, indications and warnings***								
~~LO (01)~~		~~Describe the low pressure, continuous flow type, fuel injection system used on light aircraft piston petrol engines with the aid of a schematic diagram.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(02)		Explain the advantages and difference in operation of an injection system compared with a carburettor system.	X	X	X	X	X			
~~LO (03)~~		~~Explain the requirement for two different pumps in the fuel injection system and describe their operation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (04)~~		~~Describe the task and explain the operating principle of fuel and mixture control valves in the injection system for petrol engines.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (05)~~		~~Describe the task and explain the operating principle of the fuel manifold valve, the discharge nozzles and the fuel-flow meter in the fuel injection system for petrol engines.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (06)~~		~~Describe the injection system of a diesel engine and explain the~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~function of the following components:~~ — ~~Hhigh-pressure fuel injection pump;~~ — ~~common-rail principle;~~ — ~~fuel lines;~~ — ~~fuel injectors.~~								
021 10 04 03		***Icing***								
(01)		Describe the causes and effects of carburettor icing and the action to be taken if carburettor icing is suspected.	X	X	X	X	X			
(02)		Name the meteorological conditions under which carburettor icing may occur.	X	X	X	X	X			
(03)		Describe the indications of the presence of carburettor icing for~~with~~ both a fixed pitch and a constant speed propeller.	X	X						
(04)		Describe the indications of the presence of carburettor icing for~~with~~ a helicopter.			X	X	X			
(05)		Describe the indications that will occur upon selection of carburettor heat depending on whether ice is present or not.	X	X	X	X	X			
(06)		Explain the reason for the use of alternate air on fuel injection systems and describe its operating principle.	X	X	X	X	X			
(07)		State the meteorological conditions under which induction-system icing may occur.	X	X	X	X	X			
021 10 05 00		**Cooling systems**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
021 10 05 01		***Design, operation, indications and warnings***								
(01)		Specify the reasons for cooling a piston engine.	X	X	X	X	X			
(02)		Describe the design features to enhance cylinder air cooling for aeroplanes.	X	X						
(03)		Describe the design features to enhance cylinder air cooling for helicopters (e.g. engine-driven impeller and scroll assembly, baffles).			X	X	X			
(04)		Compare the ~~advantages of~~ differences between liquid- and air-cooling systems.	X	X	X	X	X			
(05)		Identify the cylinder head temperature indication to monitor engine cooling.	X	X	X	X	X			
(06)		Describe the function and the operation of cowl flaps.	X	X						
021 10 06 00		**Lubrication systems**								
021 10 06 01		***Lubricants: characteristics, limitations***								
(01)		Describe the term 'viscosity' including the effect of temperature.	X	X	X	X	X			
(02)		Describe the viscosity grade numbering system used in aviation.	X	X	X	X	X			
021 10 06 02		***Design, operation, indications and warnings***								
(01)		State the functions of a piston-engine lubrication system.	X	X	X	X	X			
(02)		Describe the working principle of a dry-sump lubrication system and describe the functions of the following components:	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— oil tank (reservoir) and its internal components: hot well, de-aerator, vent, expansion space; — check valve (non-return valve); — pressure pump and pressure-relief valve; — scavenge pump; — filters (suction, pressure and scavenge); — oil cooler; — oil cooler bypass valve (anti-surge and thermostatic); — pressure and temperature sensors; — lines.								
(03)		Describe a wet-sump lubrication system.	X	X	X	X	X			
(04)		State the differences between a wet- and a dry-sump lubrication system and their advantages and disadvantages.	X	X	X	X	X			
~~LO (05)~~		~~State the advantages/disadvantages of each system.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(06)		List the following factors that influence oil consumption: — oil grade~~,~~; — cylinder and piston wear~~,~~; — condition of piston rings.	X	X	X	X	X			
(07)		Describe the interaction between oil pressure, oil temperature and oil quantity.	X	X	X	X	X			
021 10 07 00		**Ignition circuits**								

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL/ IR**	**ATPL**	**CPL**			
021 10 07 01		***Design, operation***								
(01)		Describe the working principle of a magneto-ignition system and the functions of the following components: — magneto~~,~~; — contact-breaker points~~,~~; — capacitor (condenser)~~,~~; — coils or windings~~,~~; — ignition switches~~,~~; — distributor~~,~~; — spark plug~~,~~; — high-tension (HT) cable.	X	X	X	X	X			
(02)		State why piston engines are equipped with two electrically independent ignition systems.	X	X	X	X	X			
(03)		State the function and operating principle of the following methods of spark augmentation: — starter vibrator (booster coil)~~,~~; — impulse-start coupling.	X	X						
(04)		State the function and operating principle of the following methods of spark augmentation: — starter vibrator (booster coil)~~,~~; — both magnetos live.			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(05)		Explain the function of the magneto check.	X	X	X	X	X			
~~LO (06)~~		~~State the reasons for using the correct temperature grade for a spark plug.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (07)~~		~~Explain the function of ignition timing advance or retard.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(08)		Explain how combustion is initiated in diesel engines.	X	X	X	X	X			
021 10 08 00		**Mixture**								
021 10 08 01		***Definition, characteristic mixtures, control instruments, associated control levers, indications***								
(01)		Define the following terms: — mixture~~,~~; — chemically correct ratio (stoichiometric)~~,~~; — best power ratio~~,~~; — lean (weak) mixture (lean or rich side of the exhaust gas temperature (EGT) top)~~,~~; — rich mixture.	X	X	X	X	X			
(02)		State the typical fuel-to-air ratio values or range of values for the above mixtures.	X	X	X	X	X			
(03)		Describe the advantages and disadvantages of weak and rich mixtures.	X	X	X	X	X			
(04)		Describe the relation between engine-specific fuel consumption and mixture ratio.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(05)		Describe the use of the exhaust gas temperature as an aid to mixture-setting.	X	X	X	X	X			
(06)		Explain the relation between mixture ratio, cylinder head temperature, detonation and pre-ignition.	X	X	X	X	X			
(07)		Explain the absence of mixture control in diesel engines.	X	X	X	X	X			
021 10 09 00		**Aeroplane: propellers**								
021 10 09 01		***Definitions, general***								
		Remark: Definitions and aerodynamic concepts are detailed in S~~s~~ubject 081 'Principles of flight (aeroplane)', T~~t~~opic 07 (Propellers), but need to be appreciated for this S~~s~~ubject as well.	X	X						
021 10 09 02		***Constant-speed propeller: design, operation, system components***								
(01)		Describe the operating principle of a constant-speed propeller system under normal flight operations with the aid of a schematic.	X	X						
(02)		Explain the need for a ~~Manifold Absolute Pressure (~~MAP~~)~~ indicator to control the power setting with a constant-speed propeller.	X	X						
(03)		State the purpose of a torque-meter.	X	X						
(04)		State the purpose and describe the operation of a low-pitch stop (centrifugal latch).	X	X						
(05)		Describe the operating principle of a single-acting and a double-acting variable pitch propeller for single- and multi-engine aeroplanes.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(06)		Describe the function and the basic operating principle of synchronising and synchro-phasing systems.	X	X						
(07)		Explain the purpose and the basic operating principle of an auto-feathering system ~~including~~ and unfeathering.	X	X						
021 10 09 03		***Reduction gearing: design***								
(01)		State the purpose of reduction gearing.	X	X						
~~LO (02)~~		~~Explain the principles of design for reduction gearing.~~	~~X~~	~~X~~						
021 10 09 04		***Propeller handling: associated control levers, degraded modes of operation, indications and warnings***								
(01)		Describe the checks to be carried out on a constant-speed propeller system after engine start.	X	X						
(02)		Describe the operation of a constant-speed propeller system during flight at different true airspeeds (TAS) and RPM including an overspeeding propeller.	X	X						
(03)		Describe the operating principle of a variable pitch propeller when feathering and unfeathering, including the operation of cockpit controls.	X	X						
(04)		Describe the operating principle of a variable pitch propeller when reverse pitch is selected, including the operation of cockpit controls.	X	X						
(05)		Describe the operation of the propeller levers during different	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		phases of flight.								
021 10 10 00		**Performance and engine handling**								
021 10 10 01		***Performance***								
~~LO (01)~~		~~Engine performance: define 'pressure altitude' and 'density altitude'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(02)		Describe the effect on power output of a petrol and diesel engine taking into consideration the following parameters: — ambient pressure, exhaust back pressure; — temperature; — density altitude; — humidity.	X	X	X	X	X			
(03)		Explain the term 'normally aspirated engine'.	X	X	X	X	X			
(04)		Power-augmentation devices: explain the requirement for power augmentation (turbocharging) of a piston engine.	X	X	X	X	X			
(05)		Describe the function and the principle of operation of the following main components of a turbocharger: — turbine~~,~~; — compressor~~,~~; — waste gate~~,~~; — waste-gate actuator. — ~~absolute-pressure controller,~~	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— ~~density controller,~~ — ~~differential-pressure controller.~~								
(06)		Explain the difference between an altitude-boosted turbocharger and a ground-boosted turbocharger.	X	X	X	X	X			
(07)		Explain turbo lag.	X	X	X	X	X			
(08)		Define the term ‘critical altitude’.	X	X	X	X	X			
(090		Explain the function of an intercooler.	X	X	X	X	X			
(10)		Define the terms ‘full-throttle height’ and ‘rated altitude’.	X	X	X	X	X			
021 10 10 02		***Engine handling***								
(01)		State the correct procedures for setting the engine controls when increasing or decreasing power.	X	X	X	X	X			
(02)		Define the following terms: — take-off power; — maximum continuous power.	X	X	X	X	X			
~~LO (03)~~		~~Describe the term ‘hydraulicing’ and the precautions to be taken prior to engine start.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(04)		Describe the start problems associated with extreme cold weather.	X	X	X	X	X			
(05)		~~FADEC for a piston engine: To be introduced at a later date.~~ Describe the principal difference between a full-authority digital engine control (FADEC) system-controlled engine and traditional	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		manual engine controls.								
(06)		Describe the engine controls available on the flight deck for a FADEC-controlled engine.	X	X	X	X	X			
(07)		Explain that the FADEC has full authority of the control of all engine parameters ensuring efficient and correct running of the engine, including protection in the event of failure.	X	X	X	X	X			
(08)		Explain the need for FADEC redundancy with regard to power supply and data input and output.	X	X	X	X	X			
021 11 00 00		**TURBINE ENGINES**								
021 11 01 00		**Basic principles**								
021 11 01 01		***Basic generation of thrust and the thrust formula***								
(01)		Describe how thrust is produced by a basic gas turbine engine.	X	X						
(02)		Describe the simple form of the thrust formula for a basic, straight ~~turbo~~jet engine and perform simple calculations (including pressure thrust).	X	X						
(03)		State that thrust can be considered to remain approximately constant over the whole aeroplane subsonic speed range.	X	X						
021 11 01 02		***Design, types and components of turbine engines~~, components~~***								
(01)		List the main components of a basic gas turbine engine~~.~~: — inlet~~,~~;	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— compressor~~,~~; — combustion chamber~~,~~; — turbine~~,~~; — outlet.								
~~LO (02)~~		~~Describe the system of station numbering in a gas turbine engine.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(03)		Describe the variation of static pressure, temperature and axial velocity in a gas turbine engine under normal operating conditions and with the aid of a working cycle diagram.	X	X	X	X	X			
(04)		Describe the differences between absolute, circumferential (tangential) and axial velocity.	X	X	X	X	X			
(05)		List the different types of gas turbine engines: — straight jet~~,~~; — turbofan~~,~~; — turboprop.	X	X						
(06)		State that a gas turbine engine can have one or more spools.	X	X	X	X	X			
(07)		Describe how thrust is produced by turbojet and turbofan engines.	X	X						
(08)		Describe how power is produced by turboprop engines.	X	X						
(09)		Describe the term 'equivalent horsepower' (= thrust horsepower + shaft horsepower).	X	X						
(10)		Explain the principle of a free turbine or free-power turbine.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(11)		Define the term 'bypass ratio' and perform simple calculations to determine it ~~bypass ratio~~.	X	X						
(12)		Define the terms 'propulsive power', 'propulsive efficiency', 'thermal efficiency' and 'total efficiency'.	X	X						
(13)		Describe the influence of compressor-pressure ratio on thermal efficiency.	X	X	X	X	X			
(14)		Explain the variations of propulsive efficiency with forward speed for turbojet, turbofan and turboprop engines.	X	X						
(15)		Define the term 'specific fuel consumption' for turbojets and turboprops.	X	X						
021 11 01 03		***Coupled turbine engine: design, operation, components and materials***								
(01)		Name the main assembly parts of a coupled turbine engine and explain ~~the~~ its operation ~~of the engine~~.			X	X	X			
(02)		Explain the limitations of the materials used with regard to maximum turbine temperature, engine and drive train torque limits.			X	X	X			
(03)		Describe the possible effects on engine components when limits are exceeded.			X	X	X			
(04)		Explain that when engine limits are exceeded, this event must be reported.			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
021 11 01 04		***Free-turbine engine: design, components and materials***								
(01)		Describe the design methods to keep the engine's size small for installation in helicopters.			X	X	X			
(02)		List the main components of a free-turbine engine.			X	X	X			
(03)		Describe how the power is developed by a turboshaft/free-turbine engine.			X	X	X			
(04)		Explain how the exhaust gas temperature is used to monitor turbine stress.			X	X	X			
021 11 02 00		**Main-engine components**								
021 11 02 01		***Aeroplane: air intake***								
(01)		State the functions of the engine air inlet/air intake.	X	X						
(02)		Describe the geometry of a subsonic (pitot-type) air inlet.	X	X						
(03)		Explain the gas-parameter changes in a subsonic air inlet at different flight speeds.	X	X						
(04)		Describe the reasons for, and the dangers of, the following operational problems concerning the engine air inlet: — airflow separation~~,~~; — inlet icing~~,~~; — inlet damage~~,~~; — f~~F~~oreign o~~O~~bject d~~D~~amage (FOD)~~,~~;	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— heavy in-flight turbulence.								
021 11 02 02		***Compressor and diffuser***								
(01)		State the purpose of the compressor.	X	X	X	X	X			
(02)		Describe the working principle of a centrifugal and an axial flow compressor.	X	X	X	X	X			
(03)		Name the following main components of a single stage and describe their function for a centrifugal compressor: — impeller~~,~~; — diffuser.	X	X	X	X	X			
(04)		Name the following main components of a single stage and describe their function for an axial compressor: — rotor vanes~~,~~; — stator vanes.	X	X	X	X	X			
(05)		Describe the gas-parameter changes in a compressor stage.	X	X	X	X	X			
(06)		Define the term 'pressure ratio' and state a typical value for one stage of a centrifugal and an axial flow compressor and for the complete compressor.	X	X	X	X	X			
(07)		State the advantages and disadvantages of increasing the number of stages in a centrifugal compressor.	X	X	X	X	X			
(08)		Explain the difference in sensitivity for ~~Foreign Object Damage (~~FOD~~)~~ of a centrifugal compressor compared with an axial flow	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		type.								
(09)		Explain the convergent air annulus through an axial flow compressor.	X	X	X	X	X			
(10)		Describe the reason for twisting the compressor blades.	X	X	X	X	X			
(11)		State the tasks of inlet guide vanes (IGVs).	X	X	X	X	X			
(12)		State the reason for the clicking noise whilst the compressor slowly rotates on the ground.	X	X	X	X	X			
(13)		State the advantages of increasing the number of spools.	X	X	X	X	X			
(14)		Explain the implications of tip losses and describe the design features to minimise the problem.	X	X	X	X	X			
(15)		Explain the problems of blade bending and flapping and describe the design features to minimise the problem.	X	X	X	X	X			
(16)		Explain the following terms: — compressor stall~~,~~; — engine surge.	X	X	X	X	X			
(17)		State the conditions that are possible causes of stall and surge.	X	X	X	X	X			
(18)		Describe the indications of stall and surge.	X	X	X	X	X			
(19)		Describe the design features used to minimise the occurrence of stall and surge.	X	X	X	X	X			
(20)		Describe a compressor map (surge envelope) with RPM lines, stall	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		limit, steady state line and acceleration line.								
(21)		Describe the function of the diffuser.	X	X	X	X	X			
021 11 02 03		***Combustion chamber***								
(01)		Define the purpose of the combustion chamber.	X	X	X	X	X			
(02)		List the requirements for combustion.	X	X	X	X	X			
(03)		Describe the working principle of a combustion chamber.	X	X	X	X	X			
(04)		Explain the reason for reducing the airflow axial velocity at the combustion chamber inlet (snout).	X	X	X	X	X			
(05)		State the function of the swirl vanes (swirler).	X	X	X	X	X			
(06)		State the function of the drain valves.	X	X	X	X	X			
(07)		Define the terms 'primary airflow' and 'secondary airflow', and explain their purpose.	X	X	X	X	X			
(08)		Explain the following two mixture ratios: — primary airflow to fuel~~,~~; — total airflow (within the combustion chamber) to fuel.	X	X	X	X	X			
(09)		Describe the gas-parameter changes in the combustion chamber.	X	X	X	X	X			
(10)		State a typical maximum value of the outlet temperature of the combustion chamber.	X	X	X	X	X			
(11)		Describe the following types of combustion chambers and state the differences between them:	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— can type; — can-annular, cannular or tubo-annular; — annular; — reverse-flow annular.								
~~LO (12)~~		~~Describe the principle of operation of a simplex and a duplex fuel spray nozzle (atomiser).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
021 11 02 04		***Turbine***								
(01)		Explain the purpose of a turbine in different types of gas turbine engines.	X	X	X	X	X			
(02)		Describe the principles of operation of impulse, reaction and impulse-reaction axial flow turbines.	X	X	X	X	X			
(03)		Name the main components of a turbine stage and their function.	X	X	X	X	X			
(04)		Describe the working principle of a turbine.	X	X	X	X	X			
(05)		Describe the gas-parameter changes in a turbine stage.	X	X	X	X	X			
(06)		Describe the function and the working principle of active clearance control.	X	X	~~X~~	~~X~~	~~X~~			
(07)		Describe the implications of tip losses and the means to minimise them.	X	X	X	X	X			
(08)		Explain why the available engine thrust is limited by the turbine inlet temperature.	X	X	~~X~~	~~X~~	~~X~~			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(09)		Explain the divergent gas-flow annulus through an axial-flow turbine.	X	X	X	X	X			
~~LO (10)~~		~~Describe turbine-blade convection, impingement and film cooling.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(11)		Explain the high mechanical-thermal stress in the turbine blades and wheels/~~disksdiscs~~	X	X	X	X	X			
~~LO (12)~~		~~Explain the term 'creep'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (13)~~		~~Explain the consequences of creep on the turbine.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (14)~~		~~Explain the terms 'low-cycle fatigue' and 'high-cycle fatigue'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
021 11 02 05		***Aeroplane: exhaust***								
(01)		Name the following main components of the exhaust unit and their function: — jet pipe~~,~~; — propelling nozzle~~,~~; — exhaust cone.	X	X						
(02)		Describe the working principle of the exhaust unit.	X	X						
(03)		Describe the gas-parameter changes in the exhaust unit.	X	X						
(04)		Define the term 'choked exhaust nozzle' (not applicable to turboprops).	X							
(06)		Explain how jet exhaust noise can be reduced.	X	X						
021 11 02 06		***Helicopter: air intake***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)		Name and explain the main task of the engine air intake.			X	X	X			
(02)		Describe the use of a convergent air-intake ducting on helicopters.			X	X	X			
(03)		Describe the reasons for and the dangers of the following operational problems concerning engine air intake: — airflow separations~~,~~; — intake icing~~,~~; — intake damage~~,~~; — FOD~~foreign object damage,~~; — heavy in-flight turbulence.			X	X	X			
(04)		Describe the conditions and circumstances during ground operations when FOD ~~foreign object damage~~ is most likely to occur.			X	X	X			
(05)		Describe and explain the principles of air intake filter systems that can be fitted to some helicopters for operations in icing and sand conditions.			X	X	X			
(06)		Describe the function of the heated pads on some helicopter air intakes.			X	X	X			
021 11 02 07		***Helicopter: exhaust***								
~~LO (01)~~		~~Name the following main components of the exhaust unit and their function.~~ — ~~jet pipe,~~			~~X~~	~~X~~	~~X~~			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— ~~exhaust cone.~~								
(02)		Describe the working principle of the exhaust unit.			X	X	X			
(03)		Describe the gas-parameter changes in the exhaust unit.			X	X	X			
021 11 03 00		**Additional components and systems**								
021 11 03 01		***Engine fuel system***								
(01)		Name the main components of the engine fuel system and state their function: — filters; — low-pressure (LP) pump; — high-pressure (HP) pump; — fuel manifold; — fuel nozzles; — HP fuel cock; — fuel control; or — hydromechanical unit.	X	X	X	X	X			
(02)		Name the two types of engine-driven high-pressure pumps, such as: — gear-type; — swash plate-type.	X	X	X	X	X			
(03)		State the tasks of the fuel control unit.	X	X	X	X	X			
(04)		List the possible input parameters to a fuel control unit to achieve a given thrust/power setting.	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
021 11 03 02		***Engine control system***								
(01)		State the tasks of the engine control system.	X	X	X	X	X			
(02)		List the following different types of engine control systems~~ (refer to AMC to CS-E 50 Engine control system (1) Applicability) and state their respective engine control (output) parameters~~: — hydromechanical ~~(Main Engine Control (MEC))~~; — hydromechanical with a limited authority electronic supervisor ~~(Power Management System/Control (PMS/PMC))~~; — single-channel ~~full-authority engine control~~ FADEC with hydromechanical backup; — dual-channel ~~full-authority electronic engine control~~ FADEC ~~system~~ with no backup or any other combination ~~(FADEC)~~.	X	X	X	X	X			
(03)		Describe a FADEC as a full-authority dual-channel system including functions such as an electronic engine control unit, wiring, sensors, variable vanes, active clearance control, bleed configuration, electrical signalling of thrust lever angle (TLA) (see also AMC to CS-E-50), and an EGT protection function and engine overspeed.	X		X	X				
(04)		Explain how redundancy is achieved by using more than one channel in a FADEC system.	X		X	X				
(05)		State the consequences of a FADEC single input data failure.	X		X	X				
(06)		State that all input and output data ~~are~~is checked by both channels in a FADEC system.	X		X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(07)		State that a FADEC system uses its own sensors and that, in some cases, also data from aircraft systems is used.	X		X	X				
(08)		State that a FADEC must have its own source of electrical power.	X		X	X				
021 11 03 03		***Engine lubrication***								
(01)		State the tasks of an engine lubrication system.	X	X						
(02)		Name the following main components of a lubrication system and state their function: — oil tank and centrifugal breather~~,~~; — oil pumps (pressure and scavenge pumps)~~,~~; — oil filters (including the bypass)~~,~~; — oil sumps~~,~~; — chip detectors~~,~~; — coolers.	X	X						
(03)		Explain that each spool is fitted with at least one ball bearing and two or more roller bearings.	X	X						
(04)		Explain the use of compressor air in oil-sealing systems (e.g. labyrinth seals).	X	X						
021 11 03 04		***Engine auxiliary gearbox***								
(05)		State the tasks of the auxiliary gearbox.	X	X						
(06)		Describe how the gearbox is driven and lubricated.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
021 11 03 05		***Engine ignition***								
(01)		State the task of the ignition system.	X	X						
(02)		Name the following main components of the ignition system and state their function~~.~~: — power sources~~,~~; — ~~trembler mechanism (vibrator),~~ — ~~transformer,~~ — ~~diodes,~~ — ~~capacitors,~~ — ~~discharge gap (high-tension (HT) tube),~~ — igniters.	X	X						
(03)		State why jet turbine engines are equipped with two electrically independent ignition systems.	X	X						
(04)		Explain the different modes of operation of the ignition system.	X	X						
021 11 03 06		***Engine starter***								
(01)		Name the main components of the starting system and state their function.	X	X						
(02)		Explain the principle of a turbine engine start.	X	X						
(03)		Describe the following two types of starters: — electric~~,~~;	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— pneumatic.								
(04)		Describe a typical start sequence (on ground/in flight) for a turbofan.	X	X						
(05)		Define ‘self-sustaining RPM’.	X	X						
021 11 03 07		***Reverse thrust***								
(01)		Name the following main components of a reverse-thrust system and state their function: — reverse-thrust select lever~~,~~; — power source (pneumatic or hydraulic)~~,~~; — actuators~~,~~; — doors~~,~~; — annunciations.	X	X						
(02)		Explain the principle of a reverse-thrust system.	X	X						
(03)		Identify the advantages and disadvantages of using reverse thrust.	X	X						
(04)		Describe and explain the following different types of thrust-reverser systems: — hot-stream reverser~~,~~; — clamshell or bucket-door system~~,~~; — cold-stream reverser (only turbofan engines)~~,~~; — blocker doors~~,~~; — cascade vanes.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(05)		Explain the implications of reversing the cold stream (fan reverser) only on a high bypass ratio engine.	X	X						
(06)		Describe the protection features against inadvertent thrust-reverse deployment in flight as present on most transport aeroplanes.	X	X						
(07)		Describe the controls and indications provided for the thrust-reverser system.	X	X						
021 11 03 08		***Helicopter specifics on design, operation and components for~~:~~ a~~A~~dditional components and systems such as lubrication system, ignition circuit, starter, accessory gearbox***								
(01)		State the task of the lubrication system.			X	X	X			
(02)		List and describe the common helicopter lubrication systems.			X	X	X			
(03)		Name the following main components of a helicopter lubrication system: — reservoir; — pump assembly; — external oil filter; — magnetic chip detectors, electronic chip detectors; — thermostatic oil coolers; — breather.			X	X	X			
(04)		Identify and name the components of a helicopter lubrication			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		system from a diagram.								
(05)		Identify the indications used to monitor a lubrication system including warning systems.			X	X	X			
(06)		Explain the differences and appropriate use of straight oil and compound oil, and describe the oil numbering system for aviation use.			X	X	X			
(07)		Explain and describe the ignition circuit for engine start and engine relight facility when the selection is set for both automatic and manual functions.			X	X	X			
(08)		Explain and describe the starter motor and the sequence of events when starting, and that for most helicopters the starter becomes the generator after the starting sequence is over.			X	X	X			
(09)		Explain and describe why the engine drives the accessory gearbox.			X	X	X			
021 11 04 00		**Engine operation and monitoring**								
_**021 11 04 01**_		_**General**_								
(01)		Explain the following aeroplane engine ~~limitations~~ ratings: — take-off~~,~~; — go-around~~,~~; — maximum continuous thrust/power~~,~~; — maximum climb thrust/power.	X	X						
(02)		Explain spool-up time.	X	X	X	X	X			

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL/ IR**	**ATPL**	**CPL**			
(03)		Explain the reason for the difference between ground and approach flight idle values (RPM).	X	X						
(04)		State the parameters that can be used for setting and monitoring the thrust/power.	X	X	X	X	X			
(05)		Describe the terms 'alpha range', 'beta range' and 'reverse thrust' as applied to a turboprop power lever.	X	X						
(06)		Explain the dangers of inadvertent beta-range selection in flight for a turboprop.	X	X						
(07)		Explain the purpose of engine trending.	X	X	~~X~~	~~X~~				
(08)		Explain how the exhaust gas temperature is used to monitor turbine stress.	X	X	X	X	X			
(09)		Describe the effect of engine acceleration and deceleration on the EGT.	X	X	X	X				
(10)		Describe the possible effects on engine components when EGT limits are exceeded.	X	X	X	X	X			
(11)		Explain why engine-limit exceedances must be reported.	X	X	X	X	X			
(12)		Explain the limitations on the use of the thrust-reverser system at low forward speed.	X	X			X			
(13)		Explain the term 'engine seizure'.	X	X	X	X	X			
(14)		State the possible causes of engine seizure and explain their preventative measures.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(15)		~~Explain the reason for the difference in the pressures of the fuel and oil in the heat exchanger.~~ Describe the potential consequences of a leak in the following two designs of fuel and oil heat exchanger: — oil pressure higher than fuel pressure with oil leaking into the fuel system, potentially affecting the combustion and running of the engine; fuel pressure higher than oil pressure with fuel leaking into the oil system, potentially increasing the risk of a fire due to fuel entering warm parts of the engine that should be free from fuel.	X	X	X	X	X			
(16)		Explain oil-filter clogging (blockage) and the implications for the lubrication system.	X	X	X	X	X			
(17)		Give examples of monitoring instruments of an engine.	X	X	X	X	X			
(18)		Describe how to identify and assess engine damage based on instrument indications.	X	X	X	X	X			
021 11 04 02		***Starting malfunctions***								
(01)		Describe the indications and the possible causes of the following aeroplane starting malfunctions: — false (dry or wet) start~~,~~; — tailpipe fire (torching)~~,~~; — hot start~~,~~; — abortive (hung) start~~,~~;	X	X						

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— no N1 rotation~~,~~; — no FADEC indications.								
(02)		Describe the indications and the possible causes of the following helicopter starting malfunctions: — false (dry or wet) start~~,~~; — tailpipe fire (torching)~~,~~; — hot start~~,~~; — abortive (hung) start~~,~~; — no N1 rotation~~,~~; — freewheel failure~~.~~, — no FADEC indications.			X	X	X			
~~LO (03)~~		~~— no FADEC indications.~~			~~X~~	~~X~~				
021 11 04 03		***Relight envelope***								
(01)		Explain the relight envelope.	X	X						
021 11 05 00		**Performance aspects**								
021 11 05 01		***Thrust, performance aspects, and limitations***								
(01)		Describe the variation of thrust and specific fuel consumption with altitude at constant TAS.	X	X						
(02)		Describe the variation of thrust and specific fuel consumption with TAS at constant altitude.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(03)		Explain the term ‘flat-rated engine’ by describing the change of take-off thrust, turbine inlet temperature and engine RPM with outside air temperature (OAT).	X	X						
(04)		Define the term ‘e~~E~~ngine p~~P~~ressure r~~R~~atio’ (EPR).	X	X						
(05)		Explain the use of reduced (flexible) and derated thrust for take-off, and explain the advantages and disadvantages when compared with a full-rated take-off.	X	X						
(06)		Describe the effects of use of bleed air on RPM, EGT, thrust and specific fuel consumption.	X	X						
021 11 05 02		***Helicopter engine ratings, engine performance and limitations, engine handling: torque, performance aspects~~,~~ ~~engine handling~~ and limitations~~.~~***								
(01)		Describe engine rating torque limits for take-off, transient and maximum continuous.			X	X	X			
(02)		Describe turbine outlet temperature (TOT) limits for take-off.			X	X	X			
(03)		Explain why TOT is a limiting factor for helicopter performance.			X	X	X			
(04)		Describe and explain the relationship between maximum torque available and density altitude, which leads to decreasing torque available with the increase of density altitude.			X	X	X			
(05)		Explain that hovering downwind, on some helicopters will noticeably increase the engine TOT.			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(06)		Explain the reason why the engine performance is less when aircraft accessories~~ are switched on,~~ (i.e. anti-ice, heating, hoist, filters~~.~~) are switched on.			X	X	X			
(07)		Describe the effects of use of bleed air on engine parameters.			X	X	X			
(08)		Explain that on some helicopter exceeding the TOT limit may cause the main rotor to droop (slow down).			X	X	X			
(09)		Describe overtorquing and explain the consequences.			X	X	X			
021 11 06 00		**Auxiliary p~~P~~ower u~~U~~nit (APU)**								
021 11 06 01		***Design, operation, functions, operational limitations***								
(01)		State that an APU is a gas turbine engine and list its tasks.	X		X	X				
(02)		State the difference between the two types of APU inlets.	X		X	X				
(03)		Define 'maximum operating and maximum starting altitude'.	X		X	X				
(04)		Name the typical APU control and monitoring instruments.	X		X	X				
(05)		Describe the APU's automatic shutdown protection.	X		X	X				
021 12 00 00		**PROTECTION AND DETECTION SYSTEMS**								
021 12 01 00		**Smoke detection**								
021 12 01 01		***Types, design, operation, indications and warnings***								
(01)		Explain the operating principle of the following types of smoke detection sensors:	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— optical~~,~~; — ionising.								
(02)		Give an example of warnings, indications and function tests.	X	X	X	X	X			
021 12 02 00		**Fire-protection systems**								
021 12 02 01		***Fire extinguishing (engine and cargo compartments)***								
(01)		Explain the operating principle of a built-in fire-extinguishing system and describe its components.	X	X	X	X	X			
(02)		State that two discharges must be provided for each engine (see CS-25.1195(c) Fire-extinguisher systems).	X	X						
021 12 02 02		***Fire detection***								
(01)		Explain the following principles involved in fire detection: — resistance and capacitance~~,~~; — gas pressure.	X	X	X	X	X			
(02)		Explain fire-detection applications such as: — bimetallic~~,~~; — continuous loop~~,~~; — gaseous loop (gas-filled detectors).	X	X	X	X	X			
(03)		Explain why generally double-loop systems are used.	X	X	X	X	X			
(04)		Give an example of warnings, indications and function tests of a fire-protection system.	X	X	X	X	X			

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			ATPL	CPL	ATPL/ IR	ATPL	CPL			
021 12 03 00		**Rain-protection system**								
021 12 03 01		***Principle and method of operation***								
(01)		Explain the principle and method of operation of the following windshield rain-protecti~~ng~~on systems for an aeroplane: — wipers~~,~~; — liquids (rain-repellent)~~,~~; — coating.	X	X						
(02)		Explain the principle and method of operation of wipers for a helicopter.			X	X	X			
021 13 00 00		**OXYGEN SYSTEMS**								
021 13 01 00		**Cockpit, portable and chemical oxygen systems**								
021 13 01 01		***Operating principles, actuation methods, comparison***								
(01)		Describe the basic operating principle of a cockpit oxygen system and describe the following different modes of operation: — normal (diluter demand)~~,~~; — 100 %~~,~~; — emergency.	X	X						
(02)		Describe the operating principle and the purposes of the following two portable oxygen systems: — smoke hood,	X	X						

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			ATPL	**CPL**	**ATPL/ IR**	**ATPL**	**CPL**			
		— portable bottle.								
(03)		Describe the following two oxygen systems that can be used to supply oxygen to passengers: — fixed system (chemical oxygen generator or gaseous system); — portable.	X	X						
(04)		Describe the actuation methods (automatic and manual) and the functioning of a passenger oxygen mask.	X	X						
(05)		Compare chemical oxygen generators to gaseous systems with respect to: — capacity~~,~~; — flow regulation.	X	X						
(06)		State the dangers of grease or oil related to the use of oxygen systems.	X	X						
021 14 00 00		**HELICOPTER: MISCELLANEOUS SYSTEMS**								
021 14 01 00		**Variable rotor speed, active vibration suppression, night-vision goggles (NVG)**								
021 14 01 ~~00~~01		**Variable rotor speed**								
~~LO (01)~~		~~Explain the system when pilots can 'beep' the~~ $\cancel{N_R}$ ~~an additional amount when manoeuvring, landing and taking off, normally at higher altitudes to obtain extra tail-rotor thrust, which makes~~			~~X~~	~~X~~	~~X~~			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~manoeuvring more positive and safer.~~								
(02)		Explain the system for 'beeping' the ~~N_R~~ N_R to its upper limit ~~to enable safer take-off~~.			X	X	X			
021 14 ~~02 00~~ 01 02		**Active vibration suppression**								
(01)		Explain and describe how the active vibration suppression system works through high-speed actuators and accelerometer inputs.			X	X	X			
021 14 ~~03 00~~ 01 03		**Night-vision goggles**								
		To be introduced at a later date.			X	X	X			
021 15 00 00		**HELICOPTER: ROTOR HEADS**								
021 15 01 00		**Main rotor**								
021 15 01 01		***Types***								
(01)		Describe the following rotor-head systems: — teetering (semi-articulated)~~,~~; — articulated~~,~~; — hingeless (rigid)~~,~~; — bearingless (semi-articulated).			X	X	X			
(02)		Describe in basic terms the following configuration of rotor systems and their advantages and disadvantages:			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— tandem~~,~~; — coaxial~~,~~; — side by side.								
(03)		Explain how flapping, dragging and feathering is achieved in each rotor-head system.			X	X	X			
021 15 01 02		***Structural components and materials, stresses, structural limitations***								
(01)		Identify from a diagram the main structural components of the main types of rotor-head systems.			X	X	X			
(02)		List and describe the methods used ~~on how~~ to detect damage and cracks.			X	X	X			
(03)		Explain and describe the structural limitations to respective rotor systems, including the dangers of negative G inputs to certain rotor-head systems.			X	X	X			
(04)		Describe the various rotor-head lubrication methods.			X	X	X			
021 15 01 03		***Design and construction***								
(01)		Describe the material technology used in rotor-head design, including construction, using the following materials or mixture of materials: — composites~~,~~; — fibreglass~~,~~;			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— alloys~~,~~; — elastomers.								
021 15 01 04		***Adjustment***								
(01)		Describe and explain the methods of adjustment which are possible on various helicopter rotor-head assemblies.			X	X	X			
021 15 02 00		**Tail rotor**								
021 15 02 01		***Types***								
(01)		Describe the following tail-rotor systems: — delta-3 hinge effect; — multi-bladed delta-3 effect; — Fenestron or ducted fan tail rotor; — no tail rotor (NOTAR) low-velocity air jet flows from tangential slots (the Coandă effect); — ~~No Tail Rotor (~~NOTAR~~)~~ high-velocity air jet flows from adjustable nozzles (the Coandă effect).			X	X	X			
(02)		Identify from a diagram the main structural components of the four main types of tail-rotor systems.			X	X	X			
(03)		Explain and describe the methods to detect damage and cracks on the tail rotor and assembly.			X	X	X			
(04)		Explain and describe the structural limitations to the respective tail-rotor systems and possible limitations regarding the turning			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		rate of the helicopter.								
(05)		Explain and describe the following methods that helicopter designers use to minimise tail-rotor drift and roll: — reducing the couple arm (tail rotor on a pylon); — offsetting the rotor mast; — use of ‘bias’ in cyclic control mechanism.			X	X	X			
(06)		Explain pitch-input mechanisms.			X	X	X			
(07)		Explain the relationship between tail-rotor thrust and engine power.			X	X	X			
(08)		Describe how the vertical fin on some types ~~on some helicopters~~ reduces the power demand of the ~~Fenestron~~ tail rotor.			X	X	X			
021 15 02 02		***Design and construction***								
(01)		List and describe the various tail-rotor designs and construction methods used on ~~current~~ helicopters currently in service.			X	X	X			
~~***021 15 02 03***~~		~~***Adjustment***~~								
~~LO (01)~~		~~Describe the rigging and adjustment of the tail-rotor system to obtain optimum position of the pilot’s yaw pedals.~~			~~X~~	~~X~~	~~X~~			
021 16 00 00		**HELICOPTER: TRANSMISSION**								
021 16 01 00		**Main gearbox**								
021 16 01 01		***Different types, design, operation, limitations***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)		Describe the following main principles of helicopter transmission systems for single- and twin-engine helicopters: — drive for the main and tail rotor; — accessory drive for the generator(s), alternator(s), hydraulic and oil pumps, oil cooler(s) and tachometers.			X	X	X			
(02)		Describe the reason for limitations on multi-engine helicopter transmissions in various engine-out situations.			X	X	X			
(03)		Describe how the passive vibration control works with gearbox mountings.			X	X	X			
021 16 02 00		**Rotor brake**								
021 16 02 01		***Types, operational considerations***								
(01)		Describe the main function of the disc type of rotor brake.			X	X	X			
(02)		Describe both hydraulic- and cable-operated rotor-brake systems.			X	X	X			
(03)		Describe the different options for the location of the rotor brake.			X	X	X			
(04)		List the following operational considerations for the use of rotor brakes: — rotor speed at engagement of rotor brake; — risk of blade sailing in windy conditions; — risk of rotor-brake overheating and possible fire when brake is applied above the maximum limit, particularly when spilled hydraulic fluid is present;			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		— avoid stopping blades over jet-pipe exhaust with engine running; — cockpit annunciation of rotor-brake operation.								
021 16 03 00		**Auxiliary systems**								
021 16 03 01		***Powering the air-conditioning system***								
~~(01)~~		~~Explain how the hoist/winch can be driven by an off-take from the auxiliary gearbox.~~			~~X~~	~~X~~	~~X~~			
(02)		Explain how power for the air-conditioning system is taken from the auxiliary gearbox.			X	X	X			
021 16 04 00		**Driveshaft and associated installation**								
021 16 04 01		***Power, construction, materials, speed and torque***								
(01)		Describe how power is transmitted from the engine to the main-rotor gearbox.			X	X	X			
(02)		Describe the material and construction of the driveshaft.			X	X	X			
(03)		Explain the need for alignment between the engine and the main-rotor gearbox.			X	X	X			
(04)		Identify how temporary misalignment occurs between driving and driven components.			X	X	X			
~~(05)~~		~~Explain the use of:~~ — ~~flexible couplings,~~			~~X~~	~~X~~	~~X~~			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— ~~Thomas couplings,~~ — ~~flexible disc packs,~~ — ~~driveshaft support bearings and temperature measurement,~~ — ~~subcritical and supercritical driveshafts.~~								
(06)		Explain the relationship between ~~the~~ driveshaft speed and torque.			X	X	X			
(07)		Describe the methods with which power is delivered to the tail rotor.			X	X	X			
(08)		Describe and identify the construction and materials of tail-rotor/Fenestron driveshafts.			X	X	X			
021 16 05 00		**Intermediate and tail gearbox**								
021 16 05 01		***Lubrication, gearing***								
(01)		Explain and describe the various arrangements when the drive changes direction and the need for an intermediate or tail gearbox.			X	X	X			
(02)		Explain the lubrication requirements for intermediate and tail-rotor gearboxes and methods of checking levels.			X	X	X			
(03)		Explain how on most helicopters the tail-rotor gearbox contains gearing, etc., for the tail-rotor pitch-change mechanism.			X	X	X			
021 16 06 00		**Clutches**								
021 16 06 01		***Purpose, operation, components, serviceability***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)		Explain the purpose of a clutch.			X	X	X			
(02)		Describe and explain the operation of a: — centrifugal clutch; — actuated clutch.			X	X	X			
(03)		List the typical components of the various clutches.			X	X	X			
(04)		Identify the following methods by which clutch serviceability can be ascertained: — brake-shoe dust; — vibration; — main-rotor run-down time; — engine speed at time of main-rotor engagement; — belt tensioning; — start protection in a belt-drive clutch system.			X	X	X			
021 16 07 00		**Freewheels**								
021 16 07 01		***Purpose, operation, components, location***								
(01)		Explain the purpose of a freewheel.			X	X	X			
(02)		Describe and explain the operation of a: — cam and roller type freewheel~~,~~; — sprag-clutch type freewheel.			X	X	X			
(03)		List the typical components of the various freewheels.			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(04)		Identify the various locations of freewheels in power plant and transmission systems.			X	X	X			
(05)		Explain the implications regarding the engagement and disengagement of the freewheel.			X	X	X			
021 17 00 00		**HELICOPTER: BLADES**								
021 17 01 00		**Main-rotor design and blade design**								
021 17 01 01		***Design, construction***								
(01)		Describe the different types of blade construction and the need for torsional stiffness.			X	X	X			
(02)		Describe the principles of heating systems/pads on some blades for anti-icing/de-icing.			X	X	X			
(03)		Describe the fully articulated rotor with hinges and feathering ~~bearings/~~hinges.			X	X	X			
021 17 01 02		***Structural components and materials***								
(01)		List the materials used in the construction of main-rotor blades.			X	X	X			
(02)		List the main structural components of a main-rotor blade and their function.			X	X	X			
(03)		Describe the drag hinge of the fully articulated rotor and the lag flexure in the hingeless rotor.			X	X	X			
(04)		Explain the necessity for drag dampers.			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
021 17 01 03		***~~Stresses~~ Forces and stresses***								
(01)		Describe main-rotor blade-loading on the ground and in flight.			X	X	X			
(02)		Describe where the most common stress areas are on rotor blades.			X	X	X			
(03)		Show how the centrifugal forces depend on rotor RPM and blade mass and how they pull on the blade's attachment to the hub. ~~Apply the formula to an example.~~ Justify the upper limit of the rotor RPM.			X	X	X			
(04)		Assume a rigid attachment and show how thrust may cause huge oscillating bending moments which stress the attachment.			X	X	X			
(05)		Explain why flapping hinges do not transfer such moments. Show the small flapping hinge offset on fully articulated rotors and zero offset in the case of teetering rotors.			X	X	X			
(06)		Describe the working principle of the flexible element in the hingeless rotor and describe the equivalent flapping hinge offset compared to that of the articulated rotor.			X	X	X			
021 17 01 04		***Structural limitations***								
(01)		Explain the structural limitations in terms of bending and rotor RPM.			X	X	X			
021 17 01 05		***Adjustment***								
(01)	X	Explain the use of trim tabs.			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
021 17 01 06		***Tip shape***								
(01)		Describe the various blade-tip shapes used by different manufacturers and compare their advantages and disadvantages.			X	X	X			
~~LO (02)~~		~~Describe how on some rotor-blade tips, static and dynamic balancing weights are attached to threaded rods and screwed into sockets in the leading edge spar and others in a support embedded into the blade tip.~~			~~X~~	~~X~~	~~X~~			
021 17 01 07		***Origins of the vertical vibrations***								
(01)		Explain the lift (thrust) variations per revolution of a blade and the resulting vertical ~~(total) rotor thrust~~ total rotor thrust (TRT) variation in the case of perfectly identical blades.			X	X	X			
(02)		Show the resulting frequencies and amplitudes as a function of the number of blades.			X	X	X			
(03)		Explain the thrust variation in the case of an out-of-track blade, causes, and frequencies (one-per-revolution).			X	X	X			
021 17 01 08		***Lateral vibrations***								
(01)		Explain blade imbalances ~~of a blade~~, causes, and effects.			X	X	X			
021 17 02 00		**Tail-rotor design and blade design**								
021 17 02 01		***Design, construction***								
(01)		Describe the most common design of tail-rotor blade construction, consisting of stainless steel shell reinforced by a honeycomb filler			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		and stainless steel leading abrasive strip.								
(02)		Explain that ballast weights are located at the inboard trailing edge and tip of blades, and that the weights used are determined when the blades are manufactured.			X	X	X			
(03)		Describe how, for some helicopters, anti-icing/de-icing systems are designed into the blade construction ~~of some helicopters~~.			X	X	X			
(04)		Describe the two-bladed rotor with a teetering hinge, and rotors with more than two blades.			X	X	X			
(05)		Describe the dangers to ground personnel and to the rotor blades, and ~~the possibilities of minimising~~ how to minimise these dangers.			X	X	X			
021 17 02 02		***~~Structural components and materials~~ Intentionally left blank***								
~~LO (01)~~		~~List the materials used in the construction of tail-rotor blades.~~			~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~List the main structural components of a tail-rotor blade and their function.~~			~~X~~	~~X~~	~~X~~			
021 17 02 03		***Stresses, vibrations and balancing***								
(01)		Describe the tail-rotor blade-loading on the ground and in flight.			X	X	X			
(02)		Explain the sources of vibration of the tail rotor and the resulting high frequencies.			X	X	X			
(03)		Explain balancing and tracking of the tail rotor.			X	X	X			
021 17 02 04		***Structural limitations***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)		Describe the structural limitations of the tail-rotor blades.			X	X	X			
(02)		Describe the method of checking the strike indicators placed on the tip of some tail-rotor blades.			X	X	X			
021 17 02 05		***Adjustment***								
(01)		Describe the adjustment of yaw pedals in the cockpit to obtain full-control authority of the tail rotor.			X	X	X			
021 17 02 06		***The Fenestron***								
(01)		~~Show~~ Describe the technical ~~details~~ layout of a Fenestron tail rotor.			X	X	X			
(02)		Explain the advantages and disadvantages of a Fenestron tail rotor.			X	X	X			
021 17 02 07		***No tail rotor (NOTAR)***								
(01)		~~Show~~ Describe the technical layout of a NOTAR design.			X	X	X			
(02)		Explain the control concepts of a NOTAR.			X	X	X			
(03)		Explain the advantages and disadvantages of a NOTAR design.			X	X	X			

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Appendix to Annex I to ED Decision 2018/001/R

'Acceptable Means of Compliance (AMCs) and Guidance Material (GM) to Part-FCL Amendment 4'

Appendix

'SUBJECT 022 — AIRCRAFT GENERAL KNOWLEDGE — INSTRUMENTATION'

to

AMC1 FCL.310; FCL.515(b); FCL.615(b)

'Theoretical knowledge examinations'

of Annex I

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SUBJECT 022 — AIRCRAFT GENERAL KNOWLEDGE — INSTRUMENTATION

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
020 00 00 00		**AIRCRAFT GENERAL KNOWLEDGE**								
022 00 00 00		**AIRCRAFT GENERAL KNOWLEDGE — INSTRUMENTATION**								
022 01 00 00		**SENSORS AND INSTRUMENTS**								
022 01 01 00		**Pressure gauge**								
022 01 01 01		***Units for pressure, sensor types, measurements***								
(01)	X	Define ‘pressure’, ‘absolute pressure’ and ‘differential pressure’.	X	X	X	X	X			
(02)	X	List the following units used for pressure measurement: — Pascal~~,~~; — bar~~,~~; — inches of mercury (in Hg)~~,~~; — pounds per square inch (PSI).	X	X	X	X	X			
(03)	X	State the relationship between the different units.	X	X	X	X	X			
(04)		List and describe the following different types of sensors used according to the pressure to be measured: — aneroid capsules~~,~~; — bellows~~,~~; — diaphragms~~,~~;	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		— bourdon tube.								
~~LO (05)~~		~~Solid-state sensors (to be introduced at a later date)~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(06)		~~For each type of sensor identify applications such as:~~ Identify pressure measurements that are applicable on an aircraft: — liquid-pressure measurement (fuel, oil, hydraulic); — air-pressure measurement (bleedair systems, air-conditioning systems); — engine-pressure measurement manifold pressure (MAP), engine pressure ratio (EPR)). — ~~Manifold Absolute Pressure (~~MAP~~)~~ gauge.	X	X	X	X	X			
~~LO (07)~~		~~Pressure probes for Engine Pressure Ratio (EPR).~~	~~X~~	~~X~~						
(08)		~~Give examples of display for each of the applications above.~~ Identify and read pressure measurement indications both for engine indications and other systems.	X	X	X	X	X			
~~LO (09)~~		~~Explain the need for remote-indicating systems.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(10)		Explain the implications of the following pressure measurement errors, both for engine indications and other systems: — loss of pressure sensing;	X	X	X	X	X			

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— incorrect pressure indications.								
022 01 02 00		**Temperature sensing**								
022 01 02 01		***Units for temperature, measurements***								
(01)	X	Explain temperature.	X	X	X	X	X			
(02)	X	List the following units that can be used for temperature measurement: — Kelvin~~,~~; — Celsius~~,~~; — Fahrenheit.	X	X	X	X	X			
(03)	X	State the relationship ~~and calculate~~ between these ~~different~~ units and convert between them.	X	X	X	X	X			
~~LO (04)~~		~~Describe and explain the operating principles of the following types of sensors:~~ ~~— expansion type (bimetallic strip),~~ ~~— electrical type (resistance, thermocouple).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (05)~~		~~State the relationship for a thermocouple between the electromotive force and the temperature to be measured.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(06)		~~For each type, identify applications such as:~~ Identify temperature measurements that are applicable to an aircraft: — gas temperature measurement (ambient air, bleed	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		air systems, air-conditioning systems, air inlet, exhaust gas, gas turbine outlets); — liquid-temperature measurement (fuel, oil, hydraulic); — component-temperature measurement (generator, transformer rectifier unit (TRU), pumps (fuel, hydraulic), power transfer unit (PTU).								
(07)		~~Give examples of display for each of the applications above.~~ Identify and read temperature measurement indications for both engine indications and other systems.	X	X	X	X	X			
022 01 03 00		**Fuel gauge**								
022 01 03 01		***Units for fuel, measurements, fuel gauges***								
(01)		State that the quantity of fuel can be measured by volume or mass.	X	X	X	X	X			
(02)		List the following units used for fuel quantity~~ when measured by mass~~: — kilogramme~~;~~, — pound~~;~~, — litres, — gallons (US and imperial).	X	X	X	X	X			
(03)		~~State the relationship between these different units.~~	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Convert between the various units.								
~~LO (04)~~		~~Define 'capacitance' and 'permittivity', and state their relationship with density.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(05)		~~List and~~ ~~E~~Explain the parameters that can affect the measurement of the volume ~~and/~~or mass of the fuel in a ~~wing~~ fuel tank: — temperature; — aircraft accelerations and attitudes; and explain how the fuel-gauge system design compensates for these changes.	X	X	X	X	X			
(06)		Describe and explain the operating principles of the following types of fuel gauges: — float system; — capacitance-type fuel-gauge system. — Ultrasound-type of fuel-gauge system: to be introduced at a later date.	X	X	X	X	X			
(07)		Describe and complete a typical post-refuelling procedure for a pilot: — recording the volume that was filled; — converting to the appropriate unit used by the aircraft fuel gauge(s) to compare the actual indicated fuel content to the calculated fuel content;	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— assess appropriate action if the numbers does not compare.								
022 01 04 00		**Fuel flowmeters**								
022 01 04 01		***Fuel flow, units for fuel flow, total fuel consumption***								
(01)		Define 'fuel flow' and where it is measured.	X	X	X	X	X			
(02)		State that fuel flow may be measured by volume or mass per unit of time.	X	X	X	X	X			
(03)		List the following units used for fuel flow when measured by mass per hour: — kilogrammes/hour~~,~~; — pounds/hour.	X	X	X	X	X			
(04)		List the following units used for fuel flow when measured by volume per hour: — litres/hour~~,~~; — imperial gallons/hour; — US gallons/hour.	X	X	X	X	X			
~~LO (05)~~		~~List and describe the following different types of fuel flowmeter:~~ — ~~mechanical,~~ — ~~electrical (analogue),~~ — ~~electronic (digital),~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~and explain how the signal can be corrected to measure mass flow.~~								
(06)		Explain how total fuel consumption is obtained.	X	X	X	X	X			
022 01 05 00		**Tachometer**								
022 01 05 01		***Types, operating principles, units for engine speed***								
(01)	X	List the following types of tachometers, describe their basic operating principle and give examples of use: — mechanical (rotating magnet); — electrical (three-phase tacho-generator); — electronic (impulse measurement with speed probe and phonic wheel)~~,~~; — and describe the operating principle of each type.	X	X	X	X	X			
~~LO (02)~~		~~For each type, identify applications such as engine-speed measurement (crankshaft speed for piston engines, spool speed for gas turbine engines), wheel-speed measurement for anti-skid systems (anti-skid systems for aeroplane only), and give examples of display.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(03)		~~State that engine speed is most commonly displayed as a percentage.~~ Explain the typical units for engine speed: — RPM for piston-engine aircraft; — percentage for turbine-engine aircraft.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		Explain that some types of RPM indicators require electrical power to provide an indication.	X	X	X	X	X			
022 01 06 00		**Thrust measurement**								
022 01 06 01		***Parameters, operating principle***								
(01)		List and describe the following two parameters used to represent thrust~~.~~: — N1; — EPR.	X	X						
(02)		~~Explain the operating principle of the EPR gauge and the consequences for the pilot in case of a malfunction including blockage and leakage.~~ Explain the operating principle of using an engine with EPR indication and explain the consequences of incorrect or missing EPR to the operation of the engine, including reverting to N1 mode.	X	X						
(03)		Give examples of display for N1 and EPR.	X	X						
022 01 07 00		**Engine torquemeter**								
022 01 07 01		***Torque, torquemeters***								
(01)		Define 'torque'.	X	X	X	X	X			
(02)		Explain the relationship between power, torque and RPM.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(03)		List the following units used for torque: — Newton meters,~~,~~; — inch or foot pounds.	X	X	X	X	X			
(04)		State that engine torque can be displayed as a percentage.	X	X	X	X	X			
(05)	X	List and describe the following different types of torquemeters, and explain their operating principles: — mechanical~~;~~, — electronic. ~~and explain their operating principles.~~	X	X	X	X	X			
(06)	X	Compare the two systems with regard to design and weight.	X	X	X	X	X			
(07)		Give examples of display.	X	X	X	X	X			
022 01 08 00		**Synchroscope**								
022 01 08 01		***Purpose, operating principle, display***								
(01)		State the purpose of a synchroscope.	X	X						
(02)	X	Explain the operating principle of a synchroscope.	X	X						
(03)		Give examples of display.	X	X						
022 01 09 00		**Engine-vibration monitoring**								
022 01 09 01		***Purpose, operating principle of a vibration-monitoring***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		system, display								
(01)		State the purpose of a vibration-monitoring system for a jet engine.	X	X						
(02)	X	Describe the operating principle of a vibration-monitoring system using the following two types of sensors: — piezoelectric crystal~~,~~; — magnet.	X	X						
(03)		~~State that no specific unit is displayed for a vibration-monitoring system.~~ Explain that there is no specific unit for vibration monitoring, i.e. it is determined by specified numeric threshold values.	X	X						
(04)		Give examples of display.	X	X						
022 01 10 00		**Time measurement**								
022 01 10 01		***On-board clock***								
(01)		~~Explain the use of time/date measurement and recording for engines and system maintenance.~~ Explain that the on-board aircraft clock provides a time reference for several of the on-board systems including aircraft communications addressing and reporting system (ACARS) and engine and systems maintenance.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
022 02 00 00		**MEASUREMENT OF AIR-DATA PARAMETERS**								
022 02 01 00		**Pressure measurement**								
022 02 01 01		***Definitions***								
(01)		~~Define 'static, total and dynamic pressures' and state the relationship between them.~~ Define the following pressure measurements and state the relationship between them: — static pressure; — dynamic pressure; — total pressure.	X	X	X	X	X	X		
~~LO (02)~~		~~Define 'impact pressure' as total pressure minus static pressure and discuss the conditions when dynamic pressure equals impact pressure.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
022 02 01 02		***Pitot/static system: design and errors***								
(01)		Describe the design and the operating principle of a: — static port/source~~,~~; — pitot tube~~,~~; — combined pitot/static probe.	X	X	X	X	X	X	X	
(02)		For each of these indicate the various locations and describe the following associated errors and how to correct, minimise the effect of or compensate for them:	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— position errors; — instrument errors; — errors due to a non-longitudinal axial flow (including manoeuvre-induced errors). ~~and the means of correction and/or compensation.~~								
(03)		Describe a typical pitot/static system and list the possible outputs.	X	X	X	X	X	X		
(04)		Explain the redundancy and the interconnections ~~of typical~~ that typically exist in complex pitot/static systems found in large aircraft.	X	X	X	X	X	X		
(05)		Explain the purpose of pitot/static system heating ~~and interpret the effect of heating on sensed pressure~~.	X	X	X	X	X	X	X	
~~LO (06)~~		~~List the affected instruments and explain the consequences for the pilot in case of a malfunction including blockage and leakage.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(07)		Describe alternate static sources and their effects when used, particularly in unpressurised aircraft.	X	X	X	X	X	X	X	
(08)		~~Solid-state sensors (to be introduced at a later date).~~ Describe a modern pitot static system using solid-state sensors near the pitot probe or static port converting the air data to numerical data (electrical signals) before being sent to the air-data computer(s).	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
022 02 02 00		**Temperature measurement**								
022 02 02 01		***Definitions***								
(01)		~~Define 'OAT', 'SAT', 'TAT' and 'measured temperature'.~~ Define the following and explain the relationship between them: — outside air temperature (OAT); — total air temperature (TAT); — static air temperature (SAT).	X	X	X	X	X	X	X	
(02)		~~Define~~ Explain the term 'ram rise' and convert TAT to SAT. ~~and 'recovery factor'.~~	X					X		
~~LO (03)~~		~~State the relationship between the different temperatures according to Mach number.~~	~~X~~							
(04)		Explain why TAT is often displayed and that TAT is the temperature input to the air-data computer.	X	X	X	X	X	X	X	
022 02 02 02		***Design and operation***								
~~LO (01)~~		~~Describe the following types of air-temperature probes and their features:~~ — ~~expansion type: bimetallic strip, direct reading;~~ — ~~electrical type wire resistance, remote reading.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(02)		~~For each of these indicate the various locations, and describe the following associated errors:~~	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— ~~position errors,~~ — ~~instrument errors,~~ ~~and the means of correction and/or compensation.~~ Indicate typical locations for both direct-reading and remote-reading temperature probes, and describe the following errors: — position error; — instrument error.								
(03)		Explain the purpose of temperature probe heating and interpret the effect of heating on sensed temperature unless automatically compensated for.	X	X	X	X	X	X		
022 02 03 00		**Angle-of-attack (AoA) measurement**								
022 02 03 01		***Sensor types, operating principles, ice protection, displays, incorrect indications***								
(01)		Describe the following two types of AoA~~angle-of-attack~~ sensors: — null-seeking (slotted) probe~~,~~; — vane detector.	X	X						
(02)		For each type, explain the operating principles.	X	X						
(03)		Explain how both types are protected against ice.	X	X						
(04)		Give examples of systems that use the AoA~~angle of attack~~	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		as an input, such as: — air-data computer; — s~~S~~tall-w~~W~~arning s~~S~~ystems; — flight-envelope protection systems.								
(05)		Give examples of and interpret different types of ~~angle-of-attack (~~AoA~~)~~ displays: — simple light arrays of green, amber and red lights; — gauges showing a numerical scale.	X	X						
(06)		Explain the implications for the pilot if the AoA indication becomes incorrect but still provides data, e.g. if the sensor is frozen in a fixed position.	X	X						
(07)		Explain how an incorrect AoA measurement can affect the controllability of an aircraft with flight-envelope protection.	X	X						
022 02 04 00		**Altimeter**								
022 02 04 01		***Units, terms, types, operating principles, displays, errors, corrections***								
~~LO (01)~~	~~X~~	~~Define 'ISA'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(02)		List the following two units used for altimeters and state the relationship between them: — feet~~,~~;	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— metres. ~~and state the relationship between them.~~								
(03)	X	Define the following terms: — height, altitude; — indicated altitude, true altitude; — pressure altitude, density altitude.	X	X	X	X	X	X	X	
(04)	X	Define the following barometric references: 'QNH', 'QFE', '1013,25'.	X	X	X	X	X	X	X	
(05)		Explain the operating principles of an altimeter.	X	X	X	X	X	X	X	
(06)	X	Describe and compare the following three types of altimeters and reason(s) why particular designs may be required in certain airspace: — simple altimeter (single capsule); — sensitive altimeter (multi-capsule); — servo-assisted altimeter.	X	X	X	X	X	X	X	
(07)	X	Give examples of associated displays: pointer, multi-pointer, drum, vertical straight scale, and digital (in HUD displays.	X	X	X	X	X	X	X	
(08)		Describe the following errors: — ~~pitot/~~static system error~~s~~; — instrument error;	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— barometric error; — temperature error (air column not at ISA conditions); — ~~time~~ lag (altimeter response to change of height)~~;~~. ~~and the means of correction.~~								
(09)		~~Give examples of altimeter corrections table from an Aircraft Operating Handbook (AOH).~~ Demonstrate the use of an altimeter correction table for the following errors: — temperature corrections; — aircraft position errors.	X	X	X	X	X	X	X	
(10)		Describe the effects of a blockage or a leakage on the static pressure line.	X	X	X	X	X	X	X	
(11)		Describe the use of GPS altitude as an alternative means of checking erroneous altimeter indications, and highlight the limitations of the GPS altitude indication.	X	X	X	X	X	X	X	
022 02 05 00		**Vertical ~~s~~Speed ~~i~~Indicator (VSI)**								
022 02 05 01		***VSI and instantaneous vertical speed indicator (IVSI)***								
(01)		List the two units used for VSI and state the relationship between them: — metres per second,	X	X	X	X	X	X		

Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
		— feet per minute~~,~~. ~~and state the relationship between them.~~								
(02)		Explain the operating principles of a VSI and an instantaneous vertical speed indicator (IVSI).	X	X	X	X	X	X	X	
(03)		Describe and compare the following ~~two~~ types of VSIs~~vertical speed indicators~~: — barometric type (VSI); — instantaneous barometric type (IVSI); — inertial type (inertial information provided by an inertial reference unit).	X	X	X	X	X	X	X	
(04)		Describe the following VSI errors: — ~~pitot/~~static system errors; — instrument errors; — time lag~~;~~. ~~and the means of correction.~~	X	X	X	X	X	X	X	
(05)		Describe the effects on a VSI of a blockage or a leakage on the static pressure line.	X	X	X	X	X	X	X	
(06)		Give examples of a VSI display.	X	X	X	X	X	X		
(07)		Compare the indications of a VSI and an IVSI during flight in turbulence and appropriate pilot technique during manoeuvring using either type.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
022 02 06 00		**Airspeed i~~I~~ndicator (ASI)**								
022 02 06 01		***Units, errors, operating principles, displays, position errors, unreliable airspeed indications***								
(01)		List the following three units used for airspeed and state the relationship between them: — nautical miles/hour ~~(knots)~~ (kt)~~,~~; — statute miles/hour (mph)~~,~~; — kilometres/hour (km/h)~~,~~. ~~and state the relationship between them.~~	X	X	X	X	X	X		
(02)		~~Define 'IAS', 'CAS', 'EAS', 'TAS' and state and explain the relationship between these speeds.~~ Define and explain the relationship between the following: — indicated airspeed (IAS); — calibrated airspeed (CAS); — true airspeed (TAS).	X	X	X	X	X	X	X	
(03)		Describe the following ASI errors and state when they must be considered: — pitot/static system errors; — instrument errors; — position errors;	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— compressibility errors; — density errors.								
(04)		Explain the operating principles of an ASI (as appropriate to aeroplanes or helicopters).	X	X	X	X	X	X	X	
(05)		Give examples of an ASI display: pointer, vertical straight scale and digital (HUD display).	X	X	X	X	X	X		
(06)		~~Interpret ASI corrections tables as used in an Aircraft Operating Handbook (AOH).~~ Demonstrate the use of an ASI corrections table for position error.	X	X	X	X	X	X		
(07)		Define and explain the following colour codes that can be used on an ASI: — white arc (flap operating speed range); — green arc (normal operating speed range); — yellow arc (caution speed range); — red line (VNE) or barber's pole (V_{MO}); — blue line (best rate of climb speed, one-engine-out for multi-engine piston light aeroplanes).	X	X						
(08)		Define and explain the following colour codes that can be used on an ASI: — green arc (normal operating speed range); — red line (VNE);			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— blue line (maximum airspeed during autorotation).								
(09)		Describe the effects on an ASI of a blockage or a leakage in the static ~~and/~~or total pressure line(s).	X	X	X	X	X	X	X	
(10)		Define the term ‘unreliable airspeed’ and describe the means by which it can be recognised such as: — different airspeed indications between ASIs; — unexpected aircraft behaviour; — buffeting; — aircraft systems warning; — aircraft attitude.	X	X	X	X	X	X	X	
(11)		Describe the appropriate procedures available to the pilot in the event of unreliable airspeed indications: — combination of a pitch attitude and power setting; — ambient wind noise inside the aircraft; — use of GPS speed indications and the limitations of this.	X	X	X	X	X	X	X	
022 02 07 00		**Machmeter**								
022 02 07 01		***Operating principle, display, CAS, TAS and Mach number***								
(01)		Define ‘Mach number’ and ‘l~~L~~ocal s~~S~~peed of s~~S~~ound’ (LSS). ~~and perform simple calculations that include these terms~~ Calculate between LSS, TAS and Mach number.	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)	X	Describe the operating principle of a Machmeter.	X							
(03)	X	Explain why a Machmeter does not suffer from compressibility error. ~~suffers only from pitot/static system errors.~~	X							
(04)		Give examples of a Machmeter display: pointer, drum, vertical straight scale, digital.	X							
(05)		Describe the effects on a Machmeter of a blockage or a leakage in the static ~~and/~~or total pressure line(s).	X							
(06)		~~State the relationship between Mach number, CAS and TAS, and interpret their variations according to FL and temperature changes.~~ Explain the relationship between CAS, TAS and Mach number. Explain how CAS, TAS and Mach number vary in relation to each other during a climb, a descent, or in level flight in different temperature conditions.	X							
(07)		State the existence of ~~MMO~~ maximum operating limit speed (V_{MO}) and maximum operating Mach number (M_{MO})	X							
(08)		Describe typical indications of M_{MO} and V_{MO} on analogue and digital instruments.	X							
(09)		Describe the relationship between M_{MO} and V_{MO} with	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		change in altitude and the implications of climbing at constant IAS and descending at constant Mach number with respect to the margin to M_{MO} and V_{MO}.								
(10)		Describe the implications of climbing or descending at constant Mach number or constant IAS with respect to the margin to the stall speed or maximum speed.	X							
022 02 08 00		**Air-d~~D~~ata c~~C~~omputer (ADC)**								
022 02 08 01		***Operating principle, data, errors, air-data inertial reference unit***								
(01)		Explain the operating principle of an ADC.	X	X	X	X	X	X		
(02)	X	List the following possible input data: — TAT~~,~~; — static pressure~~,~~; — total pressure~~,~~; — measured temperature~~,~~; — ~~angle of attack~~AoA~~,~~; — flaps position~~,~~; — ~~and~~ landing gear position~~,~~; — stored aircraft data.	X	X	X	X	X	X		
(03)	X	List the following possible output data, as applicable to areoplanes or helicopters:	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— IAS~~,~~; — TAS~~,~~; — SAT~~,~~; — TAT~~,~~; — Mach number~~,~~; — ~~angle of attack~~AoA, — altitude~~,~~; — vertical speed~~,~~; — ~~VMO/MMO~~ V_{MO}/M_{MO} pointer.								
~~LO (04)~~		~~For each output, list the datum/data sensed and explain the principle of calculation.~~	~~X~~		~~X~~	~~X~~				
(05)		Explain how position, instrument, compressibility and density errors can be compensated/corrected to achieve a TAS calculation.	X	X	X	X	X	X		
~~LO (06)~~		~~Explain why accuracy is improved for each output datum when compared to raw data.~~	~~X~~		~~X~~	~~X~~				
(07)		Give examples of instruments ~~and/~~or systems which may use ADC output data.	X	X	X	X	X	X		
(08)		~~State that an ADC can be a stand-alone system or integrated with the Inertial Reference Unit (ADIRU).~~ Explain that an air data inertial reference unit (ADIRU) is an ADC integrated with an inertial reference unit (IRU),	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		that there will be separate controls for the ADC part and inertial reference (IR) part, and that incorrect selection during failure scenarios may lead to unintended and potentially irreversible consequences.								
(09)	X	Explain the ADC architecture for air-data measurement including sensors, processing units and displays, as opposed to stand-alone air-data measurement instruments.	X	X	X	X	X	X		
~~LO (10)~~		~~Explain the advantage of an ADC for air-data information management compared to raw data.~~	~~X~~		~~X~~	~~X~~				
(11)		Describe the consequences of the loss of an ADC compared to the failure of individual instruments.	X	X	X	X	X	X		
022 03 00 00		**MAGNETISM — DIRECT-READING COMPASS AND FLUX VALVE**								
022 03 01 00		**Earth's magnetic field**								
022 03 01 01		***Magnetic field, variation, dip***								
(01)		Describe the magnetic field of the Earth.	X	X	X	X	X	X		
(02)	X	Explain the properties of a magnet.	X	X	X	X	X	X		
(03)		Define the following terms: — magnetic variation~~,~~; — magnetic dip (inclination).	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		Describe that a magnetic compass will align itself to both the horizontal (azimuth) and vertical (dip) components of the Earth's magnetic field, thus will not function in the vicinity of the magnetic poles.	X	X	X	X	X	X		
(05)		Demonstrate the use of variation values (given as East/West (E/W) or +/–) to calculate: — true heading to magnetic heading; — magnetic heading to true heading.	X	X	X	X	X	X		
022 03 02 00		**Aircraft magnetic field**								
022 03 02 01		***Permanent magnetism, electromagnetism, deviation***								
(01)	X	~~Define and explain the following terms:~~ — ~~magnetic and non-magnetic material;~~ — ~~hard and soft iron;~~ — ~~permanent magnetism and electromagnetism.~~ Explain the following differences between permanent magnetism and electromagnetism: — when they are present; — what affects their magnitude.	X	X	X	X	X	X		
(02)	X	Explain the principles of and the reasons for: — compass swinging (determination of initial deviations);	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— compass compensation (correction of deviations found); — compass calibration (determination of residual deviations).								
(03)		~~List the causes of the aircraft's magnetic field and explain how it affects the accuracy of the compass indications.~~ Explain how permanent magnetism within the aircraft structure and electromagnetism from the aircraft systems affect the accuracy of a compass.	X	X	X	X	X	X		
(04)		Describe the purpose and the use of a deviation correction card.	X	X	X	X	X	X		
(05)		Demonstrate the use of deviation values (either given as E/W or +/–) from a compass deviation card to calculate: — compass heading to magnetic heading; — magnetic heading to compass heading.	X	X	X	X	X	X	X	
022 03 03 00		**Direct-reading magnetic compass**								
022 03 03 01		***Purpose, errors, timed turns, serviceability***								
(1)		~~Define the role~~ Explain the purpose of a direct-reading magnetic compass.	X	X	X	X	X	X		
~~LO (02)~~		~~Describe and explain the design of a vertical card-type compass.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (03)~~		~~Describe the deviation compensation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(04)		~~Describe and interpret the effects of the following errors:~~ — ~~acceleration,~~ — ~~turning,~~ — ~~attitude,~~ — ~~deviation.~~ Describe how the direct-reading magnetic compass will only show correct indications during straight, level and unaccelerated flight, and that an error will occur during the following flight manoeuvres (no numerical examples): — acceleration and deceleration; — turning; — during pitch-up or pitch-down manoeuvres.	X	X	X	X	X	X		
(05)		~~Explain how to use and interpret the direct-reading compass indications during a turn.~~ Explain how the use of timed turns eliminates the problem of the turning errors of a direct-reading magnetic compass and calculate the duration of a rate-1 turn for a given change of heading.	X	X	X	X	X	X		
(06)		Describe the serviceability check for a direct-reading magnetic compass prior to flight, such as: — the physical appearance of the device;	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— comparing the indication to another known direction such as a different compass or runway direction.								
022 03 04 00		**Flux valve**								
022 03 04 01		***Purpose, operating principle, location, errors***								
(01)		Explain the purpose of a flux valve.	X	X	X	X	X	X		
(02)	X	Explain its operating principle.	X	X	X	X	X	X		
(03)		~~Indicate various locations and precautions needed.~~ Indicate typical locations of the flux valve(s).	X	X	X	X	X	X		
(04)		Give the remote-reading compass system as example of application for a flux valve.	X	X	X	X	X	X		
(05)		~~State that because of the electromagnetic deviation correction, the flux-valve output itself does not have a deviation correction card.~~ Explain that deviation is compensated for and, therefore, eliminates the need for a deviation correction card.	X	X	X	X	X	X		
(06)		~~Describe and interpret the effects of the following errors:~~ — ~~acceleration,~~ — ~~turning,~~ — ~~attitude,~~ — ~~deviation.~~ Explain that a flux valve does not suffer from the same	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		magnitude of errors as a direct-reading magnetic compass when turning, accelerating or decelerating and during pitch-up or pitch-down manoeuvres.								
022 04 00 00		**GYROSCOPIC INSTRUMENTS**								
022 04 01 00		**Gyroscope: basic principles**								
022 04 01 01		***Gyroscopic forces, degrees of freedom, gyro wander, driving gyroscopes***								
(01)	X	Define a ‘gyro’.	X	X	X	X	X	X	X	
(02)	X	Explain the fundamentals of the theory of gyroscopic forces.	X	X	X	X	X	X	X	
O (03)	X	Define the ‘degrees of freedom’ of a gyro. *Remark: As a convention, the degrees of freedom of a gyroscope do not include its own axis of rotation (the spin axis).*	X	X	X	X	X	X	X	
(04)	X	Explain the following terms: — rigidity~~,~~; — precession~~,~~; — wander (drift/topple).	X	X	X	X	X	X		
(05)		~~Distinguish between:~~ — ~~real wander and apparent wander;~~ — ~~apparent wander due to the rotation of the Earth~~	X	X	X	X	X	X		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
		~~and transport wander.~~ Explain the three types of gyro wander: — real wander; — apparent wander; — transport wander.								
~~LO (06)~~		~~Describe a free (space) gyro and a tied gyro.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(07)		~~Describe and compare electrically and pneumatically-driven gyroscopes.~~ Describe the two ways of driving gyroscopes and any associated indications: — air/vacuum; — electrically.	X	X	X	X	X	X	X	
~~LO (08)~~		~~Explain the construction and operating principles of a:~~ — ~~rate gyro,~~ — ~~rate-integrating gyro.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
022 04 02 00		**Rate-of-turn indicator — Turn coordinator — Balance (slip) indicator**								
_022 04 02 01_		**_Indications, relation between bank angle, rate of turn and TAS_**								
(01)		Explain the purpose of a rate-of-turn and balance (slip) indicator.	X	X	X	X	X	X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		Define a 'rate-1~~one~~ turn'.	X	X	X	X	X	X	X	
(03)		~~Describe the construction and principles of operation of a rate-of-turn indicator.~~ Describe the indications given by a rate-of-turn indicator.	X	X	X	X	X	X	X	
~~LO (04)~~		~~State the degrees of freedom of a rate-of-turn indicator.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(05)		Explain the relation between bank angle, rate of turn and TAS, and how bank angle becomes the limiting factor at high speed (no calculations).	X	X	X	X	X	X	X	
~~LO (06)~~		~~Explain why the indication of a rate-of-turn indicator is only correct for one TAS and when turn is coordinated.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~LO (07)~~		~~Describe the construction and principles of operation of a balance (slip) indicator.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(08)		Explain the purpose of a balance (slip) indicator and its principle of operation.	X	X	X	X	X	X	X	
(09)		Describe the indications of a rate-of-turn and balance (slip) indicator during a balanced, slip or skid turn.	X	X	X	X	X	X	X	
(10)		~~Describe the construction and principles of operation of a turn coordinator (or turn-and-bank indicator).~~ Describe the indications given by a turn coordinator (or turn-and-bank indicator).	X	X	X	X	X	X	X	
(11)		Compare the indications on the rate-of-turn indicator and	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		the turn coordinator.								
022 04 03 00		**Attitude indicator (artificial horizon)**								
022 04 03 01		***Purpose, types, effect of aircraft acceleration, display***								
(01)		Explain the purpose of the attitude indicator.	X	X	X	X	X	X	X	
(02)		~~Describe the different designs and principles of operation of attitude indicators (air-driven, electric).~~ Identify the two types of attitude indicators: — attitude indicator; — attitude and director indicator (ADI).	X	X	X	X	X	X	X	
(03)	X	State the degrees of freedom.	X	X	X	X	X	X		
~~LO (04)~~		~~Describe the gimbal system.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(05)		Describe the effects of the aircraft's acceleration and turns on instrument indications.	X	X	X	X	X	X		
(06)		Describe ~~the~~ a typical attitude display and instrument markings.	X	X	X	X	X	X	X	
~~LO (07)~~		~~Explain the purpose of a vertical gyro unit.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (08)~~		~~List and describe the following components of a vertical gyro unit:~~ — ~~inputs: pitch and roll sensors;~~ — ~~transmission and amplification (synchros and~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~amplifiers);~~ — ~~outputs: display units such as Attitude Direction Indicator (ADI), auto-flight control systems.~~								
~~LO (09)~~		~~State the advantages and disadvantages of a vertical gyro unit compared to an attitude indicator with regard to:~~ — ~~design (power source, weight and volume);~~ — ~~accuracy of the information displayed;~~ — ~~availability of the information for several systems (ADI, AFCS).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
022 04 04 00		**Directional gyroscope**								
022 04 04 01		***Purpose, types, drift, alignment to compass heading***								
(01)		Explain the purpose of the directional gyroscope.	X	X	X	X	X	X	X	
(02)		~~Describe the following two types of directional gyroscopes:~~ — ~~air-driven directional gyro;~~ — ~~electric directional gyro.~~ Identify the two types of gyro-driven direction indicators: — direction indicator; — horizontal situation indicator (HSI).	X	X	X	X	X	X	X	
~~LO (03)~~		~~State the degrees of freedom.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (04)~~		~~Describe the gimbal system.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (05)~~		~~Define the following different errors:~~ — ~~design and manufacturing imperfections (random wander);~~ — ~~apparent wander (rotation of the Earth);~~ — ~~transport wander (movement relative to the Earth's surface);~~ ~~and explain their effects.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (06)~~		~~Calculate the apparent wander (apparent drift rate in degrees per hour) of an uncompensated gyro according to latitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(07)		Explain how the directional gyroscope will drift over time due to the following: — rotation of the Earth; — aircraft manoeuvring; — aircraft movement over the Earth's surface/direction of travel.	X	X	X	X	X	X		
(08)		Describe the procedure for the pilot to align the directional gyroscope to the correct compass heading.	X	X	X	X	X	X		
022 04 05 00		**Remote-reading compass systems**								
022 04 05 01		***Operating principles, components, comparison with a direct-reading magnetic compass***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Describe the principles of operation of a remote-reading compass system.	X	X	X	X	X	X	X	
(02)		Using a block diagram, list and explain the function of the following components of a remote-reading compass system: — flux detection unit; — gyro unit; — transducers, precession amplifiers, annunciator; — display unit (compass card, synchronising and set-heading knob, DG/compass/slave/free switch).	X	X	X	X	X	X	X	
(03)		State the advantages and disadvantages of a remote-reading compass system compared to a direct-reading magnetic compass with regard to: — design (power source, weight and volume); — deviation due to aircraft magnetism; — turning and acceleration errors; — attitude errors; — accuracy and stability of the information displayed; — availability of the information for several systems (compass card, RMI, automatic flight control system (AFCS)).	X	X	X	X	X	X		
022 04 06 00		**Solid-state systems — attitude and heading reference**	X	X	X	X	X	X		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		system (AHRS) **~~(the following paragraph is to be introduced at a later date)~~**								
022 04 06 01		***Components, indications***								
(01)		~~State that the Micro-Electromechanical Sensors (MEMS) technology can be used to make:~~ Explain that the AHRS is a replacement for traditional gyros using solid-state technology with no moving parts and is a single unit consisting of: — solid-state accelerometers; — solid-state rate sensor gyroscopes; — solid-state magnetometers (measurement of the Earth’s magnetic field).	X	X	X	X	X	X	X	
~~LO (02)~~		~~Describe the basic principle of a solid-state Attitude and Heading Reference System (AHRS) using a solid-state 3-axis rate sensor, 3-axis accelerometer and a 3-axis magnetometer.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~LO (03)~~		~~Compare the solid-state AHRS with the mechanical gyroscope and flux-gate system with regard to:~~ — ~~size and weight,~~ — ~~accuracy,~~ — ~~reliability,~~ — ~~cost.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		Explain that the AHRS senses rotation and acceleration for all three axes and senses the direction of the Earth’s magnetic field where the indications are normally provided on electronic screens (electronic flight instrument system (EFIS)).	X	X	X	X	X	X	X	
~~022 05 00 00~~		**~~INERTIAL NAVIGATION AND REFERENCE SYSTEMS (INS AND IRS)~~**								
~~022 05 01 00~~		**~~Inertial Navigation Systems (INS) (stabilised inertial platform)~~**								
~~022 05 01 01~~		***~~Basic principles~~***								
~~LO~~		~~Explain the basic principles of inertial navigation.~~	~~X~~		~~X~~	~~X~~		~~X~~		
~~022 05 01 02~~		***~~Design~~***								
~~LO~~		~~List and describe the main components of a stabilised inertial platform.~~	~~X~~		~~X~~	~~X~~				
~~LO~~		~~Explain the different corrections made to stabilise the platform.~~	~~X~~		~~X~~	~~X~~				
~~LO~~		~~List the following two effects that must be compensated for:~~ — ~~Coriolis,~~ — ~~centrifugal.~~	~~X~~		~~X~~	~~X~~				

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO~~		~~Explain the alignment of the system, the different phases associated and the conditions required.~~	~~X~~		~~X~~	~~X~~				
~~LO~~		~~Explain the Schuler condition and give the value of the Schuler period.~~	~~X~~		~~X~~	~~X~~				
~~022 05 01 03~~		***~~Errors, accuracy~~***								
~~LO~~		~~State that there are three different types of errors:~~ — ~~bounded errors,~~ — ~~unbounded errors,~~ — ~~other errors.~~	~~X~~		~~X~~	~~X~~				
~~LO~~		~~Give average values for bounded and unbounded errors according to time.~~	~~X~~		~~X~~	~~X~~				
~~LO~~		~~State that an average value for the position error of the INS according to time is 1,5 NM/hour or more.~~	~~X~~		~~X~~	~~X~~				
~~022 05 01 04~~		***~~Operation~~***								
~~LO~~		~~Give examples of INS control and display panels.~~	~~X~~		~~X~~	~~X~~				
~~LO~~		~~Give an average value of alignment time at midlatitudes.~~	~~X~~		~~X~~	~~X~~				
~~LO~~		~~List the outputs given by an INS.~~	~~X~~		~~X~~	~~X~~				
~~LO~~		~~Describe and explain the consequences concerning the loss of alignment by an INS in flight.~~	~~X~~		~~X~~	~~X~~				
~~022 05 02 00~~		**~~Inertial Reference Systems (IRS) (strapped-down)~~**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~022 05 02 01~~		***~~Basic principles~~***								
~~LO~~		~~Describe the operating principle of a strapped-down IRS.~~	~~X~~		~~X~~	~~X~~				
~~LO~~		~~State the differences between a strapped-down inertial system (IRS) and a stabilised inertial platform (INS).~~	~~X~~		~~X~~	~~X~~				
~~022 05 02 02~~		***~~Design~~***								
~~LO~~		~~List and describe the following main components of an IRS:~~ — ~~rate sensors (laser gyros),~~ — ~~inertial accelerometers,~~ — ~~high-performance processors,~~ — ~~display unit.~~	~~X~~		~~X~~	~~X~~		~~X~~		
~~LO~~		~~Explain the construction and operating principles of a Ring Laser Gyroscope (RLG).~~	~~X~~		~~X~~	~~X~~		~~X~~		
~~LO~~		~~Explain the different computations and corrections to be made to achieve data processing.~~	~~X~~		~~X~~	~~X~~				
~~LO~~		~~Explain the alignment of the system, the different phases associated and the conditions required.~~	~~X~~		~~X~~	~~X~~		~~X~~		
~~LO~~		~~Explain why the Schuler condition is still required.~~	~~X~~		~~X~~	~~X~~				
~~LO~~		~~Describe the 'lock-in' (laser lock) phenomena and the means to overcome it.~~	~~X~~		~~X~~	~~X~~				

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO~~		~~State that an IRS can be a stand-alone system or integrated with an ADC (ADIRU).~~	~~X~~		~~X~~	~~X~~		~~X~~		
~~022 05 02 03~~		***~~Errors, accuracy~~***								
~~LO~~		~~Compare IRS and INS for errors and accuracy.~~	~~X~~		~~X~~	~~X~~				
~~022 05 02 04~~		***~~Operation~~***								
~~LO~~		~~Compare IRS and INS, and give recent examples of control panels.~~	~~X~~		~~X~~	~~X~~		~~X~~		
~~LO~~		~~List the outputs given by an IRS.~~	~~X~~		~~X~~	~~X~~		~~X~~		
~~LO~~		~~Give the advantages and disadvantages of an IRS compared to an INS.~~	~~X~~		~~X~~	~~X~~				
022 05 00 00		**INERTIAL NAVIGATION**								
022 05 01 00		**Basic principles**								
022 05 01 01		***Systems***								
(01)		State that inertial navigation/reference systems are the main source of attitude and one of the main sources of navigational data in commercial air transport aeroplanes.	X		X	X				
(02)		State that inertial systems require no external input, except TAS, to determine aircraft attitude and navigational data.	X		X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)		State that earlier gyro mechanically stabilised platforms are (technically incorrectly but conventionally) referred to as inertial navigation systems (INSs) and more modern fixed (strap down) platforms are conventionally referred to as inertial reference systems (IRS). INS can be considered to be stand-alone, whereas IRS are integrated with the FMS.	X		X	X				
(04)		Explain the basic principles of inertial navigation (including double integration of measured acceleration and the necessity for north–south, east–west and vertical components to be measured/extracted).	X		X	X				
(05)		Explain the necessity of applying correction for transport precession, and Earth rate precession, coriolis and gravity.	X		X	X				
(06)		State that in modern aircraft fitted with inertial reference system (IRS) and flight management system (FMS), the flight management computer (FMC) position is normally derived from a mathematical analysis of IRS, global positioning system (GPS), and distance measuring equipment (DME) data, VOR and LOC.	X		X	X				
(07)		List all navigational data that can be determined by a stand-alone inertial navigation system.	X		X	X				
(08)		State that a strap-down system is fixed to the structure of the aircraft and normally consists of three laser ring gyros	X		X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		and three accelerometers.								
(09)		State the differences between a laser ring gyro and a conventional mechanical gyro.	X		X	X				
022 05 02 00		**Alignment and operation**								
022 05 02 01		***Alignment process, incorrect entries, control panels***								
(01)		State that during the alignment process, the inertial platform is levelled (INS) or the local vertical is determined (IRS) and true north/aircraft heading established.	X		X	X				
(02)		Explain that the aircraft must be stationary during alignment, the aircraft position is entered during the alignment phase, and that the alignment process takes around 10 to 20 minutes at mid latitudes (longer at high latitudes).	X		X	X				
(03)		State that in-flight realignment is not possible and loss of alignment leads to loss of navigational data although attitude information may still be available.	X		X	X				
(04)		Explain that the inertial navigation system (INS) platform is maintained level and north-aligned after alignment is complete and the aircraft is in motion.	X		X	X				
(05)		State that an incorrect entry of latitude may lead to a loss of alignment and is more critical than the incorrect entry	X		X	X				

TRAINING INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		of longitude.								
(06)		State that the positional error of a stand-alone INS varies (a typical value can be quoted as 1–2 NM/h) and is dependent on the gyro drift rate, accelerometer bias, misalignment of the platform, and computational errors.	X		X	X				
(07)		Explain that, on a modern aircraft, there is likely to be an air data inertial reference unit (ADIRU), which is an inertial reference unit (IRU) integrated with an air data computer (ADC).	X		X	X				
(08)		Identify examples of IRS control panels.	X		X	X				
(09)		Explain the following selections on the IRU mode selector: — NAV (normal operation); — ATT (attitude only).	X		X	X				
(10)		State that the majority of the IRS data can be accessed through the FMS control and display unit (CDU)/flight management and guidance system (FMGS) multifunctional control and display unit (MCDU).	X		X	X				
(11)		Describe the procedure available to the pilot for assessing the performance of individual IRUs after a flight: — reviewing the residual indicated ground speed	X		X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		when the aircraft has parked; — reviewing the drift given as NM/h.								
022 06 00 00		**AEROPLANE: AUTOMATIC FLIGHT CONTROL SYSTEMS**								
022 06 01 00		**General~~: Definitions and control loops~~**								
022 06 01 01		***Definitions and control loops***								
(01)		~~State~~ Describe the following purposes of an a~~A~~utomatic f~~F~~light c~~C~~ontrol s~~S~~ystem (AFCS): — enhancement of flight controls; — reduction of pilot workload.	X	X				X		
(02)		Define and explain the following two functions of an AFCS: — aircraft control: ~~control of the aeroplane's movement about~~ stabilise the aircraft around its centre of gravity (CG); — aircraft guidance: guidance of the ~~aeroplane's CG (flight path)~~ aircraft's flight path.	X	X				X		
(03)		~~Define and explain 'closed loop' and open loop.~~ Describe the following two automatic control principles: — closed loop, where a feedback from an action or state is compared to the desired action or state; — open loop, where there is no feedback loop.	X	X						
~~LO (04)~~		~~Explain that the inner loop is for aircraft control and outer~~	~~X~~	~~X~~						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~loop is for aircraft guidance.~~								
(05)		List the following ~~different~~ elements of a closed-loop control system and explain their basic function: — input signal; — error detector; — ~~signal processing (computation of output signal according to control laws);~~ — ~~output signal;~~ — signal processor providing a measured output signal according to set criteria or laws; — control element such as an actuator; — feedback signal to error detector for comparison with input signal.	X	X						
(06)		Describe how a closed-loop system may enter a state of self-induced oscillation if the system overcompensates for deviations from the desired state.	X	X						
(07)		Explain how a state of self-induced oscillations may be detected and describe the effects of self-induced oscillations: — aircraft controllability; — aircraft safety; — timely ~~manual~~ intervention as a way of mitigating	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		loss of control; — techniques that may be used to maintain positive control of the aircraft.								
022 06 02 00		**Autopilot system~~: design and operation~~**								
022 06 02 01		***Design and operation***								
(01)		Define the three basic control channels.	X	X						
(02)		~~List the following different types of autopilot systems: 1-axis, 2-axis and 3-axis.~~ Define the three different types of autopilots: — single or 1 axis (roll); — 2 axes (pith and roll); — 3 axes (pitch, roll and yaw);	X	X						
(03)		~~List and describe the main components of an autopilot system.~~ Describe the purpose of the following components of an autopilot system: — flight control unit (FCU), mode control panel (MCP) or equivalent; — flight mode annunciator (FMA) (see Subject 022 06 04 00); — autopilot computer;	X	X						

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— actuator.								
(04)		~~Explain and describe the following lateral modes: roll, heading, VOR/LOC, NAV or LNAV.~~ Explain the following lateral modes: — heading (HDG)/track (TRK); — VOR (VOR)/localiser (LOC); — lateral navigation/managed navigation (LNAV or NAV).	X	X						
(05)		Describe the purpose of control laws for pitch and roll modes.	X	X						
(06)		~~Explain and describe the following longitudinal (or vertical) modes: pitch, vertical speed, level change, altitude hold (ALT), profile or VNAV, G/S.~~ Explain the following vertical modes: — vertical speed (V/S); — flight path angle (FPA); — level change (LVL CHG)/open climb (OP CLB) or open descent (OP DES); — speed reference system (SRS); — altitude (ALT) hold; — vertical navigation (VNAV)/managed climb (CLB) or descent (DES);	X	X						

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
		— glideslope (G/S).								
~~LO (07)~~		~~Give basic examples for pitch and roll channels of inner loops and outer loops with the help of a diagram.~~	~~X~~	~~X~~						
(08)		~~Explain the influence of gain variation on precision and stability.~~ Describe how the autopilot uses speed, aircraft configuration or flight phase as a measure for the magnitude of control inputs and how this may affect precision and stability.	X	X						
~~LO (09)~~		~~Explain gain adaptation with regard to speed, configuration or flight phase.~~	X	X						
(10)		~~Explain and describe the following common (or mixed) modes: take-off, go-around and approach.~~ ~~*Remark: The landing sequence is studied in 022 06 04 00.*~~ Explain the following mixed modes: — take-off; — go-around; — approach (APP).	X	X						
(11)		~~List the different types of actuation configuration and compare their advantages/disadvantages.~~ Describe the two types of autopilot configurations and explain the implications to the pilot for either and when	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		comparing the two principles: — flight-deck controls move with the control surface when the autopilot is engaged; — flight-deck controls remain static when the autopilot is engaged.								
(12)		~~List the inputs and outputs of a 3-axis autopilot system.~~ Describe the purpose of the following inputs and outputs for an autopilot system: — attitude information; — flight path/trajectory information; — control surface position information; — airspeed information; — aircraft configuration information; — FCU/MCP selections; — FMAs.	X	X						
(13)		~~Describe and explain the synchronisation function.~~ Describe the purpose of the synchronisation function when engaging the autopilot and explain why the autopilot should be engaged when the aircraft is in trim.	X	X						
~~LO (14)~~		~~Give examples of engagement and disengagement systems and conditions.~~	~~X~~	~~X~~						
(15)		~~Define the 'Control Wheel Steering' (CWS) mode~~	X	X						

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~according to CS-25 (see AMC 25.1329, paragraph 4.3).~~ Define the control wheel steering (CWS) mode as manual manoeuvring of the aircraft through the autopilot computer and autopilot servos/actuators using the control column/control wheel.								
(16)		~~Describe the CWS mode operation.~~ Describe the following elements of CWS: — CWS as an autopilot mode; — flight phases where CWS cannot be used; — whether the pilot or the autopilot is controlling the flight path; — the availability of flight path/performance protections; — potential different feel and control response compared to manual flight.	X	X						
~~LO (17)~~		~~Describe with the help of a control panel of an autopilot system and a flight mode annunciator/indicator the actions and the checks performed by a pilot through a complete sequence:~~ — ~~from Heading (HDG) selection to VOR/LOC guidance (arm/capture/track);~~ — ~~from Altitude selection (LVL change) to Altitude (ALT) hold (arm/intercept/hold).~~	~~X~~	~~X~~						

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (18)~~		~~Describe and explain the different phases and the associated annunciations/indications from level change to altitude capture and from heading mode to VOR/LOC capture.~~	~~X~~	~~X~~						
~~LO (19)~~		~~Describe and explain the existence of operational limits for lateral modes (LOC capture) with regard to speed/angle of interception/distance to threshold, and for longitudinal modes (ALT or G/S capture) with regard to V/S.~~	~~X~~	~~X~~						
(14)		Describe touch control steering (TCS) and highlight the differences when compared to CWS: — autopilot remains engaged but autopilot servos/actuators are disconnected from the control surfaces; — manual control of the aircraft as long as TCS button is depressed; — autopilot servos/actuators reconnect when TCS button is released and the autopilot returns to previously engaged mode(s).	X	X				X		
(15)		Explain that only one autopilot may be engaged at any time except for when APP is armed in order to facilitate a fail-operational autoland.	X	X				X		
(16)		Explain the difference between an armed and an engaged	X	X				X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		mode: — not all modes have an armed state available; — a mode will only become armed if certain criteria are met; — an armed mode will become engaged (replacing the previously engaged mode, if any) when certain criteria are met.								
(17)		Describe the sequence of events when a mode is engaged and the different phases: — initial phase where attitude is changed to obtain a new trajectory in order to achieve the new parameter; — the trajectory will be based on rate of closure which is again based on the difference between the original parameter and the new parameter; — capture phase where the aircraft will follow a predefined rate of change of trajectory to achieve the new parameter without overshooting/ undershooting; — tracking or hold phase where the aircraft will maintain the set parameter until a new change has been initiated.	X	X				X		
(18)		Explain automatic mode reversion and typical situations	X	X				X		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		where it may occur: — no suitable data for the current mode such as flight plan discontinuity when in LNAV/managed NAV; — change of parameter during capture phase for original parameter such as change of altitude target during ALT ACQ/ALT*; — mismanagement of a mode resulting in engagement of the autopilot envelope protection, e.g. selecting excessive V/S resulting in a loss of speed control.								
(19)		Explain the dangers of mismanagement of the following modes: — use of V/S and lack of speed protection, i.e. excessive V/S or FPA may be selected with subsequent uncontrolled loss or gain of airspeed; — arming VOR/LOC or APP outside the protected area of the localiser or ILS.	X	X				X		
(26)		Describe how failure of other systems may influence the availability of the autopilot and how incorrect data from other systems may result in an undesirable aircraft state, potentially without any failure indications. Explain the importance of prompt and appropriate pilot intervention during such events.	X	X				X		
(27)		Explain an appropriate procedure for disengaging the	X	X				X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		autopilot and why both aural and visual warnings are used to indicate that the autopilot is being disengaged: — temporary warning for intended disengagement using the design method; — continuous warning for unintended disengagement or using a method other than the design method.								
(28)		Explain the following regarding autopilot and aircraft with manual trim: — the autopilot may not engage unless the aircraft controls are in trim; — the aircraft will normally be in trim when the autopilot is disconnected; — use of manual trim when the autopilot is engaged will normally lead to autopilot disconnection and a risk of an out-of-trim situation.	X	X				X		
022 06 03 00		**Flight d~~D~~irector: design and operation**								
022 06 03 01		***Purpose, use, indications, modes, data***								
(01)		~~State~~ Explain the purpose of a flight director ~~(FD)~~ system.	X	X				X		
~~LO (02)~~		~~List and describe the main components of an FD system.~~	~~X~~	~~X~~						
(03)		~~List~~ Describe the different types of display: — pitch and roll crossbars; — V-bar.	X	X				X		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		Explain the differences between a flight director and an autopilot ~~(AP) system~~ and how the flight director provides a means of cross-checking the control/guidance commands sent to the autopilot.	X	X				X		
(05)		~~Explain how an FD and an AP can be used together, separately (AP with no FD, or FD with no AP), or none of them.~~ Explain why the flight director must be followed when engaged/shown, and describe the appropriate use of the flight director: — flight director only; — autopilot only; — flight director and autopilot; — typical job-share between pilots (pilot flying (PF)/pilot monitoring (PM)) for selecting the parameters when autopilot is engaged versus disengaged.	X	X				X		
(06)		~~Give examples of different situations with the respective indications of the command bars.~~ Give examples of different scenarios and the resulting flight director indications.	X	X				X		
(07)		Explain that the flight director computes and indicates the direction and magnitude of control inputs required in	X	X				X		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		order to achieve an attitude to follow a trajectory.								
(08)		Explain how the modes available for the flight director are the same as those available for the autopilot, and that the same panel (FCU/MCP) is normally used for selection.	X	X				X		
(09)		Explain the importance of checking the FMC data or selected autopilot modes through the FMA when using the flight directors. If the flight directors are showing incorrect guidance, they should not be followed and should be turned off.	X	X				X		
022 06 04 00		**Aeroplane: f~~F~~light m~~M~~ode a~~A~~nnunciator (FMA)**								
022 06 04 01		***Purpose, modes, display scenarios***								
(01)		~~Explain the purpose and the importance of the FMA.~~ Explain the purpose of FMAs and their importance being the only indication of the state of a system rather than a switch position.	X	X				X		
~~LO (02)~~		~~State that the FMA provides:~~ — ~~AFCS lateral and vertical modes;~~ — ~~auto-throttle modes;~~ — ~~FD selection, AP engagement and automatic landing capacity;~~ — ~~failure and alert messages.~~	~~X~~	~~X~~						
(03)		Describe where the FMAs are normally shown and how	X	X				X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		the FMAs will be divided into sections (as applicable to aircraft complexity): — vertical modes; — lateral modes; — autothrust modes; — autopilot and flight director annunciators; — landing capability.								
(04)		Explain why FMAs for engaged or armed modes have different colour or different font size.	X	X				X		
(05)		Describe the following FMA display scenarios: — engagement of a mode; — mode change from armed to becoming engaged; — mode reversion.	X	X				X		
(06)		Explain the importance of monitoring the FMAs and announcing mode changes at all times (including when selecting a new mode) and why only certain mode changes will be accompanied by an aural notification or additional visual cues.	X	X				X		
(07)		Describe the consequences of not understanding what the FMAs imply or missing mode changes, and how it may lead to an undesirable aircraft state.	X	X				X		
022 06 05 00		**Autoland~~: design and operation~~**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
022 06 05 01		***Design and operation***								
(01)		Explain the purpose of an autoland system.	X					X		
(02)		~~List and describe the main components of an autoland system.~~ Explain the significance of the following components required for an autoland: — autopilot; — autothrust; — radio altimeter; — ILS receivers.	X					X		
(03)		~~Define~~ Explain the following terms (reference to CS-AWO 'All Weather Operations'): — fail-passive automatic landing system; — fail-operational ~~(fail active)~~ automatic landing system; — fail-operational hybrid landing system; — alert height~~;~~. ~~according to CS-AWO.~~	X							
(04)		~~Describe and explain the autoland sequence and the associated annunciations/indications from initial approach to roll-out (AP disengagement) or go-around.~~	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Describe the autoland sequence including the following: — FMAs regarding the landing capability of the aircraft; — the significance of monitoring the FMAs to ensure the automatic arming/engagement of modes triggered by defined radio altitudes or other thresholds; — in the event of a go-around, that the aircraft performs the go-around manoeuvre both by reading the FMAs and supporting those readings by raw data; — during the landing phase that 'FLARE' mode engages at the appropriate radio altitude, including typical time frame and actions if 'FLARE' does not engage; — after landing, that 'ROLL-OUT' mode engages and the significance of disconnecting the autopilot prior to vacating the runway.								
(05)		~~List and explain the operational limitations to perform an autoland.~~ Explain that there are operational limitations in order to legally perform an autoland beyond the technical capability of the aircraft.	X							
(06)		Explain the purpose and significance of alert height, describe the indications and implications, and consider	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		typical pilot actions for a failure situation: — above the alert height; — below the alert height.								
(07)		Describe typical failures that, if occurring below the alert height, will trigger a warning: — all autopilots disengage; — loss of ILS signal or components thereof; — excessive ILS deviations; — radio-altimeter failure.	X							
(08)		Describe how the failure of various systems, including systems not directly involved in the autoland process, can influence the ability to perform an autoland or affect the minima down to which the approach may be conducted.	X							
(09)		Describe the fail-operational hybrid landing system as a primary fail-passive automatic landing system with a secondary independent guidance system such as a head-up display (HUD) to enable the pilot to complete a manual landing if the primary system fails.	X							
022 07 00 00		**HELICOPTER: AUTOMATIC FLIGHT CONTROL SYSTEMS**								
022 07 01 00		**General principles**								
022 07 01 01		***Stabilisation***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Explain the similarities and differences between SAS and AFCS (the latter can actually fly the helicopter to perform certain functions selected by the pilot). Some AFCSs just have altitude and heading hold whilst others include a vertical speed or IAS hold mode, where a constant rate of climb/decent or IAS is maintained by the AFCS.			X	X	X			
022 07 01 02		***Reduction of pilot workload***								
(01)		Appreciate how effective the AFCS is in reducing pilot workload by improving basic aircraft control harmony and decreasing disturbances.			X	X	X			
022 07 01 03		***Enhancement of helicopter capability***								
(01)		Explain how an AFCS improves helicopter flight safety during: — search and rescue (SAR) ~~because of~~ thanks to increased capabilities; — flight by sole reference to instruments; — underslung load operations; — white-out conditions in snow-covered landscapes; — an approach to land with lack of visual cues.			X	X	X			
(02)		Explain that the ~~Search and Rescue (~~SAR~~)~~ modes of AFCS include the following functions: — ability to autohover;			X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		— facility for mark on target (MOT) approach to hover; — automatically transition ~~down~~ from cruise down to a predetermined point or over-flown point; — ability for the rear crew to move the helicopter around in the hover; — the ability to automatically transition ~~back~~ from the hover back to cruise flight; — the ability to fly various search patterns.								
(03)		Explain that ~~the~~ earlier autohover systems use Doppler velocity sensors and ~~the later~~ modern systems use inertial sensors plus GPS, and normally include a two-dimensional hover-velocity indicator for the pilots.			X	X	X			
(04)		Explain why some SAR helicopters have both radio-altimeter height hold and barometric altitude hold.			X	X	X			
022 07 01 04		***Failures***								
(01)		Explain the various redundancies and independent systems that are built into the AFCSs.			X	X	X			
(02)		Appreciate that the pilot can override the system in the event of a failure.			X	X	X			
(03)		Explain a series actuator ‘hard over’ which equals aircraft attitude runaway.			X	X	X			
(04)		Explain the consequences of a saturation of the series			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		actuators.								
022 07 02 00		**Components: o~~O~~peration**								
022 07 02 01		***Basic sensors***								
(01)		Explain the basic sensors in the system and their functions.			X	X	X			
(02)		Explain that the number of sensors will be dependent on the number of coupled modes of the system.			X	X	X			
022 07 02 02		***Specific sensors***								
(01)		Explain the function of the microswitches and strain gauges in the system which sense pilot input to prevent excessive feedback forces from the system.			X	X	X			
022 07 02 03		***Actuators***								
(01)		Explain the principles of operation of the series and parallel actuators, spring-box clutches and the autotrim system.			X	X	X			
(02)		Explain the principle of operation of the electronic hydraulic actuators in the system.			X	X	X			
022 07 02 04		***Pilot~~/~~-system interface: control panels, system indications, warnings***								
(01)		Describe the typical layout of the AFCS control panel.			X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		Describe the system indications and warnings.			X	X	X			
022 07 02 05		***Operation***								
(01)		Explain the functions of the redundant sensors' simplex and duplex channels (single/dual channel).			X	X	X			
022 07 03 00		**Stability a~~A~~ugmentation s~~S~~ystem (SAS)**								
022 07 03 01		***General principles and operation***								
(01)		Explain the general principles and operation of an SAS with regard to: — rate damping; — short-term attitude hold; — effect on static stability; — effect on dynamic stability; — aerodynamic cross-coupling; — effect on manoeuvrability; — control response; — engagement/disengagement; — authority.			X	X	X			
(02)		Explain and describe the general working principles and primary use of a SAS by damping pitch, roll and yaw motions.			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)		Describe a simple SAS with force~~d~~-trim system which uses magnetic clutch and springs to hold cyclic control in the position where it was last released.			X	X	X			
(04)		Explain the interaction of trim with SAS/s~~S~~tability and c~~C~~ontrol a~~A~~ugmentation s~~S~~ystem (SCAS).			X	X	X			
(05)		Appreciate that the system can be overridden by the pilot and that individual channels can be deselected.			X	X	X			
(06)		Describe the operational limits of the system.			X	X	X			
(07)		Explain why the system should be turned off in severe turbulence or when extreme flight attitudes are reached.			X	X	X			
(08)		Explain the safety design features built into some SASs to limit the authority of the actuators to 10–20 % of the full-control throw in order to allow the pilot to override if actuators demand an unsafe control input.			X	X	X			
(09)		Explain how cross-coupling produces an adverse effect on roll-to-yaw coupling, when the helicopter is subjected to gusts.			X	X	X			
(10)		Explain the collective-to-pitch coupling, side-slip-to-pitch coupling and inter-axis coupling.			X	X	X			
022 07 04 00		**Autopilot — a~~A~~utomatic stability equipment**								
022 07 04 01		***General principles***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Explain the general autopilot principles with regard to: — long-term attitude hold; — fly-through; — changing the reference (beep trim, trim release).			X	X	X			
022 07 04 02		***Basic modes (3/4 axes)***								
(01)		Explain the AFCS operation on cyclic axes (pitch/roll), yaw axis, and on collective (fourth axis).			X	X	X			
022 07 04 03		***Automatic guidance (upper modes of AFCS)***								
(01)		Explain the function of the attitude-hold system in an AFCS.			X	X	X			
(02)		Explain the function of the heading-hold system in an AFCS.			X	X	X			
(03)		Explain the function of the vertical-speed hold system in an AFCS.			X	X	X			
(04)		Explain the function of the navigation-coupling system in an AFCS.			X	X	X			
(05)		Explain the function of the VOR-/ILS-coupling system in an AFCS.			X	X	X			
(06)		Explain the function of the hover-mode system in an AFCS (including Doppler and radio-altimeter systems).			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(07)		Explain the function of the SAR mode (automatic transition to hover and back to cruise) in an AFCS.			X	X	X			
022 07 04 04		***Flight d~~D~~irector: design and operation***								
(01)		Explain the purpose of a f~~F~~light d~~D~~irector ~~(FD)~~ system.			X	X	X			
(02)		~~List~~ Describe the different types of display: — pitch and roll crossbars; — V-bar.			X	X	X			
(03)		State the difference between the flight director ~~FD~~ system and the autopilot system. Explain how each can be used independently.			X	X	X			
(04)		List and describe the main components of ~~an~~ the flight director ~~FD~~ system.			X	X	X			
(05)		Give examples of different situations with the respective indications of the command bars.			X	X	X			
(06)		Explain the architecture of the different flight directors ~~FDs~~ fitted to helicopters and the importance to monitor other instruments as well as the flight director. ~~FD, because on~~			X	X	X			
(07)		Explain how some helicopter types ~~which~~ have the collective setting as a ~~on the~~ flight director ~~FD~~ command~~,~~; however, the command does not provide~~, there is no~~ protection against a ~~collective~~ transmission overtorque.			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(08)		Describe the collective setting and yaw depiction on flight director ~~FD~~ for some helicopters.			X	X	X			
022 07 04 05		***Automatic f~~F~~light c~~C~~ontrol p~~P~~anel (AFCP)***								
(01)		Explain the purpose and ~~the~~ importance of the AFCP.			X	X	X			
(02)		State that the AFCP provides: — AFCS basic and upper modes; — flight director ~~FD~~ selection, SAS and AP engagement; — failure and alert messages.			X	X	X			
022 08 00 00		**TRIMS — YAW DAMPER — FLIGHT-ENVELOPE PROTECTION**								
022 08 01 00		**Trim systems~~: design and operation~~**								
022 08 01 01		***Design and operation***								
(01)		Explain the purpose of the trim system and describe the layout with one trim system for each control axis, depending on the complexity of the aircraft.	X	X						
~~LO (02)~~		~~State the existence of a trim system for each of the three axes.~~	~~X~~	~~X~~						
(03)		Give examples of trim indicators and their function, and explain the significance of a 'green band/area' for the pitch trim.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		Describe and explain an automatic pitch-trim system for a conventional aeroplane.	X	X						
(05)		Describe and explain an automatic pitch-trim system for an FBW~~fly-by-wire~~ aeroplane and that it is also operating during manual flight; however, during certain phases it may be automatically disabled to alter the handling characteristics of the aircraft.	X	X						
~~LO (06)~~		~~State that for a fly-by-wire aeroplane the automatic pitch-trim system operates also during manual flight.~~	~~X~~							
(07)		Describe the consequences of manual operation on the trim wheel when the automatic pitch-trim system is engaged.	X	X						
(08)		Describe and explain the engagement and disengagement conditions of the autopilot according to trim controls.	X	X						
(09)		Define 'Mach trim' and state that the Mach-trim system can be independent.	X	X						
~~LO (10)~~		~~State that for a fly-by-wire aeroplane an autotrim system can be available for each of the three axes.~~ ~~*Remark: For the fly-by-wire LOs, please refer to reference 21.5.4.0.*~~	~~X~~	~~X~~						
(11)		Describe the implications for the pilot in the event of a runaway trim or significant out-of-trim state.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
022 08 02 00		**Yaw damper: design and operation**								
022 08 02 01		***Design and operation***								
(01)		Explain the purpose of the yaw-damper system.	X	X						
~~LO (02)~~		~~List and describe the main components of a yaw-damper system.~~	~~X~~	~~X~~						
(03)		Explain the purpose of the Dutch-roll filter (filtering of the yaw input signal).	X	X						
(04)		Explain the operation of a yaw-damper system and state the difference between a yaw-damper system and a 3-axis autopilot operation on the rudder channel.	X	X						
022 08 03 00		**Flight-~~e~~Envelope ~~p~~Protection (FEP)**								
022 08 03 01		***Purpose, input parameters, functions***								
(01)		Explain the purpose of the ~~(~~FEP~~)~~.	X	X				X		
(02)		~~List the~~ Explain typical input parameters ~~of~~ to the FEP: — AoA; — aircraft configuration; — airspeed information.	X	X				X		
(03)		Explain the following functions of the FEP: — stall protection~~,~~; — overspeed protection.	X	X				X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(04)		~~State that~~ Explain how the stall-protection function and the overspeed-protection function apply to both mechanical/conventional and FBW~~fly-by-wire~~ control systems, but other functions (e.g. pitch or bank limitation) can only apply to FBW~~fly-by-wire~~ control systems.	X	X				X		
022 09 00 00		**~~AUTO-THROTTLE — AUTOMATIC THRUST CONTROL SYSTEM~~** **AUTOTHRUST – AUTOMATIC THRUST CONTROL SYSTEM**								
022 09 01 00		**Autothrust system**								
022 09 01 01		***Purpose, operation, overcompensation, speed control***								
(01)		~~State~~ Describe the purpose of the ~~auto-throttle (AT)~~ autothrust system and explain how the FMAs will be the only indication on active autothrust modes.	X							
(02)		Explain the operation of an ~~AT~~ autothrust system with regard to the following modes: — take-off/go-around (TOGA); — climb or maximum continuous thrust (MCT), N1 or EPR targeted (THR CLB, THR MCT, N1, THR HOLD, EPR); — speed (SPEED, MCP SPD); — idle thrust (THR IDLE, RETARD/ARM); — landing ~~(‘flare’ or ‘retard’)~~ (RETARD, THR IDLE).	X							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (03)~~		~~Describe the control loop of an AT system with regard to:~~ — ~~inputs: mode selection unit and switches (disengagement and engagement: TO-GA switches), radio altitude, air–ground logic switches;~~ — ~~error detection: comparison between reference values (N1 or EPR, speed) and actual values;~~ — ~~signal processing (control laws of the thrust-lever displacement according to error signal);~~ — ~~outputs: AT servo-actuator;~~ — ~~feedback: Thrust Lever Angle (TLA), data from ADC (TAS, Mach number), engine parameters (N1 or EPR).~~	~~X~~							
(04)		~~State the existence of AT systems where thrust modes are determined by the lever position (no thrust mode panel or thrust rating panel, no TOGA switches).~~ Describe the two main variants of autothrust systems: — mode selections available on the FCU/MCP and thrust levers move with autothrust commands; — mode selections made using the thrust levers which remain static during autothrust operation.		X							
(05)		~~Explain the limitations of an AT system in case of turbulence.~~ Explain how flight in turbulence/wind shear giving fluctuating airspeed indications may lead to the	X								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		autothrust overcompensating in an oscillating manner and that manual thrust may be required to settle the airspeed. Airspeed indications/trend vectors may give an indication of appropriate thrust adjustments but any reaction should not be too aggressive.								
(06)		Explain the threats associated with the use of autothrust resulting in the pilot losing the sense of energy awareness (e.g. speed, thrust).	X							
(07)		Explain the relationship between autopilot pitch modes and autothrust modes and how the autopilot and autothrust will interact upon selecting modes for one of the systems.	X							
(08)		Explain the principles of speed control and how speed can be controlled: — by varying the engine thrust; — by varying the aircraft pitch.	X							
(09)		Explain the potential implications on speed control when the autothrust controls speed and the autopilot pitch channel has a fixed pitch target for the following mode combinations: — MCP SPD/SPEED and ALT HOLD/ALT; — MCP SPD/SPEED and VSP (climb); — MCP SPD/SPEED and VSP (descent).	X							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(10)		Explain the potential implications on speed control when the autothrust has a fixed thrust target and the autopilot pitch channel controls speed for the following mode combinations: — N1/THR CLB and LVL CHG/OP CLB; — ARM/THR IDLE and LVL CHG/OP DES.	X							
022 10 00 00		**COMMUNICATION SYSTEMS**								
022 10 01 00		**Voice communication, data-link transmission**								
022 10 01 01		***Definitions and transmission modes***								
(01)		~~State~~ Describe the purpose of a data-link transmission system.	X		X	X				
(02)		Compare voice communication versus data-link transmission systems.	X		X	X				
(03)		~~State that VHF, HF and SATCOM devices can be used for voice communication and data link transmission.~~ Describe the communication links that are used in aircraft: — high-frequency (HF) communications; — very high-frequency (VHF) communications; — satellite communications (SATCOM).	X		X	X				
(04)		~~State the advantages and disadvantages of each transmission mode with regard to:~~	X		X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Consider the properties of the communication links with regard to: — signal quality; — range/area coverage; — R~~r~~ange; — line-of-sight limitations; — quality of the signal received; — interference due to ionospheric conditions; — data transmission speed.								
~~LO (05)~~		~~State that the satellite communication networks do not cover extreme polar regions.~~	~~X~~							
(06)		~~Define 'downlink and uplink communications'.~~ Define and explain the following terms in relation to aircraft datalink communications: — message/data uplink; — message/data downlink.	X		X	X				
~~LO (07)~~		~~State that a D-ATIS is an ATIS message received by data link.~~	~~X~~							
022 10 01 02		***Systems: a~~A~~rchitecture, design and operation***								
~~LO (01)~~		~~Name the two following data link service providers:~~ — ~~SITA,~~	~~X~~							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— ~~ARINC,~~ ~~and state their function.~~								
(02)		Describe the purpose of the ACARS network.	X							
(03)		~~Describe the two following systems using the VHF/HF/SATCOM data link transmission:~~ — ~~Aircraft Communication Addressing and Reporting System (ACARS);~~ — ~~Air Traffic Service Unit (ATSU).~~ Describe the systems using the ACARS network through the air traffic service unit (ATSU) suite: — aeronautical/airline operational control (AOC); — air traffic control (ATC).	X							
(04)		~~List and describe the following possible onboard components of an ATSU:~~ — ~~communications management unit (VHF/HF/SATCOM);~~ — ~~Data Communication Display Unit (DCDU);~~ — ~~Multi-Control Display Unit (MCDU) for AOC, ATC and messages from the crew (downlink communication);~~ — ~~ATC message visual warning;~~ — ~~printer.~~ Explain the purpose of the following parts of the on-board	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		equipment: — communications computer; — control display unit (CDU)/multifunction control display unit (MCDU); — data communication display unit (DCDU); — ATC message visual annunciator; — printer.								
(05)		Give examples of airline operations communications (AOC) datalink messages such as: — out of the gate, off the ground, on the ground, into the gate (OOOI); — load sheet; — passenger information (connecting flights); — weather reports (METAR, TAF); — maintenance reports (engine exceedances); — aircraft technical data; — free-text messages.	X							
(06)		Give examples of ~~air traffic communications (~~ATC~~)~~ data-link messages such as: — departure clearance; — oceanic clearance; — digital ATIS (D-ATIS);	X							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— controller-pilot data-link communications (CPDLC).								
022 10 02 00		**Future a~~A~~ir n~~N~~avigation s~~S~~ystems (FANSs)**								
022 10 02 01		***Versions, applications, CPDLC messages, ADS contracts***								
(01)		~~State~~ Describe the existence of the ICAO communication, navigation, surveillance/air traffic management (CNS/ATM) concept.	X							
(02)		~~Define and explain the 'FANS concept' (including FANS A and FANS B).~~ Explain the two versions of FANSs: — FANS A/FANS 1 using the ACARS network; — FANS B/FANS 2 using the ACARS network and the aeronautical telecommunication network (ATN).	X							
~~LO (03)~~		~~State that FANS A/FANS 1 uses the ACARS network.~~	~~X~~							
(04)		List and explain the following FANS A/FANS 1 applications: — ATS facility notification (AFN); — automatic dependent surveillance (ADS); — CPDLC.	X							
(05)		Compare the ADS application with the secondary surveillance radar function, and the CPDLC application with VHF communication systems.	X							
(06)		State that an ~~ATC centre~~ ATCU can use the ADS	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		application only, or the CPDLC application only, or both of them (not including AFN).								
(07)		~~Describe a notification phase (LOG ON) and state its purpose.~~ Describe the AFN process for logging on with an ATCU and typical data that will be included in the message.	X							
(08)		~~List the different types of messages of the CPDLC function and give examples of CPDLC data link messages.~~ Describe typical types of CPDLC messages and the typical pilot work practices when requesting or accepting a CPDLC clearance.	X							
(09)		List and describe the different types of ADS contracts that are controlled by the ATCU and beyond the control of the pilot: — periodic: data sent at set time intervals; — on demand: data sent when requested; — on event: data sent when an event occurs (e.g. heading change, climb initiated, etc.);~~.~~ — emergency mode.	X							
~~LO (10)~~		~~State that the controller can modify the 'periodic', 'on demand' and 'on event' contracts or the parameters of these contracts (optional data groups), and that these modifications do not require crew notification.~~	~~X~~							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(11)		~~Describe the 'emergency mode'.~~ Describe the purpose of the ADS emergency mode contract and highlight the difference to the ATCU controlled contracts.	X							
022 11 00 00		**FLIGHT MANAGEMENT SYSTEM (FMS)/FLIGHT MANAGEMENT AND GUIDANCE SYSTEM (FMGS)**								
~~LO~~		~~*Remark: The use of an FMS as a navigation system is detailed in Radio Navigation (062), reference 062 05 04 00.*~~								
022 11 01 00		**Design**								
022 11 01 01		***Purpose, architecture, failures, functions***								
(01)		~~State~~ Explain the purpose of an FMS.	X		X	X		X		
(02)		Describe a typical dual FMS architecture including the following components: — flight management computer (FMC); — CDU/MCDU; — cross-talk bus.	X		X	X				
(03)		~~Describe the different possible configurations of this architecture during degraded modes of operation.~~ Describe the following failures of a dual FMS architecture and explain the potential implications to the pilots:	X		X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		— failure of one FMC; — failure of one CDU/MCDU; — failure of the cross-talk bus.								
(04)		~~List the possible inputs and outputs of an FMS.~~ ~~*Remark: No standard of FMS can be given because the FMS is type specific for aircraft manufacturers and the FMS standard is defined by the airline customer.*~~ Describe how the FMS integrates with other systems and gathers data in order to provide outputs depending on its level of complexity.	X		X	X		X		
~~LO (05)~~		~~Describe the interfaces of the FMS with AFCS.~~	~~X~~		~~X~~	~~X~~				
~~LO (06)~~		~~Describe the interfaces of the FMS with the AT system.~~	~~X~~							
(07)		Explain how the FMS may provide the following functions: — navigation; — lateral and vertical flight planning; — performance parameters.	X	X	X	X		X		
022 11 02 00		~~**Navigation database, aircraft database**~~ **FMC databases**								
~~LO (01)~~		~~Describe the contents and the main features of the navigation database and of the aircraft database: read-only information, updating cycle.~~	~~X~~		~~X~~	~~X~~		~~X~~		

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
~~LO (02)~~		~~Define and explain the 'performance factor'.~~	~~X~~		~~X~~	~~X~~				
022 11 02 01		***Navigation database***								
(01)		Explain the purpose of, and describe typical content of, the navigation database.	X		X	X		X		
(02)		Describe the 28-day aeronautical information regulation and control (AIRAC) update cycle of the navigation database and explain the reason for having two navigation databases (one active, one standby) and the implication this has to the pilot.	X		X	X		X		
(03)		Explain the purpose of typical user-defined waypoints such as: — latitude/longitude coordinates; — place/bearing/distance (PBD); — place/bearing place/bearing (PBX); — place/distance (PD).	X		X	X		X		
(04)		Explain that the pilot cannot change or overwrite any of the data in the navigation database and that any user-defined waypoints, routes and inputted data will be erased when a different database is activated.	X		X	X		X		
(05)		Explain the threats and implications to the pilot of changing the database by error either on the ground or while flying.	X		X	X		X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
022 11 02 02		***Aircraft performance database***								
(01)		Explain the purpose of, and describe the typical content of, the aircraft performance database.	X		X	X		X		
(02)		Explain the importance of verifying that the aircraft performance database is based on the correct data, such as engine type and aircraft variant.	X		X	X		X		
(03)		Explain that the contents of the aircraft performance database cannot be modified by the pilot.	X		X	X		X		
(04)		Explain the purpose of performance factor and how it influences the calculations.	X		X	X		X		
(05)		Explain the purpose of cost index (CI) and how it influences the calculations.	X							
022 11 03 00		**Operations, limitations**								
022 11 03 01		***Data, calculations, position inputs, raw data***								
(01)		~~List and describe data computation and functions including position computations (multisensors), flight management, lateral/vertical navigation and guidance.~~ Describe typical data that may be provided by the FMS: — lateral and vertical navigation guidance; — present position; — time predictions;	X		X	X		X		

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— fuel predictions; — altitude/flight level predictions.								
(02)		~~State the difference between computations based on measured data (use of sensors) and computations based on database information and give examples.~~ Explain how the FMS will use a combination of inputted/database and measured data in order to calculate projections and provide output data.	X		X	X		X		
(03)		Explain the issues and threats using inputted/database data and give examples of consequences of inputting data incorrectly/using incorrect data.	X		X	X		X		
~~LO (03)~~		~~Define and explain the 'Cost Index' (CI).~~	~~X~~							
~~LO (04)~~		~~Describe navigation accuracy computations and approach~~	~~X~~		~~X~~	~~X~~				

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~capability, degraded modes of operation: back-up navigation, use of raw data to confirm position/RAIM function for RNAV procedures.~~								
(04)		~~Describe fuel computations with standard and non-standard configurations including one engine out, landing gear down, flaps, spoilers, use of the anti-icing system, increase of consumption due to an MEL/CDL item, etc.~~ Describe fuel consumption calculations during standard operations and explain typical data that will have an influence on the accuracy of the calculations.	X		X	X				
(05)		Explain the implications on the accuracy of the calculations during flight in abnormal configurations (such as engine out, gear down, flaps extended, spoilers extended, etc.) if the FMS is unable to detect the failure.	X		X	X				
(06)		~~Describe automatic radio navigation and tuning (COMM, NAV).~~ Describe and explain the purpose of an FMS having dedicated radio-navigation receivers that it will tune automatically.	X		X	X				
(07)		Explain typical position inputs to an FMS: — GPS; — IRS;	X		X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— DME; — VOR; — LOC; — runway threshold (RWY THR).								
(08)		Explain how the FMS will create its own FMS position fix and that the FMS calculations will be based on the FMS position. Depending on the type of system, the FMS position may be calculated from: — a single source of position data where the most accurate data available at a given time will be used; — multiple sources from which a position will be derived using the combined inputs.	X		X	X				
(09)		Explain the implications of a reduction in available position inputs to the FMS, especially GPS in relation to the capability of performing RNP/PBN approaches.	X		X	X				
(10)		Explain the difference between following the FMS data compared to following raw data from radio-navigation receivers and describe how there may be limitations for using FMS data as primary source to follow an instrument approach procedure (IAP) such as LOC, VOR or NDB.	X		X	X		X		
022 11 04 00		**Human–machine interface (control display unit (CDU/ multipurpose control display unit (MCDU))**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
022 11 04 01		***Puspose, scratchpad, data input, set-up process***								
~~LO (01)~~		~~Give examples and describe the basic functions of the man–machine interface (MCDU).~~	~~X~~		~~X~~	~~X~~				
(02)		Describe the purpose of a CDU/MCDU.	X		X	X		X		
(03)		Describe the typical layout of a CDU/MCDU and the general purpose of the following: — screen; — line select keys; — menu select keys; — alphanumerical keys.	X		X	X		X		
(04)		Explain the function of the 'scratchpad' part of the screen.	X		X	X		X		
(05)		Describe how input of some data is compulsory for the function of the FMS and other data is optional, and that different symbology is used to highlight this: — rectangular boxes = compulsory information; — dashed line = optional information.	X		X	X		X		
(06)		Describe a typical FMS pre-flight set-up process through the CDU/MCDU to cover the most basic information (with the aim to create awareness of required information as this is irrespective of aircraft type and FMS/FMGS make): — ident page (who am I = aircraft type/variant, engine	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		type/rating and appropriate navigation database); — position initialisation (where am I = position for aligning the IRS and FMS position); — route initialisation (where am I going to = place of departure/destination and alternate(s)); — route programming (how will I get there = SIDs, STARS, route (company or otherwise)); — performance initialisation (when will I arrive = weights, flap setting, FLEX/assumed temperature/derate, take-off speeds).								
022 12 00 00		**ALERTING SYSTEMS, PROXIMITY SYSTEMS**								
022 12 01 00		**General**								
022 12 01 01		***Alerting systems ccording to CS 25 and CS 29***								
(01)		State definitions, category, criteria and characteristics of alerting systems according to CS-25/AM~~J~~C 25.1322 for aeroplanes and CS-29 for helicopters as appropriate.	X	X	X	X	X			
022 12 02 00		**Flight w~~W~~arning s~~S~~ystems (FWSs)**								
022 12 02 01		***Annunciations, master warning, master caution, advisory***								
(01)		~~State the purpose of an FWS and list the typical sources (abnormal situations) of a warning and/or an alert.~~ State the annunciations given by the FWS and typical	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		location for the annunciator(s): — master warning; — master caution; — advisory.								
~~LO (02)~~		~~List the main components of an FWS.~~	~~X~~		~~X~~	~~X~~	~~X~~			
(03)		Explain master warning: — colour of annunciator: red; — nature of aural alerts: continuous; — typical failure scenarios triggering the alert.	X	X	X	X	X	X		
(04)		Explain master caution: — colour of the annunciator: amber or yellow; — nature of aural alerts: attention-getter; — typical failure scenarios triggering the alert.	X	X	X	X	X	X		
(05)		Describe a typical procedure following a master warning or master caution alert: — acknowledging the failure; — silencing the aural warning; — initiating the appropriate response/procedure.	X	X	X	X	X	X		
(06)		Explain advisory: — colour of the annunciator: any other than red, amber, yellow or green;	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— absence of aural alert; — typical scenarios triggering the advisory.								
022 12 03 00		**Stall w~~W~~arning s~~S~~ystems (SWSs)**								
022 12 03 01		***Function, types, components***								
(01)		~~State the function of an SWS.~~ Describe the function of an SWS and explain why the warning must be unique.	X	X						
~~LO (02)~~		~~State the characteristics of an SWS according to CS 25.207(c).~~	~~X~~	~~X~~						
(03)		~~List~~ Describe the different types of SWSs~~stall warning systems~~.	X	X						
(04)		List the main components of an SWS.	X	X						
~~LO (05)~~		~~List the inputs and outputs of an SWS.~~	~~X~~	~~X~~						
(06)		Explain the difference between the stall warning speed and the actual stalling speed of the aeroplane.	X	X						
022 12 04 00		**Stall protection**								
022 12 04 01		***Function, types***								
(01)		~~State~~ Describe the function of a stall protection system.	X							
(02)		~~List~~ Describe the different types of stall protection systems including the difference between mechanical and	X							

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
		FBW~~fly-by-wire~~ controls.								
~~LO (03)~~		~~List the main components of a stall protection system.~~	~~X~~							
~~LO (04)~~		~~List the inputs and outputs of a stall protection system.~~	~~X~~							
(05)		Explain the difference between an SWS ~~stall warning system~~ and a stall protection system.	X							
022 12 05 00		**Overspeed warning**								
022 12 05 01		***Purpose, aural warning, V_{MO}/M_{MO} pointer***								
(01)		Explain the purpose of an overspeed warning system (~~VMO/MMO~~ V_{MO} /M_{MO} pointer).	X	X						
~~LO (02)~~		~~Explain the design of a mechanical VMO/MMO pointer.~~	~~X~~	~~X~~						
(03)		State that for large aeroplanes~~,~~ an aural warning must be associated to the overspeed warning if an electronic display is used (see AMC 25.11, paragraph 10.b(2), p. 2-GEN-22).	X	X						
(04)		Describe and g~~G~~ive examples of ~~VMO/MMO~~ M_{MO} pointer: barber's/barber pole pointer, barber's/barber pole vertical scale.	X	X						
022 12 06 00		**Take-off warning**								
022 12 06 01		***Purpose***								
(01)		~~State~~ Explain the purpose of a take-off warning system and list the typical abnormal situations which generate a	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		warning (see AMC 25.703, paragraphs 4 and 5).								
022 12 07 00		**Altitude alert system**								
022 12 07 01		***Function, displays, alerts***								
(01)		~~State~~ Describe the function of ~~and describe~~ an altitude alert system.	X	X	X	X	X	X		
(02)		~~List and~~ Describe ~~the~~ different types of displays and possible alerts.	X	X	X	X	X	X		
022 12 08 00		**Radio altimeter**								
022 12 08 01		***Purpose, range, displays, incorrect indications***								
(01)		~~State~~ Explain the ~~function~~ purpose of a low-altitude radio altimeter.	X	X	X	X	X	X		
(02)		Describe the principle of the distance (height) measurement.	X	X	X	X	X	X		
~~LO (03)~~		~~State the bandwidth and frequency range used.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(04)		~~List the different components of a radio altimeter and~~ Describe the different types of radio-altimeter displays.	X	X	X	X	X	X		
(05)		~~List the systems using radio-altimeter information.~~ Describe how the radio altimeter provides input to other systems and how a radio-altimeter failure may impact on the functioning of these systems.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(06)		State the range ~~and accuracy~~ of a radio altimeter.	X	X	X	X	X	X		
~~LO (07)~~		~~Describe and explain the cable-length compensation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(08)		Explain the potential implications of an incorrect radio-altimeter indication and how this in particular may affect the following systems: — autothrust; — ground-proximity warning systems (GPWSs).	X	X				X		
022 12 09 00		**Ground-proximity warning systems (GPWSs)**								
022 12 09 01		***GPWSs: design, operation, indications***								
(01)		~~State~~ Explain the purpose of a ~~ground-proximity warning system (~~GPWSs~~)~~.	X		X	X				
~~LO (02)~~		~~List the components of a GPWS.~~	~~X~~		~~X~~	~~X~~				
(03)		~~List the~~ Explain inputs and outputs of a GPWS and describe its operating principle.	X		X	X				
(04)		List and describe the different modes of operation of a GPWS.	X		X	X				
022 12 09 02		***Terrain-~~a~~Avoidance ~~w~~Warning ~~s~~System (TAWS)~~,~~; other name: ~~e~~Enhanced GPWS (EGPWS)***								
(01)		~~State~~ Explain the purpose of a TAWS for aeroplanes and of a HTAWS for helicopters, and explain the difference from a GPWS.	X		X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (02)~~		~~List the components of a TAWS/ HTAWS.~~	~~X~~		~~X~~	~~X~~				
(03)		~~List the~~ Explain inputs and outputs of a TAWS/HTAWS and describe its working principle.	X		X	X				
(04)		Give examples of terrain displays and list the different possible alerts.	X		X	X				
(05)		Give examples of time response left to the pilot according to look-ahead distance, speed and aircraft performances.	X		X	X				
(06)		Explain why the TAWS/HTAWS must be coupled to a precise-position sensor.	X		X	X				
(07)		Explain the possibility of triggering spurious TAWS/HTAWS warnings as a result of mismanaging the flight path in the proximity to obstacles: — high rate of descent; — high airspeed; — a combination of high rate of descent and high airspeed.	X		X	X				
022 12 09 03		~~***Runway awareness and advisory system***~~ ~~(to be introduced at a later date)~~ ***Intentionally left blank***								
~~LO (01)~~		~~Explain that a runway awareness and advisory system is a software upgrade of the existing TAWS (EGPWS) to reduce runway incursions.~~	~~X~~							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
022 12 10 00		**ACAS/TCAS ~~principles and operations~~**	X	X	X	X	X	X		
022 12 10 01		***Principles and operations***								
(01)		State that ACAS II is an ICAO standard for anti-collision purposes.	X	X	X	X	X	X		
~~LO (02)~~		~~State that TCAS II version 7 is compliant with the ACAS II standard.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(03)		Explain that ACAS II is an anti-collision system and does not guarantee any specific separation.	X	X	X	X	X	X		
(04)		Describe the purpose of an ACAS II system as an anti-collision system.	X	X	X	X	X	X		
(05)		~~Define a 'Resolution Advisory' (RA) and a 'Traffic Advisory' (TA)~~ Describe the following outputs from a TCAS: — other intruders; — proximate intruders; — traffic advisory (TA); — resolution advisory (RA).	X	X	X	X	X	X		
(06)		~~State that RAs are calculated in the vertical plane only (climb or descent).~~ State that ACAS II will issue commands in the vertical plane only (climb, descent or maintain), and that the	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		commands are complied with as a manual manoeuvre.								
(07)		~~Explain the difference between a corrective RA and a preventive RA (no modification of vertical speed).~~ Explain that an RA may or may not require any active control input and the implications of reacting instinctively without awareness of actual control inputs required to comply with the RA.	X	X	X	X	X	X		
(08)		Explain that if two aircraft are fitted with ACAS II, the RA will be coordinated.	X	X	X	X	X	X		
(09)		State that ACAS II equipment can take into account several threats simultaneously.	X	X	X	X	X	X		
(10)		State that a detected aircraft without altitude-reporting can only generate a TA; describe typical type of traffic and how this can create distractions during flight in certain areas of significant air traffic activity.	X	X	X	X	X	X		
(11)		~~Describe the TCAS II system in with regard to:~~ Describe the interaction between the TCAS II system and the transponder, radio altimeter and the air-data computer: — A~~a~~ntenna used; — computer and links with radio altimeter, air-data computer and mode-S transponder.	X	X	X	X	X	X		

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
~~LO (12)~~		~~Identify the inputs and outputs of TCAS II.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(13)		Explain the principle of TCAS II interrogations.	X	X	X	X	X	X		
(14)		State ~~that~~ the typical standard detection range for TCAS II: — 35–40 NM horizontally; — approximately 2 000 ft above and below (any setting); — extension to approximately 10 000 ft above (ABV selected) or approximately 10 000 ft below (BLW selected).	X	X	X	X	X	X		
~~LO (15)~~		~~State that the normal interrogation period is 1 second.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(16)		Explain the principle of 'reduced surveillance'.	X	X	X	X	X	X		
(17)		~~Explain that in high-density traffic areas the period can be extended to 5 seconds and the transmission power reduction can reduce the range detection down to 5 NM.~~ Explain that in high-density traffic areas the range may automatically be decreased in order to enable detection of the threats in the proximity of the aircraft due to a limitation of the maximum number of possible intruders the system is able to process.	X	X	X	X	X	X		
(18)		Identify the equipment which an intruder must be fitted with in order to be detected by TCAS II.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(19)		Explain in the anti-collision process: — ~~that~~ the criteria used to trigger an alarm (TA or RA) are the time to reach the closest point of approach (CPA) (called TAU) and the difference of altitude; — ~~that~~ an intruder will be classified as 'proximate' when being less than 6 NM and 1 200 ft from the TCAS-equipped aircraft; — ~~that~~ the time limit to CPA is different depending on aircraft altitude, is linked to a sensitivity level (SL), and state that the value to trigger an RA is from 15 to 35 seconds; — ~~that,~~ in case of an RA, the intended vertical separation varies from 300 to 600 ft (700 ft above FL420), depending on the SL; — ~~that~~ below 1 000 ft above ground, no RA can be generated; — ~~that~~ below 1 450 ft (radio-altimeter value) 'increase descent' RA is inhibited; — ~~that, in~~ at high altitude, performances of the type of aircraft are taken into account to inhibit 'climb' and 'increase climb' RA.	X	X	X	X	X	X		
(20)		List and interpret the following information available from TCAS: — the different possible statuses of a detected aircraft:	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		‘other’, ‘roximate’, ’intruder’; — the appropriate graphic symbols and their position on the horizontal display; — different aural warnings.								
(21)		~~Explain that an RA is presented as a possible vertical speed on a TCAS indicator or on the Primary Flight Display (PFD).~~ Explain the indications of a TA and an RA and how an RA will generate a red area on the VSI. Some variants will also include a green area. To manoeuvre the aircraft to comply with the RA, the pilot should ‘avoid the red’ or ‘fly the green’.	X	X	X	X	X	X		
~~LO (22)~~		~~Describe the possible presentation of an RA on a VSI or on a PFD.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(23)		Explain that the pilot must not interpret the horizontal track of an intruder upon the display.	X	X	X	X	X	X		
022 12 11 00		**Rotor/engine overspeed alert system**								
022 12 11 01		***Design, operation, displays, alarms***								
(01)		Describe the basic design principles, operation, displays and warning/alarm systems fitted to different helicopters.			X	X	X			
022 13 00 00		**INTEGRATED INSTRUMENTS — ELECTRONIC DISPLAYS**								
022 13 01 00		**Electronic display units**								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
022 13 01 01		***Design, limitations***								
(01)		List the different technologies used, e.g. CRT and LCD, and the associated limitations: — cockpit temperature; — glare~~.~~; — resolution.	X	X	X	X	X	X	X	
022 13 02 00		**Mechanical integrated instruments~~: aAttitude and dDirector iIndicator (ADI)/hHorizontal sSituation iIndicator (HSI)~~**								
022 13 02 01		***Attitude and director indicator (ADI)/horizontal situation indicator (HSI)***								
(01)		Describe an ADI and an HSI.	X	X	X	X	X	X	X	
(02)		List all the information that can be displayed on ~~for~~ either instruments.	X	X	X	X	X	X	X	
022 13 03 00		**Electronic f~~F~~light i~~I~~nstrument s~~S~~ystems (EFISs)**								
		~~*Remarks:*~~ ~~*1 — The use of EFIS as navigation display system is also detailed in Radio Navigation (062), reference 062 05 05 02 (EFIS instruments).*~~ ~~*2 — Reference to AMC 25-1322 can be used for aeroplanes only.*~~								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
022 13 03 01		***Design, operation***								
~~LO (01)~~		~~List and describe the different components of an EFIS.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(02)		List the following ~~possible inputs and outputs~~ parts of an EFIS: — control panel~~,~~; — display units~~,~~; — symbol generator~~,~~; — remote light sensor.	X	X	X	X	X	X		
~~LO (03)~~		~~Describe the function of the symbol generator unit.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(04)		Describe the typical layout of the EFIS display units and how there may be a facility to transfer the information from one display unit on to another if a display unit fail.	X	X	X	X	X	X		
(05)		Explain the need for standby instruments to supplement the EFIS in the event of all the display units failing and the challenge of using these standby instruments, namely their size and position on the flight deck.	X	X	X	X	X	X		
(06)		Explain the difference between a symbol generator failing and a display unit failing and the implications if there are redundant symbol generators available.	X	X	X	X	X	X		
(07)		Describe the purpose of an EFIS control panel and typical selections that may be available: — altimeter pressure setting;	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— navigation display (ND) mode selector; — ND range selector; — ND data selector (waypoints, facilities, constraints, data, etc.); — radio-navigation aids selector (VOR 1/2 or ADF 1/2); — decision altitude (DA)/decision height (DH) selection.								
022 13 03 02		***Primary f~~F~~light d~~D~~isplay (PFD), e~~E~~lectronic a~~A~~ttitude d~~D~~irector i~~I~~ndicator (EADI)***								
(01)		~~State~~ Describe that a PFD (or an EADI) presents a dynamic colour display of all the parameters necessary to control the aircraft, and that the main layout conforms with the 'basic T' principle: — attitude information in the centre; — airspeed information on the left; — altitude information on the right; — heading/track indication lower centre;.	X	X	X	X	X	X	X	
~~LO (02)~~		~~List and describe the following information that can be displayed on the PFD unit of an aircraft:~~ — F~~f~~light mode annunciation~~;~~, — basic T~~:~~. ~~• attitude,~~ ~~• IAS,~~ ~~• altitude,~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
		• ~~heading/track indications;~~ — ~~vertical speed;~~ — ~~maximum-airspeed warning;~~ — ~~selected airspeed;~~ — ~~speed-trend vector;~~ — ~~selected altitude;~~ — ~~current barometric reference;~~ — ~~steering indications (FD command bars);~~ — ~~selected heading;~~ — ~~flight path vector (FPV);~~ — ~~radio altitude;~~ — ~~decision height;~~ — ~~ILS indications;~~ — ~~ACAS (TCAS) indications;~~ — ~~failure flags and messages.~~								
~~LO (03)~~		~~List and describe the following information that can also be displayed on the PFD unit of an aeroplane:~~ — T~~t~~ake-off and landing reference speeds; — minimum airspeed; — lower selectable airspeed; — Mach number.	~~X~~							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		Describe the typical design of the attitude information: — artificial horizon with aircraft symbol; — superimposed flight director command bars.	X	X	X	X	X	X	X	
(05)		Describe the typical design of the speed tape: — rolling speed scale with numerical read-out of current speed; — limiting airspeeds according to configuration; — speed trend vector; — bug/indication for selected airspeed.	X	X	X	X	X	X	X	
(06)		Explain the Mach number indications and how a selected Mach number is presented with the speed bug on a corresponding IAS on the speed tape with the Mach number shown as a numerical indication outside the speed tape.	X							
(07)		Describe the typical design of the altitude information: — rolling altitude scale with numerical read-out of current altitude; — altimeter pressure setting; — bug/indication for selected altitude; — means of highlighting the altitude if certain criteria are met.	X	X	X	X	X	X	X	
(08)		Describe the typical design of the heading/track	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		information: — rolling compass scale/rose with numerical read-out of current heading/track. — bug/indication for selected heading/track.								
(09)		Describe the typical design and location of the following information: — flight mode annunciators (FMAs); — vertical speed indicator including TCAS RA command indications; — radio altitude; — ILS localiser/glideslopeand RNP/PBN, GBAS or SBAS ~~or~~ horizontal/vertical flight path deviation indicator; — decision altitude/height (DA/H).	X	X	X	X	X	X	X	
022 13 03 03		***Navigation d~~D~~isplay (ND), e~~E~~lectronic h~~H~~orizontal s~~S~~ituation i~~I~~ndicator (EHSI)***								
(01)		~~State~~ Describe that an ND (or an EHSI) provides a mode-selectable colour flight ND~~navigation display~~.	X	X	X	X	X	X	X	
(02)		List ~~and describe~~ the following four modes typically available to be displayed on an ND unit: — MAP (or ARC)~~,~~; — VOR (or ROSE VOR)~~,~~; — APP (or ROSE LS)~~,~~;	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— PLAN.								
~~LO (03)~~		~~List and explain the following information that can be displayed with the MAP (or ARC) mode on an ND unit:~~ — ~~selected and current track;~~ — ~~selected and current heading (magnetic or true-north reference);~~ — ~~cross-track error;~~ — ~~origin and destination airport with runway selected;~~ — ~~bearings to or from the tuned and selected stations;~~ — ~~active and/or secondary flight plan;~~ — ~~range marks;~~ — ~~ground speed;~~ — ~~TAS and ground speed;~~ — ~~wind direction and speed;~~ — ~~next-waypoint distance and estimated time of arrival;~~ — ~~additional navigation facilities (STA), waypoint (WPT) and airports (ARPT);~~ — ~~weather radar information;~~ — ~~traffic information from the ACAS (TCAS);~~ — ~~terrain information from the TAWS or HTAWS (EGPWS);~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— ~~failure flags and messages.~~								
(03)		List and explain the following information that can be displayed with the MAP (or ARC) mode selected on an ND unit: — aircraft symbol, compass scale and range markers; — current heading and track (either one may be ‘up’ depending on selection), true or magnetic; — selected heading and track; — TAS/GS; — wind direction and speed (W/V); — raw data radio magnetic indicator (RMI) needles/pointers for VOR/automatic direction-finding equipment (ADF), if selected, including the frequency or ident of the selected navigation facility; — route/flight plan data from the FMS; — TO/next waypoint data from the FMS; — data from the navigation database such as airports, waypoints or navigation facilities as selected; — weather radar information; — TCAS traffic information (no TCAS commands); — TAWS (EGPWS) terrain information; — f~~F~~ailure flags and messages.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (04)~~		~~List and explain the following information that can be displayed with the VOR/APP (or ROSE VOR/ROSE LS) mode on an ND unit:~~ — ~~selected and current track;~~ — ~~selected and current heading (magnetic or true north reference)~~ — ~~VOR course or ILS localizer course~~ — ~~VOR (VOR or ROSE VOR mode) or LOC course deviation (APP or ROSE LS);~~ — ~~glide-slope pointer (APP or ROSE LS);~~ — ~~frequency or identifier of the tuned station;~~ — ~~ground speed;~~ — ~~TAS and ground speed;~~ — ~~wind direction and speed;~~ — ~~failure flags and messages.~~	X	X	X	X	X	X		
(04)		List and explain the following information that can be displayed with the VOR or APP (or ROSE VOR or ROSE LS) mode selected on an ND unit: — aircraft symbol and compass scale; — current heading and track (either one may be 'up' depending on selection), true or magnetic; — selected heading and track;	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— TAS/ground speed (GS); — wind direction and speed (W/V); — VOR or ILS frequency and identification of the selected navigation aid; — VOR selected course, deviation indicator and a TO/FROM indicator in a HS-type display format when in VOR mode; — localiser selected course, deviation indicator and glideslope indicator in a HIS-type display format when in APP mode. — weather radar information; — TCAS traffic information (no TCAS commands); — TAWS (EGPWS) terrain information; — failure flags and messages.								
~~LO (05)~~		~~List and explain the following information that can be displayed with the PLAN mode on an ND unit:~~ — ~~selected and current track;~~ — ~~origin and destination airport with runway selected;~~ — ~~active and/or secondary flight plan;~~ — ~~range marks;~~ — ~~ground speed;~~ — ~~TAS and ground speed;~~	~~X~~	~~X~~						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— ~~wind direction and speed;~~ — ~~next-waypoint distance and estimated time of arrival;~~ — ~~additional navigation facilities (STA), waypoint (WPT) and airports (ARPT);~~ — ~~failure flags and messages.~~								
(06)		List and explain the following information that can be displayed with the PLAN mode selected on an ND unit: — north-up compass rose and range markers; — aircraft symbol oriented according to aircraft heading; — TAS/GS; — wind direction and speed (W/V); — route/flight plan data from the FMS; — TO/next waypoint data from the FMS; — data from the navigation database such as airports, waypoints or navigation facilities as selected; — failure flags and messages.	X	X	X	X	X	X		
~~LO (07)~~		~~Give examples of possible transfers between units.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (08)~~		~~Give examples of EFIS control panels.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(09)		Explain the purpose of PLAN mode and it characteristics such as:	X	X	X	X	X	X		

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— no compass information; — north is up on the display unit at all times; — the centre waypoint is the selected waypoint on the FMS CDU; — scrolling through the flight plan on the FMS CDU will shift the map view along the flight path; — the aircraft symbol will be positioned in the appropriate place along the flight path; — using PLAN mode as the primary mode during flight may lead to disorientation and loss of situational awareness.								
(10)		Distinguish the difference between the appearance of an EXPANDED or FULL/ROSE mode and how the displayed range differs between them.	X	X	X	X	X	X		
(11)		Explain the combination of mode and range selection including how selecting the appropriate range and displayed data can improve situational awareness for a given phase of flight.	X	X	X	X	X	X		
022 13 04 00		**Engine parameters, crew warnings, aircraft systems, procedure and mission display systems**								
022 13 04 01		***Purposes of systems, display systems, checklists***								
(01)		State the purpose of the following systems:	X		X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— engine instruments centralised display unit; — crew alerting system/aircraft ~~associated with an and electronic checklist~~ display unit; — facility for appropriate on-screen checklists; — that the aircraft systems display unit enables the display of normal and degraded modes of operation of the aircraft systems~~.~~; — that the systems/aircraft display unit is able to show pictorial systems diagrams/schematics and associated parameters.								
(02)		~~Describe the architecture of each system and give examples of display.~~ Describe the similarities to EFIS with regard to basic system architecture.	X		X	X				
(03)		Give the following different names by which engine parameters, crew warnings, aircraft systems and procedures display systems are known: — m~~M~~ultifunction d~~D~~isplay u~~U~~nit (MFDU); — e~~E~~ngine i~~I~~ndication and c~~C~~rew a~~A~~lerting s~~S~~ystems (EICASs); — e~~E~~ngine and w~~W~~arning d~~D~~isplay (EWD); — e~~E~~lectronic c~~C~~entralised a~~A~~ircraft m~~M~~onitor (ECAM)~~.~~; — systems display (S/D).	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		Give the names of the following different display systems and describe their main functions: — v~~V~~ehicle e~~E~~ngine m~~M~~onitoring d~~D~~isplay (VEMD); — i~~I~~ntegrated i~~I~~nstruments d~~D~~isplay s~~S~~ystem (IIDS).			X	X				
(05)		State the purpose of a mission display unit.			X	X				
(06)		Describe the architecture of each system and give examples of display.			X	X				
(07)		Explain why awareness of the consequences of the actions commanded by the automatic checklist is required.	X		X	X				
(08)		Explain the limited ability of the computer to assess a situation other than using the exceedance of certain thresholds to trigger the main and subsequent events and programmed actions.	X		X	X				
(09)		Describe an appropriate procedure for following an on-screen checklist associated with a failure scenario including the following: — confirm the failure with the other flight crew member prior to performing any of the actions; — seek confirmation prior to manipulating any guarded switches or thrust levers;	X		X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— follow the checklist slowly and methodically; — assess the possible implications of making certain selections, such as opening the fuel cross-feed if there is a fuel leak even though the electronic checklist may ask for the action.								
022 13 05 00		**Engine first limit indicator**								
022 13 05 01		***Design, operation, information on display***								
(01)		Describe the principles of design and operation, and compare the different indications and displays available.			X	X	X			
(02)		Describe what information can be displayed on the screen, when the screen is in the limited ~~screen~~ composite mode.			X	X	X			
022 13 06 00		**Electronic f~~F~~light b~~B~~ag (EFB)** ~~(to be introduced at a later date)~~								
022 13 06 01		***Purpose, certification, malfunctions***								
(01)		Explain the purpose of the EFB and list typical equipment: — computer laptop; — tablet device; — integrated avionics suite in the aircraft.	X	X	X	X	X	X		
(02)		Describe the ‘class’ hardware certification:	X		X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— portable: portable electronic device (PED) that can be used inside or outside the aircraft, is not part of the certified aircraft configuration and does not require tools to remove it from the flight-deck cradle, if one exists; — installed: an electronic device that is considered an aircraft part covered by the aircraft airworthiness approval, thus is a minimum equipment list (MEL) item in the event of failure.								
(03)		Describe the 'type' software certification: — type A: applications whose misuse or malfunctions have no adverse effect on flight safety; — type B: applications for which evaluation of the hazards presented by misuse or malfunctions is required.	X		X	X				
(04)		Explain implications of malfunctions with the EFB installation in a fully electronic flight-deck environment: — mass and balance calculations; — performance calculations; — access to charts; — access to manuals.	X		X	X				
022 13 07 00		**Head up display (HUD), synthetic vision system (SVS) and enhanced visual system (EVS)**	X		X	X				

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
022 13 07 01		***Components, benefits, modes of operation***								
(01)		State the components of a typical HUD installation: — HUD projector and stowable combiner; — HUD controls such as declutter and dimmer; — HUD computer.	X		X	X				
(02)		Explain the reasons and benefits of having an HUD: — increased situational awareness due to reduced need to look inside to view primary flight information; — lower minima for both departure and landing; — improved accuracy of flying thus reduced susceptibility to enter a state of aircraft upset.	X		X	X				
(03)		Describe how the HUD replicates the information on the primary flight display (PFD) by showing the following data: — altitude; — speed, including speed trend; — heading; — flight path vector (track and vertical flight path); — flight mode annunciator (FMA); — CAS, TAWS and wind shear command annunciations.	X		X	X				
(04)		Describe the following modes of operation of an HUD: — normal display mode that may automatically adapt the information based on the phase of flight;	X		X	X				

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— declutter function.								
(05)		Describe the principle of SVS: — an enhanced database used as reference to provide terrain and ground features to be shown on the PFD; — limitations due to being a synthetic image not based on actual sensory information thus not lowering landing minima; — implications if aircraft position accuracy becomes reduced.	X		X	X				
(06)		Describe the principle of EVS: — includes external sensors such as infrared cameras to generate a real-time image on the PFD or on the HUD; — limitation of the fact that an infrared camera uses temperature and temperature difference in order to produce an image; — enables lower minima because of the real-time image, thus enhancing the visibility as experienced by the pilot.	**X**		**X**	**X**				
022 14 00 00		**MAINTENANCE, MONITORING AND RECORDING SYSTEMS**								
~~LO (01)~~		~~State the basic technologies used for this equipment and its performances.~~ ~~_Remark: No knowledge of the applicable operational_~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~*requirements is necessary.*~~								
022 14 01 00		**Cockpit v~~V~~oice r~~R~~ecorder (CVR)**								
022 14 01 01		***Purpose, components, parameters***								
(01)		~~State~~ Describe the purpose of a CVR, its typical location, and explain the implications of knowingly erasing or tampering with any information or equipment.	X	X	X	X	X			
(02)		List the main components of a CVR: — a shock-resistant tape recorder or digital storage associated with an underwater locating ~~device~~ beacon (ULB); — a cockpit area microphone (CAM); — a control unit with the following controls: auto/on, test and erase, and a headset jack~~.~~; — limited flight-deck controls such as erase and test switches.	X	X	X	X	X			
(03)		List the following main parameters recorded on the CVR: — voice communications transmitted from or received on the flight deck; — the aural environment of the flight deck; — voice communication of flight crew members using the aeroplane's interphone system; — voice or audio signals introduced into a headset or	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		speaker; — voice communication of flight crew members using the public address system, ~~when~~ if installed.								
022 14 02 00		**Flight d~~D~~ata r~~R~~ecorder~~s~~ (FDR)**								
022 14 02 01		***Purpose, components, parameters***								
(01)		~~State~~ Describe the purpose of an FDR and its typical location.	X	X						
(02)		List the main components of an FDR: — a shock-resistant data recorder associated with a ULB; — a data interface and acquisition unit; — a recording system (digital flight data recorder); — two control units (start sequence, event mark setting); — limited flight-deck controls, but includes an event switch.	X	X						
(03)		List the following main parameters recorded on the FDR: — time or relative time count; — attitude (pitch and roll); — airspeed; — pressure altitude;	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— heading; — normal acceleration; — propulsive/thrust power on each engine and ~~cockpit~~ flight deck thrust/power lever position, if applicable; — flaps/slats configuration or ~~cockpit~~ flight deck selection; — ground spoilers ~~and/~~or speed brake selection.								
(04)		State that additional parameters can be recorded according to FDR capacity and ~~the~~ applicable operational requirements.	X							
022 14 03 00		**Maintenance and monitoring systems**								
022 14 03 01		***Helicopter o~~O~~perations m~~M~~onitoring p~~P~~rogram~~me~~ (HOMP): design, operation, performance***								
(01)		Describe the HOMP as a helicopter version of the aeroplane f~~F~~light d~~D~~ata m~~M~~onitoring (FDM) program~~me~~s.			X	X				
(02)		State that the HOMP software consists of three integrated modules: — f~~F~~light d~~D~~ata e~~E~~vents (FDEs); — f~~F~~light d~~D~~ata m~~M~~easurements (FDMs); — f~~F~~light d~~D~~ata t~~T~~races (FDTs).			X	X				
(03)		Describe and explain the information flow of an HOMP.			X	X				

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		Describe HOMP operation and management processes.			X	X				
022 14 03 02		***Integrated h~~H~~ealth and u~~U~~sage m~~M~~onitoring s~~S~~ystem (IHUMS): design, operation, performance***								
(01)		Describe the main features of an IHUMS: — rotor system health; — cockpit voice recorder (CVR)/flight data recorder (FDR); — gearbox system health; — engine health; — exceedance monitoring; — usage monitoring; — transparent operation; — ground station features; — ~~exceedance monitoring;~~ — monitoring; — ~~gearbox health;~~ — rotor track and~~&~~ balance; — engine performance trending; — ~~usage monitoring;~~ — quality controlled to level 2.			X	X				
(02)		Describe the ground station features of an IHUMS.			X	X				

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)		Summarise the benefits of an IHUMS including: — reduced risk of catastrophic failure of rotor or gearbox; — improved rotor track and~~&~~ balance giving lower vibration levels; — accurate recording of flight exceedances; — ~~cockpit voice recorder~~ CVR/FDR ~~flight data recorder~~ allows accurate accident /incident investigation and~~&~~ HOMP; — maintenance cost savings.			X	X				
(04)		State the benefits of an IHUMS and an HOMP.			X	X				
022 14 03 03		***Aeroplane c~~C~~ondition m~~M~~onitoring s~~S~~ystem (ACMS): general, design, operation***								
(01)		State the purpose of an ACMS.	X							
(02)		Describe the structure of an ACMS including: — inputs: aircraft systems (such as air conditioning, autoflight, flight controls, fuel, landing gear, navigation, pneumatic, APU, engine), MCDU; — data management unit; — recording unit: digital recorder; — outputs: printer, ACARS or ATSU.	X							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)		State that maintenance messages sent by an ACMS can be transmitted without crew notification.	X							
(04)		Explain that data from the ACMS can be used as part of an FDM and safety programme.	X							
(05)		Explain that the FDM program collects data anonymously; however, grave exceedance of parameters may warrant a further investigation of the event by the operator.	X							
(06)		Explain the purpose of FDM as a system for identifying adverse safety trends and tailoring training programmes in order to enhance the overall safety of the operation.	X							
022 15 00 00		**DIGITAL CIRCUITS AND COMPUTERS**								
022 15 01 00		**Digital circuits and computers~~: gGeneral, definitions and design~~**								
022 15 01 01		***General, definitions and design***								
(01)		Define a 'computer' as a machine for manipulating data according to a list of instructions.	X		X	X		X	X	
~~LO (02)~~		~~List the following main components of a stored-programme ('Von Neumann architecture') on a basic computer:~~ — ~~Central Processing Unit (CPU) including the Arithmetic Logic Unit (ALU) and the control unit;~~ — ~~memory;~~	~~X~~		~~X~~	~~X~~				

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— ~~input and output devices (peripherals);~~ ~~and state their functions.~~								
(03)		~~State the existence of the different buses and their function.~~ Explain the term 'bus' being used as a term for a facility (wiring, optical fibre, etc.) transferring data between different parts of a computer, both internally and externally.	X		X	X		X	X	
(04)		Define the terms 'hardware' and 'software'.	X		X	X		X	X	
~~(05)~~	~~X~~	~~Define and explain the terms 'multitasking' and 'multiprocessing'.~~	~~X~~		~~X~~	~~X~~		~~X~~	~~X~~	
(06)	X	With the help of the relevant 022 references, give examples of airborne computers~~, such as ADC, FMS, GPWS, etc.~~, and list the possible peripheral equipment for each system, such as: — ADC with pitot probe(s), static port(s) and indicators; — FMS with GPS, CDU/MCDU and ND; — GPWS with radio altimeter, ADC and ND.	X		X	X		X	X	
~~LO (07)~~		~~Describe the principle of the following technologies used for memories:~~ — ~~chip circuit,~~ — ~~magnetic disk,~~	~~X~~		~~X~~	~~X~~				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— ~~optical disk.~~								
~~(08)~~		~~Explain the difference in practical use between the following types of memoryies:~~ — ~~volatile memory, requiring electrical power to retain the information,~~ — ~~non-volatile memory, not requiring electrical power to retain the information;.~~	~~X~~		~~X~~	~~X~~		~~X~~	~~X~~	
~~**022 15 02 00**~~		~~**Software: General, definitions and certification specifications**~~								
~~LO (01)~~		~~State the difference between assembly languages, high-level languages and scripting languages.~~	~~X~~		~~X~~	~~X~~				
~~LO (02)~~		~~Define the term 'Operating System' (OS) and give different examples including airborne systems such as FMS or ATSU (for aeroplanes only).~~	~~X~~		~~X~~	~~X~~				
~~LO (03)~~		~~State the existence of 'Software Considerations in Airborne Systems and Equipment Certification' (see document referenced RTCA/DO-178B or EUROCAE ED-12B).~~	~~X~~		~~X~~	~~X~~				
~~LO (04)~~		~~List the specific levels of safety criticality according to the EUROCAE ED-12B document.~~	~~X~~		~~X~~	~~X~~				

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Appendix to Annex I to ED Decision 2018/001/R

'Acceptable Means of Compliance (AMCs) and Guidance Material (GM) to Part-FCL Amendment 4'

Appendix
'SUBJECT 031 — FLIGHT PERFORMANCE AND PLANNING: MASS AND BALANCE — AEROPLANES/HELICOPTERS'
to
AMC1 FCL.310; FCL.515(b); FCL.615(b)
'Theoretical knowledge examinations'
of Annex I

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SUBJECT 031 — FLIGHT PERFORMANCE AND PLANNING: MASS AND BALANCE — AEROPLANES/HELICOPTERS

Note that the term 'mass' is used to describe a quantity of matter, and 'weight' when describing the force. However, the term 'weight' is normally used in aviation to colloquially describe mass. The professional pilot should always note the units to determine whether the term 'weight' is being used to describe a force (e.g. unit newton) or quantity of matter (e.g. unit kilogram).

(1) ~~MASS~~ DEFINITIONS OF MASSES, LOADS AND INDEXES

Allowed take-off mass

The mass taking into consideration all possible limitations for take-off including restrictions caused by regulated take-off mass and regulated landing mass.

Area load or floor load

The load (or mass) distributed over a defined area. ~~Units of measurement used~~ Example units:

— SI: N/m^2, kg/m^2;

— Non-SI: psi, lb/ft^2.

Basic empty mass (BEM)

The mass of an aircraft plus standard items such as: unusable fuel; full operating fluids; fire extinguishers; emergency oxygen equipment. (The lowest mass that is used in FCL exams.)

Dry operating mass (DOM)

The total mass of an aircraft ready for a specific type of operation excluding all usable fuel and traffic load. This mass includes items such as:

— crew and crew baggage;

— catering and removable passenger service equipment (food, beverages, potable water, lavatory chemicals, etc.);

— special operational equipment (e.g. stretchers, rescue hoist, cargo sling).

Dry operating index (DOI)

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The aircraft index at dry operating mass.

Index

An index is a moment reduced in a numerical value by an index formula.

In-flight mass/Gross mass

The mass of an aircraft in flight at a specified time.

Landing mass

The mass of ~~the~~ an aircraft at landing.

Maximum structural in-flight mass with external loads (applicable to helicopters only)

The maximum permissible total mass of the helicopter with external loads.

Maximum structural landing mass

The maximum permissible total mass of ~~the~~ an aircraft at landing under normal circumstances.

Maximum structural mass

The maximum permissible total mass of the aircraft at any time. It will be given only if there is no difference between maximum structural taxi mass, maximum structural take-off mass and maximum structural landing mass.

Maximum structural take-off mass

The maximum permissible total mass of the aircraft at commencement of take-off.

Maximum (structural) taxi mass or maximum (structural) ramp mass

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The maximum permissible total mass of the aircraft at commencement of taxiing.

Maximum zero fuel mass

The maximum permissible mass of an aircraft with no usable fuel.

Minimum mass (applicable to helicopters only)

The minimum permissible total mass for specific helicopter operations.

Operating mass

The dry operating mass plus take-off fuel ~~but without traffic load~~.

Payload

The total mass of passengers, baggage and cargo but excluding any non-revenue load.

Performance-limited landing mass

The mass subject to the destination airfield limitations. ~~It must never exceed the maximum structural limit.~~

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Performance-limited take-off mass

The take-off mass subject to departure airfield limitations. ~~It must never exceed the maximum structural limit.~~

Ramp mass

See 'taxi~~ing~~ mass'.

Regulated landing mass

The lower of performance-limited landing mass and maximum structural landing mass.

Regulated take-off mass

The lower of performance-limited take-off mass and maximum structural take-off mass.

Running (or linear) load

The load (or mass) distributed over a defined length of a cargo compartment irrespective of load width. ~~Units of measurement used~~ Example units:

— SI: N/m, kg/m;

— Non-SI: lb/in, lb/ft.

Take-off fuel

The total amount of usable fuel at take-off.

Take-off mass

The mass of ~~the~~ an aircraft including everything and everyone ~~contained in it~~ carried at the commencement of the take-off for helicopters and take-off run for aeroplanes.

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Taxi mass or ramp mass

The mass of ~~the~~ an aircraft at the commencement of taxiing.

Traffic load

The total mass of passengers, baggage and cargo including any non-revenue load.

Zero fuel mass

The dry operating mass plus traffic load ~~but excluding fuel~~.

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
030 00 00 00		**FLIGHT PERFORMANCE AND PLANNING**								
031 00 00 00		**MASS AND BALANCE — AEROPLANES/HELICOPTERS**								
031 01 00 00		**PURPOSE OF MASS-AND-BALANCE CONSIDERATIONS**								
031 01 01 00		**Mass limitations**								
031 01 01 01		***Importance with regard to structural limitations***								
(01)	X	Describe the relationship between aircraft mass and structural stress. *Remark: See also Subject 021 01 01 00.*	X	X	X	X	X			
(02)	X	Describe why ~~that~~ mass must be limited to ensure adequate margins of strength.	X	X	X	X	X			
031 01 01 02		***Importance with regard to performance*** *Remark: See also ~~S~~subjects 032/034 and 081/082.*								
(01)		Describe the relationship between aircraft mass and aircraft performance.	X	X	X	X	X			
(02)	X	Describe why ~~that~~ aircraft mass must be limited to ensure adequate aircraft performance.	X	X	X	X	X			
~~LO (03)~~		~~Describe that the actual aircraft mass must be known during flight as the basis for performance-related decisions.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
031 01 02 00		**Centre-of-gravity (CG) limitations**								
031 01 02 01		***Importance with regard to stability and controllability*** *Remark: See also ~~S~~subjects 081/082.*								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)	X	Describe the relationship between CG position and stability/controllability of the aircraft.	X	X	X	X	X			
(02)		Describe the consequences if CG is in front of the forward limit.	X	X	X	X	X			
(03)		Describe the consequences if CG is behind the aft limit.	X	X	X	X	X			
031 01 02 02		***Importance with regard to performance*** *Remark: See also ~~S~~subjects 032/034 and 081/082.*								
(01)	X	Describe the relationship between CG position and aircraft performance.	X	X	X	X	X			
(02)		Describe the effects of CG position on performance parameters (speeds, altitude, endurance and range).	X	X	X	X	X			
031 02 00 00		**LOADING**								
031 02 01 00		**Terminology**								
031 02 01 01		***Mass terms***								
(01)	X	Define the following mass terms: — basic empty mass; — dry operating mass; — operating mass; — take-off mass; — landing mass; — ramp/taxi~~ing~~ mass; — in-flight mass (gross mass); — zero fuel mass.	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
031 02 01 02		***Load terms (including fuel terms)*** *Remark: See also S~~s~~ubject 033.*								
(01)	X	Define the following load terms: — payload/traffic load; — block fuel; — taxi~~ing~~ fuel; — take-off fuel; — trip fuel; — reserve fuel (contingency, alternate, final reserve and additional fuel); — extra fuel.	X	X	X	X	X			
(02)		Explain the relationship between the various load-and-mass components listed in 031 02 01 01 and 031 02 01 02.	X	X	X	X	X			
(03)		Calculate the mass of particular components from other given components.	X	X	X	X	X			
(04)		Convert fuel mass, fuel volume and fuel density given in different units used in aviation.	X	X	X	X	X			
031 02 02 00		**Mass limits**								
031 02 02 01		***Structural limitations***								
(01)	X	Define the maximum zero-fuel mass.	X	X						
(02)	X	Define the maximum ramp/taxi~~ing~~ mass.	X							
(03)	X	Define the maximum take-off mass.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (04)~~	~~X~~	~~Maximum in-flight (gross) mass.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(05)	X	Define the maximum in-flight (gross) mass with external load.			X	X	X			
(06)	X	Define the maximum landing mass.	X	X	X	X	X			
031 02 02 02		***Performance and regulated limitations***								
(01)		~~Define~~ Describe the following performance and regulated mass limitations: — performance-limited take-off mass; — performance-limited landing mass; — regulated take-off mass; — regulated landing mass.	X	X	X	X	X			
031 02 02 03		***Cargo compartment limitations***								
~~LO (01)~~		~~Define the following cargo-compartment limitations:~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(02)	X	Describe the m~~M~~aximum floor load (maximum load per unit of area).	X	X	X	X	X			
(03)	X	Describe the m~~M~~aximum running load (maximum load per unit of fuselage length).	X	X	X	X	X			
031 02 03 00		**Mass calculations**								
031 02 03 01		***Maximum masses for take-off and landing***								
(01)		Calculate the maximum mass for take-off (regulated take-off mass) given mass-and-load components and structural/ performance limits.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(02)		Calculate the maximum mass for landing (regulated landing mass) given mass-and-load components and structural/performance limits.	X	X	X	X	X			
(03)		Calculate the allowed mass for take-off.	X	X	X	X	X			
031 02 03 02		***Allowed traffic load and fuel load***								
(01)		Calculate the maximum allowed traffic load and fuel load in order not to exceed the given allowed take-off mass.	X	X	X	X	X			
(02)		Calculate 'under load'/'over load' given the allowed mass for take-off, operating mass and actual traffic load.	X	X	X	X	X			
031 02 03 03		***Use of standard masses for passengers, baggage and crew***								
(01)	X	Extract the appropriate standard masses for passengers, baggage and crew from relevant documents or operator requirements.	X	X	X	X	X			
(02)		Calculate the traffic load by using standard masses.	X	X	X	X	X			
031 03 00 00		~~**FUNDAMENTALS OF CENTRE-OF-GRAVITY CALCULATIONS**~~ **INTENTIONALLY LEFT BLANK**								
~~**031 03 01 00**~~		~~**Definition of Centre of Gravity (CG)**~~								
~~LO (01)~~		~~Define and explain the meaning of 'CG'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~**031 03 02 00**~~		~~**Conditions of equilibrium (balance of forces and balance of moments**~~								
~~LO (01)~~		~~Define 'datum' (reference point), 'moment arm' and 'moment'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~Name the conditions of equilibrium.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~**031 03 03 00**~~		~~**Basic calculations of CG**~~								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (01)~~		~~Resolve numerical problems using the principle of equilibrium of forces and moments.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
031 04 00 00		**MASS-AND-BALANCE DETAILS OF AIRCRAFT**								
031 04 01 00		**Contents of mass-and-balance documentation**								
031 04 01 01		***Datum, moment arm***								
(01)	X	State ~~Name~~ where the datum and moment arms for aircraft can be found.	X	X	X	X	X			
(02)	X	Extract the appropriate data from given documents.	X	X	X	X	X			
(03)	X	Define 'datum' (reference point), 'moment arm' and 'moment'.	X	X	X	X	X			
031 04 01 02		***CG position as distance from datum***								
(01)	X	~~Name~~ State where the CG position for an aircraft at basic empty mass can be found.	X	X	X	X	X			
(02)	X	~~Name~~ State where the CG limits for an aircraft can be found.	X	X	X	X	X			
~~LO (03)~~		~~Extract the CG limits from given aircraft documents.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(04)		Describe ~~State~~ the different forms in presenting CG position as distance from datum or other references.	X	X	X	X	X			
(05)		Explain the meaning of centre of gravity (CG).	X	X	X	X	X			
031 04 01 03		***CG position as percentage of mean aerodynamic chord (% MAC)*** *Remark: Knowledge of the definition of MAC is covered under ~~reference~~ subject 081 01 01 05.*								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		~~Determine~~ Extract ~~%~~ MAC information from aircraft documents.	X	X						
(02)		Explain the principle of using % MAC for the description of the CG position.	X	X						
(03)		Calculate the CG position as % MAC.	X	X						
031 04 01 04		***Longitudinal CG limits***								
(01)		Extract the appropriate data from given sample documents.	X	X	X	X	X			
031 04 01 05		***Lateral CG limits***								
(01)		Extract the appropriate data from given sample documents.			X	X	X			
031 04 01 06		***Details of passenger and cargo compartments***								
(01)		Extract the appropriate data (e.g. seating schemes, compartment dimensions and limitations) from given sample documents.	X	X	X	X	X	~~X~~		
031 04 01 07		***Details of fuel system relevant to mass-and-balance considerations***								
(01)	X	Extract the appropriate data (e.g. fuel-tank capacities and fuel-tank positions) from given sample documents.	X	X	X	X	X	~~X~~		
(02)		Explain and calculate aircraft CG movement as flight progresses, given location of fuel tank (inner wing, outer wing, central, additional aft central, horizontal stabiliser), and mass of fuel consumed from that tank and aeroplane's previous CG~~.~~.	X							
(03)		Explain advantages and risks associated with fuel tanks in the aeroplane's fin or horizontal stabiliser.	X							
031 04 02 00		**Determination of aircraft empty mass and CG position by weighing**								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
031 04 02 01		***Weighing of aircraft (general aspects)***								
(01)		~~Explain~~Describe the general procedure and regulations ~~for weighing of~~ relating to when an aircraft should be reweighed or data recalculated. ~~(conditions, intervals, reasons and requirements for reweighing).~~ *Remark: See the applicable operational requirements.*	X	X	X	X	X			
(02)	X	Extract and interpret entries from/in 'mass (weight) report' of an aircraft.	X	X	X	X	X			
031 04 02 02		***Calculation of mass and CG position of an aircraft using weighing data***								
(01)		Calculate the mass and CG position of an aircraft from given reaction forces on jacking points.	X	X	X	X	X			
031 04 03 00		**Extraction of basic empty mass (BEM) and CG data from aircraft documentation**								
031 04 03 01		***~~Basic empty mass~~ ~~(~~BEM~~)~~ or dry operating mass (DOM)***								
(01)	X	Extract values for BEM and/or DOM from given documents.	X	X	X	X	X			
031 04 03 02		***CG position and/or moment at BEM/DOM***								
(01)		Extract values for CG position and moment at BEM and/or DOM from given documents.	X	X	X	X	X			
031 04 03 03		***Deviations from standard configuration***								
(01)		Extract values from given documents for deviation from standard configuration as a result of varying crew, optional equipment, optional fuel tanks, etc.	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
031 05 00 00		**DETERMINATION OF CG POSITION**								
031 05 01 00		**Methods**								
031 05 01 01		***Arithmetic method***								
(01)		Calculate the CG position of an aircraft by using the formula: CG position = sum of moments / total mass.	X	X	X	X	X			
031 05 01 02		***Graphic method***								
(01)		Determine the CG position of an aircraft by using the loading graphs given in sample documents.	X	X	X	X	X			
031 05 01 03		***Index method***								
(01)	X	Explain the principle of the index method.	X	X	X	X	X			
(02)		Define the terms 'index' ~~'loaded index'~~ and 'dry operating index' (DOI), and calculate the DOI given the relevant formula and data.	X	X	X	X	X			
(03)		Explain ~~State~~ the advantage(s) of the index method.	X	X	X	X	X			
031 05 02 00		**Load and trim sheet**								
031 05 02 01		***General considerations***								
(01)	X	Explain the principle and the purpose of load sheets.	X	X						
(02)	X	Explain the principle and the purpose of trim sheets.	X							
031 05 02 02		***Load sheet/balance schedule and CG envelope for light aeroplanes and for helicopters***								
(01)		Add loading data and calculate masses in a sample load sheet/balance schedule.	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		Calculate moments and CG positions.	X	X	X	X	X			
(03)		Check CG position at zero-fuel mass and take-off mass to be within the CG envelope including last-minute changes, if applicable.	X	X	X	X	X			
031 05 02 03		***Load sheet for large aeroplanes***								
(01)		~~Explain the purpose of load-sheet sections and the methods for establishing~~ Complete a sample load sheet to determine the 'allowed mass for take-off', 'allowed traffic load' and 'under load'.	X							
(02)		Explain the purpose of each load sheet section~~s and the methods for assessing load distribution~~.	X							
(03)		Explain that the purpose of boxed maximum figures in load sheet sections is to ~~and methods for~~ cross-check~~ing~~ the actual and limiting mass values.	X							
(04)		C~~alculate and/or c~~omplete and cross-check a sample load sheet.	X							
031 05 02 04		***Trim sheet for large aeroplanes***								
(01)		Explain the purpose of the trim sheet and the methods to determine the CG position.	X							
(02)		Check ~~that~~ if the zero fuel mass CG and/or index is within the limits.	X							
(03)		Determine the fuel index by using the 'fuel index correction table' and determine the CG position as % MAC.	X							
(04)		Check that the take-off mass CG and/or index are within the limits.	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(05)		Determine 'stabiliser trim units' for take-off.	X							
(06)		Explain the difference between certified and operational CG limits.	X							
(07)		Determine the zero-fuel mass CG or index.	X							
(08)		Explain the relationship between pitch and CG position and the operational significance.	X							
031 05 02 05		***~~Last-minute changes~~Intentionally left blank***								
~~(01)~~		~~Complete a load and trim sheet for last-minute changes.~~	X							
031 05 02 06		***Other methods to present load and trim information***								
(01)	X	Describe and extract information from other methods of presenting load and balance information, e.g. aircraft communications addressing and reporting system (ACARS), electronic flight bags (EFBs), and the 'less paper in the cockpit' (LPC) software.	X							
031 05 03 00		**Repositioning of CG**								
031 05 03 01		***Repositioning of CG by shifting the load***								
(01)		Calculate the mass to be moved over a given distance, or to/from given compartments, to establish a defined CG position.	X	X	X	X	X			
(02)		Calculate the distance to move a given mass to establish a defined CG position.	X	X	X	X	X			

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
(03)	X	Describe the methods to check the cargo has been loaded in correct position in relation to the loading manifest, including identifying hazard of cargo loaded in reverse order (visual inspection of one or more unit load devices (ULDs).	X	X						
(04)		Determine whether CG remains within limits if cargo has been loaded in incorrect order or at incorrect location.	X	X						
031 05 03 02		***Repositioning of CG by additional load or ballast or by load or ballast removal***								
(01)		Calculate the amount of additional load or ballast to be loaded at or removed from a given position or compartment to establish a defined CG position.	X	X	X	X	X			
(02)		Calculate the loading position or compartment for a given amount of additional load or ballast to establish a defined CG position.	X	X	X	X	X			
031 06 00 00		**CARGO HANDLING**								
031 06 01 00		**Types of cargo ~~(general aspects)~~**								
031 06 01 01		***Types of cargo (general aspects)***								
(01)		~~Explain~~ Describe the ~~basic idea of~~ typical types of cargo, e.g. containerised cargo, palletised cargo, bulk cargo, and the advantages of containerised and palletised cargo.	X	X	X	X	X			
031 06 02 00		**Floor-area load and running-load limitations ~~in cargo compartments~~**								
031 06 02 01		***Floor-area load and running-load limitations in cargo compartments***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Calculate the required floor-contact area for a given load to avoid exceeding the maximum permissible floor load of a cargo compartment.	X	X	X	X	X			
(02)		Calculate the maximum mass of a container with given floor-contact area to avoid exceeding the maximum permissible floor load of a cargo compartment.	X	X	X	X	X			
(03)		Calculate the linear load distribution of a container to avoid exceeding the maximum permissible running load.	X	X	X	X	X			
031 06 03 00		**Securement of load**								
031 06 03 01		***Securement of load (reasons and methods)***								
(01)		Explain the reasons to ~~for~~ restraine~~ing~~ or secure~~ing~~ cargo and baggage.~~ having an adequate tie-down of loads.~~	X	X	X	X	X			
(02)		~~Name~~Describe the basic methods ~~for~~ to restraini~~ng~~ or secure~~ing~~ loads (unit load devices secured by latches on roller tracks or to tie down points by straps; bulk cargo restrained by restraining nets attached to attachment points and tie-down points).	X	X	X	X	X			

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Appendix to Annex I to ED Decision 2018/001/R

'Acceptable Means of Compliance (AMCs) and Guidance Material (GM) to Part-FCL Amendment 4'

Appendix
'SUBJECT 032 — FLIGHT PERFORMANCE AND PLANNING — PERFORMANCE — AEROPLANES'
to
AMC1 FCL.310; FCL.515(b); FCL.615(b)
'Theoretical knowledge examinations'
of Annex I

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SUBJECT 032 — FLIGHT PERFORMANCE AND PLANNING — PERFORMANCE — AEROPLANES

Note that the term 'mass' is used to describe a quantity of matter, and 'weight' when describing the force. However, the term 'weight' is normally used in aviation to colloquially describe mass. The professional pilot should always note the units to determine whether the term 'weight' is being used to describe a force (e.g. unit newton) or quantity of matter (e.g. unit kilogram).

~~(1)~~ For theoretical knowledge examination purposes:

— 'c~~C~~limb angle' is assumed to be air-mass-related~~.~~;

— 'f~~F~~light-path angle' is assumed to be ground-related~~.~~;

— 's~~S~~creen height for take-off' is the vertical distance between the take-off surface and the take-off flight path at the end of the take-off distance~~.~~;

— 's~~S~~creen height for landing' is the vertical distance between the landing surface and the landing flight path from which the landing distance begins.

~~(2) For mass definitions, please refer to CHAPTER D (SUBJECT 031 — MASS AND BALANCE).~~

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
030 00 00 00		**FLIGHT PERFORMANCE AND PLANNING**								
032 00 00 00		**PERFORMANCE — AEROPLANES**								
032 01 00 00		**GENERAL**								
032 01 01 00		**Performance legislation**								
032 01 01 01		***Applicability of ~~A~~airworthiness requirements according to CS-23 and CS-25***								
(01)	X	Describe the use of application of of certification specification (CS) with regard to the different kinds of ~~Interpret~~ the ~~European Union airworthiness requirements according to~~ aeroplanes ~~relating to aeroplane performance.~~	X	X						
~~LO (02)~~		~~Interpret the European Union airworthiness requirements according to CS-25 aeroplanes relating to aeroplane performance.~~	X							
(03)	X	Describe ~~Name~~ the general differences between aeroplanes ~~as~~ certified according to CS-23 (CS-23.1, CS-23.3) and CS-25 (CS-25.1, CS-25.20).	X							
032 01 01 02		***Operational regulations and safety***								
(01)	X	Describe the basic concept ~~Interpret~~ that the applicable operational requirements differ depending on ~~related to~~ aeroplane performance.	X	X						
(02)		Describe ~~Name and define~~ the performance classes for commercial air transport~~ation~~ according to the applicable operational requirements.	X	X						
032 01 01 03		***Performance and safety***								

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)	X	State that aeroplane performance required for commercial air transport may limit the weight of a dispatched aeroplane in order to achieve a sufficient level of safety.	X	X						
(02)	X	Describe that the minimum level of safety required for commercial air transport is ensured through the combination of airworthiness requirements and operational limitations, i.e. the more stringent airworthiness requirements of CS-25 enable a wider range of operating conditions for these aeroplanes.	X	X						
032 01 01 04		***Performance definitions and safety factors***								
(01)	X	Describe measured performance and explain how it is determined.	X	X						
(02)		Describe gross performance.	X	X						
(03)		Describe net performance and safety factors.	X	X						
(04)	X	Describe that the size of a safety factor depends on the likelihood of the event and the range of the measured performance data.	X	X						
(05)		Describe the relationship between net and gross take-off and landing distances, and net and gross climb and descent gradients.	X	X						
032 01 02 00		**General performance theory**								
~~032 01 02 01~~		***~~Stages of flight~~ Intentionally left blank***								

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~LO (01)~~		~~Describe the following stages of flight:~~ — ~~take-off;~~ — ~~climbing flight;~~ — ~~level flight;~~ — ~~descending flight;~~ — ~~approach and landing.~~	~~X~~	~~X~~						
032 01 02 02		***Definitions and terms ~~and concepts~~***								
~~LO (01)~~		~~Define ‘steady’ flight.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Resolve the forces during steady climbing and descending flight.~~	~~X~~	~~X~~						
~~LO (03)~~		~~Determine the opposing forces during horizontal steady flight.~~	~~X~~	~~X~~						
~~LO (04)~~		~~Interpret the ‘thrust/power required’ and ’thrust/power available’ curves.~~	X	X						
~~LO (05)~~		~~Describe the meaning of ‘excess thrust and power’ using appropriate graphs.~~	X	X						
~~LO (06)~~		~~Describe the effect of excess thrust and power on speed and/or climb performance.~~	~~X~~	~~X~~						
~~LO (07)~~		~~Calculate the all engine and one-engine out climb gradient from given values of thrust, drag and aeroplane mass.~~	X	X						
~~LO (08)~~		~~Explain climb, level flight and descent performance in relation to the combination of thrust/power available and required.~~	~~X~~	~~X~~						
~~LO (09)~~		~~Describe the difference between a climb angle and gradient.~~	~~X~~	~~X~~						
(10)	X	Define the terms ‘climb angle’ and ‘climb gradient’.	X	X						

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(11)	X	Define the terms 'flight-path angle' and 'flight-path gradient'.	X	X						
(12)	X	Define the terms 'descent angle' and 'descent gradient'.	X	X						
(13)	X	Explain the difference between climb/descent angle and flight-path angle.	X	X						
(14)	X	Define ~~'service' and~~ 'absolute ceiling'.	X	X						
(15)		Describe the ~~terms~~ 'clearway' ~~(CWY)'~~ and 'stopway' ~~(STW)'~~ according to CS-Definitions.	X	X						
(16)		Describe ~~Define the terms~~: — t~~T~~ake-o~~O~~ff r~~R~~un a~~A~~vailable (TORA); — t~~T~~ake-o~~O~~ff d~~D~~istance a~~A~~vailable (TODA); — a~~A~~ccelerate-s~~S~~top d~~D~~istance a~~A~~vailable (ASDA)~~.~~; and determine each from given data or appropriate aerodrome charts.	X	X						
(17)		Describe ~~Define~~ 'screen height' including ~~and list~~ its various values.	X	X						
(18)	X	Define the terms 'range' and 'endurance'.	X	X						
(19)		Define an aeroplane's 's~~S~~pecific r~~R~~ange' (SR) in terms of nautical air miles (NAM) per unit of fuel, and specific range over the ground (SR_G) in terms of nautical ground miles (NGM) per unit of fuel.	X	X						
~~LO (20)~~		~~Define an aeroplane's 'Specific Fuel Consumption (SFC)~~ ~~*Remark: Engine specific fuel consumption is covered in 021.*~~	~~X~~	~~X~~						
(21)		Define the power available and power required.	X	X						
032 01 02 03		***Variables influencing performance***								

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)	X	Name the following factors that affect aeroplane performance~~, in particular~~: pressure altitude and temperature,~~ air density~~, wind, aeroplane weight~~mass~~, aeroplane configuration, aeroplane anti-skid status, aeroplane centre of gravity (CG), aerodrome runway surface, and aerodrome runway slope.	X	X						
(02)	X	Describe how, for different density altitudes, the thrust and power available vary with speed for a propeller-driven aeroplane.	X	X						
(03)	X	Describe how, for different density altitudes, the thrust and power available vary with speed for a turbojet aeroplane.	X							
(04)		Describe how, for different density altitudes, the drag and power required vary with indicated airspeeds (IAS) and true airspeeds (TAS).	X	X						
(05)		Describe how, for different aeroplane weights and configurations, the drag and power required vary with IAS and TAS.	X	X						
032 01 03 00		**Level flight, range and endurance**								
_**032 01 03 01**_		_**Steady level flight**_								
(01)	X	Explain how drag (thrust) and power required vary with speed in straight and level flight.	X	X						
(02)	X	Explain ~~Describe~~ the effect of excess thrust and power on speed in level flight ~~and/or climb performance~~.	X	X						
(03)		Interpret the ‘thrust/power required’ and ‘thrust/power available’ curves in straight and level flight.	X	X						
(04)		Describe how the maximum achievable straight and level flight IAS and TAS vary with altitude.	X	X						

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(05)		Describe situations in which a pilot may elect to fly for ~~Define the cruise procedures~~ 'maximum endurance' or ~~and~~ 'maximum range'.	X	X						
032 01 03 02		***Range***								
(01)		Define a turbojet aeroplane's s~~S~~pecific f~~F~~uel c~~C~~onsumption (SFC) and describe how it affects fuel flow and specific range.	X							
(02)		Define a propeller-driven aeroplane's ~~Specific Fuel Consumption (~~SFC~~)~~ and describe how it affects fuel flow and specific range.	X	X						
(03)		Explain the optimum speed for maximum SR for a turbojet aeroplane in relation to the drag curve.	X							
(04)		Explain the optimum speed to achieve maximum SR for a propeller-driven aeroplane in relation to the power required and drag graphs.	X	X						
(05)		Explain the effect of aeroplane weight and CG position on fuel consumption, range and the optimum speed for maximum SR.	X	X						
(06)		State ~~Define aeroplane~~ how a turbojet engine's ~~Specific Fuel Consumption (~~SFC~~)~~ varies with temperature and thrust.	X							
(07)		Explain how SR for a turbojet aeroplane varies with altitude and under different meteorological conditions.	X							
(08)		Explain how SR_G for a propeller-driven aeroplane varies with altitude and under different meteorological conditions.	X	X						
(09)		Explain the effect of weight~~ mass~~ on the optimum altitude for maximum range.	X	X						
(10)		Describe the effect of wind on SR_G and the optimum speed for SR_G, when compared to SR and the optimum speed for SR.	X	X						

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
032 01 03 03		***Maximum endurance***								
(01)		Explain fuel flow in relation to TAS and thrust for a turbojet aeroplane.	X							
(02)		State ~~Find~~ the speed for maximum endurance for a turbojet aeroplane.	X							
(03)		Explain fuel flow in relation to TAS and thrust for a propeller-driven aeroplane.	X	X						
(04)		State ~~Find~~ the speed for maximum endurance for a propeller-driven aeroplane and the disadvantages of holding at this speed (e.g. high angle of attack (AoA) and lack of speed stability).	X	X						
(05)		Explain the effect of wind and altitude on endurance, and the maximum endurance speed for a turbojet aeroplane.	X							
(06)		Explain the effect of wind and altitude on endurance, and the maximum endurance speed for a propeller-driven aeroplane.	X	X						
(07)		Describe the benefits of managing your en-route airspeed to reduce or avoid holding time, and the operational situations when it could be used (commanded by the pilot or air traffic control (ATC), when delays at arrival airport occur).	X	X						
032 01 04 00		**Climbing**								
032 01 04 01		***Climbing (climb performance)***								
(01)		Resolve the forces during a steady climb~~ing and descending flight~~.	X	X						

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Syllabus	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL/ IR**	**ATPL**	**CPL**			
(02)		Define and explain the following terms: — critical engine; — speed for best angle of climb (V_X); — speed for best rate of climb (V_Y).	X	X						
(03)		Explain climb~~, level flight and descent~~ performance in relation to the ~~combination of~~ thrust~~/power~~ available and thrust required (angle of climb), and power available and power required (rate of climb).	X	X						
(04)		Explain ~~Describe~~ the meaning and effect of ‘excess thrust’ and ‘excess power’ in a steady climb.	X	X						
(05)		Interpret the ‘thrust/power required’ and ‘thrust/power available’ curves in a steady climb.	X	X						
(06)		~~Describe~~ State the difference between ~~a~~ climb angle and gradient.	X	X						
(07)		Explain the effect of weight ~~mass~~ on the climb angle and rate of climb and the speed for best angle and best rate of climb.	X	X						
(08)		Explain the effects of ~~temperature, wind~~ pressure altitude and temperature, including an inversion on climb performance (angle and rate of climb).	X	X						
(09)		Explain the effect of configuration on climb performance (angle and rate of climb, and V_X and V_Y).	X	X						
(10)		Describe the effect of engine failure on ~~take-off~~ climb performance (angle and rate of climb, and V_X and V_Y).	X	X						

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(11)		Calculate the all-engine- out and one-engine-out climb gradient from given values of engine thrust and aeroplane drag and ~~aeroplane~~ weight~~mass~~.	X	X						
032 01 05 00		**Descending**								
032 01 05 01		***Descending (descent performance)***								
(01)		Resolve the forces during steady ~~climbing and~~ descent~~ding flight~~ and in the glide.	X	X						
(02)		Explain ~~climb, level flight and~~ descent performance in relation to ~~the combination of~~ thrust~~/power~~ available and thrust required (drag), and power available and power required.	X	X						
(03)		Explain ~~Describe~~ the meaning of ‘excess thrust required’ (excess drag) and ‘excess power required’ in a steady descent.	X	X						
(04)		Interpret the ‘thrust/power required’ and ‘thrust/power available’ curves in a steady descent.	X	X						
(05)		Explain the effect of mass, altitude, wind, speed and configuration on the glide descent.	X	X						
(06)		Explain the effect of mass, altitude, wind, speed and configuration on the powered descent.	X	X						
032 02 00 00		**CS-23/EU OPS PERFORMANCE CLASS B — THEORY ~~SINGLE-ENGINE AEROPLANES~~**								
032 02 01 00		**Airworthiness requirements ~~and definitions of speeds used~~**								
032 02 01 01		***Airworthiness requirements and definitions***								

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)	X	Define the following ~~to~~ speeds ~~according CS-23~~: — stall speeds V_S, V_{S0} and V_{S1}; — rotation speed V_R; — speed at 50 ft above the take-off surface level; — reference landing speed V_{REF}.	X	X						
(02)		Describe the limitations on V_R, on the speed at 50 ft above the take-off surface and on V_{REF}, and given the appropriate stall speed, estimate the values based on these limitations for a single-engine, class B aeroplane.	X	X						
(03)		Describe the limitations on V_R, on the speed at 50 ft above the take-off surface and on V_{REF}, and given the appropriate stall speed, estimate the values based on these limitations for a multi-engine, class B aeroplane.	X	X						
(04)	X	Describe ~~Interpret~~ the European Union airworthiness requirements according to CS-23 relating to aeroplane performance (CS-23 SUBPART A — GENERAL, PERFORMANCE, CS-23.45 to 23.78 inclusive).	X	X						
(05)		Define and identify the critical engine of a multi-engine propeller aeroplane.	X	X						
(06)		Explain the effect of ~~the critical engine inoperative~~ an engine failure on the power required, ~~and~~ the total drag (thrust required) and climb performance of a multi-engine aeroplane.	X	X						
(07)		Explain the effect of engine failure on the minimum control speed ~~controllability~~ of a multi-engine aeroplane under given conditions (temperature and pressure altitude).	X	X						

FOR INFORMATION ONLY

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~032 02 02 00~~		**~~Effect of variables on single-engine aeroplane performance~~ Intentionally left blank**								
~~LO (01)~~		~~Explain the effect of the wind component on take-off and landing performance.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Determine the regulatory factors for take-off and landing according to the applicable operational requirements.~~	~~X~~	~~X~~						
~~LO (03)~~		~~Explain the effects of temperature, wind and altitude on climb performance.~~	~~X~~	~~X~~						
~~LO (04)~~		~~Explain the effects of altitude and temperature on cruise performance~~.	~~X~~	~~X~~						
~~LO (05)~~		~~Explain the effects of mass, wind, and speed on descent performance.~~	X	X						
032 02 03 00		**Take-off and landing**								
032 02 03 01		***Take-off and landing (definitions and effects)***								
~~LO (01)~~		~~Interpret the take-off and landing requirements according to EUOPS~~	X	X						
(02)	X	Define the following distances and masses: — take-off distance; — landing distance; — ground-roll distance; — maximum allowed take-off mass; — maximum allowed landing mass.	X	X						

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(03)		Explain the effect of flap-setting on the take-off, landing and ground-roll distances.	X	X						
(04)		Explain the effects of the following runway (RWY) variables on take-off distances: — RWY slope; — RWY surface conditions: dry, wet and contaminated; — RWY elevation.	X	X						
(05)		For both fixed-pitch propeller aeroplanes and constant speed propeller aeroplanes, explain the effect of airspeed on thrust during the take-off run.	X	X						
(06)		Describe ~~Explain~~ the effects of brake release before take-off power is set on the TOD~~A~~ and ASD~~A~~.	X	X						
(07)		Explain the effect of wind on take-off and landing distances and determine the actual headwind/tailwind component given the runway direction, wind speed and direction, by use of wind component graphs, mathematical calculations, and rule of thumb.	X	X						
(08)		Explain why an aeroplane has maximum crosswind limit(s) and determine the crosswind component given the runway direction, wind speed and direction, by use of wind component graphs, mathematical calculations, and rule of thumb.	X	X						
(09)		Explain the percentage of accountability for headwind and tailwind components during take-off and landing calculations.	X	X						
(10)		Explain the effect of runway conditions on the landing distance.	X	X						

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(11)		Explain the effects of pressure altitude and temperature on the take-off distance, take-off climb, landing distance and approach climb.	X	X						
(12)		Describe the landing airborne distance and ground-roll distance and estimate the effect on the landing distance when the aeroplane is too fast or too high at the screen.	X	X						
(13)		Describe the net take-off flight path (NTOFP) for a multi-engine, class B aeroplane.	X	X						
(14)		Describe the dimensions of the NTOFP accountability area (domain).	X	X						
032 02 04 00		**Climb, cruise and descent**								
032 02 04 01		***Climb, cruise and descent (requirements and calculations)***								
~~LO (01)~~		~~Explain the effects of the different recommended power settings on range and endurance.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Explain the effects of wind and altitude on maximum endurance speed.~~	~~X~~	~~X~~						
(03)		Describe the climb and en-route requirements according to the applicable operational requirements.	X	X						
(04)		For a single-engine aeroplane, calculate the expected obstacle clearance (in visual meteorological conditions (VMC)) given gross climb performance, obstacle height and distance from reference zero.	X	X						
(05)		For a single-engine aeroplane, calculate the net glide gradient and net glide distance, given aeroplane altitude, terrain elevation, gross gradient or lift/drag ratio (L/D ratio), and headwind or tailwind component.	X	X						

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~032 02 05 00~~		**~~Use of aeroplane performance data~~**								
~~032 02 05 01~~		***~~Take-off~~***								
~~LO (01)~~		~~Find the minimum or maximum wind component.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Find the take-off distance and ground-roll distance.~~	~~X~~	~~X~~						
~~LO (03)~~		~~Find the take-off speed.~~	~~X~~	~~X~~						
~~032 02 05 02~~		***~~Climb~~***								
~~LO (01)~~		~~Find the maximum rate-of-climb speed.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Find the time, distance and fuel to climb.~~	~~X~~	~~X~~						
~~LO (03)~~		~~Find the rate of climb.~~	~~X~~	~~X~~						
~~032 02 05 03~~		***~~Cruise~~***								
~~LO (01)~~		~~Find power settings, cruise true airspeed (TAS) and fuel consumption.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Find range and endurance.~~	~~X~~	~~X~~						
~~032 02 05 04~~		***~~Landing~~***								
~~LO (01)~~		~~Find the and/or minimum or maximum wind component.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Find the landing distance and ground-roll distance.~~	~~X~~	~~X~~						
032 03 00 00		**CS-23/EU-OPS PERFORMANCE CLASS B — USE OF AEROPLANE PERFORMANCE DATA FOR SINGLE- AND MULTI-ENGINE AEROPLANES**								
032 03 01 00		**~~Definitions of terms and speeds~~ Intentionally left blank**								

FOR INFORMATION ONLY

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~LO (01)~~		~~Define and explain the following terms:~~ — ~~critical engine;~~ — ~~speed for best angle of climb (V_X);~~ — ~~speed for best rate of climb (V_Y).~~	~~X~~	~~X~~						
~~LO (02)~~		~~Explain the effect of the critical engine inoperative on the power required and the total drag.~~	~~X~~	~~X~~						
~~LO (03)~~		~~Explain the effect of engine failure on controllability under given conditions.~~	~~X~~	~~X~~						
032 03 02 00		**~~Effect of variables on multi-engine aeroplane performance~~ Intentionally left blank**								
~~032 03 02 01~~		***~~Take-off and landing~~***								
~~LO (01)~~		~~Explain the effect of flap-setting on the ground-roll distance.~~	~~X~~	~~X~~						
~~LO (02)~~		~~For both fixed and constant speed propellers, explain the effect of airspeed on thrust during the take-off run.~~	~~X~~	~~X~~						
~~LO (03)~~		~~Explain the effect of pressure altitude on performance-limited take-off mass.~~	~~X~~	~~X~~						
~~LO (04)~~		~~Explain the effect of runway conditions on the take-off distance.~~	~~X~~	~~X~~						
~~LO (05)~~		~~Determine the regulation factors for take-off according to the applicable operational requirements.~~	~~X~~	~~X~~						
~~LO (06)~~		~~Explain the percentage of accountability for headwind and tailwind components during take-off and landing calculations.~~	~~X~~	~~X~~						
~~LO (07)~~		~~Interpret obstacle clearance at take-off.~~	~~X~~	~~X~~						

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Syllabus	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL/ IR**	**ATPL**	**CPL**			
~~LO (08)~~		~~Explain the effect of selected power settings, flap settings and aeroplane mass on the rate of climb.~~	X	X						
~~LO (09)~~		~~Describe the effect of engine failure on take-off climb performance.~~	~~X~~	~~X~~						
~~LO (10)~~		~~Explain the effect of brake release before take-off power is set on the take-off and accelerate-stop distance.~~	~~X~~	~~X~~						
~~032 03 02 02~~		***~~Climb, cruise and descent~~***								
~~LO (01)~~		~~Explain the effect of CG on fuel consumption.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Explain the effect of mass on the speed for best angle and best rate of climb.~~	~~X~~	~~X~~						
~~LO (03)~~		~~Explain the effect of temperature and altitude on fuel flow.~~	~~X~~	~~X~~						
~~LO (04)~~		~~Explain the effect of wind on the maximum range speed and speed for maximum climb angle.~~	~~X~~	~~X~~						
~~LO (05)~~		~~Explain the effect of mass, altitude, wind, speed and configuration on glide descent.~~	X	X						
~~LO (06)~~		~~Describe the various cruise techniques.~~	~~X~~	~~X~~						
~~LO (07)~~		~~Describe the effect of loss of engine power on climb and cruise performance.~~	~~X~~	~~X~~						
~~032 03 02 03~~		***~~Landing~~***								
~~LO (01)~~		~~Explain the effect of runway conditions on the landing distance.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Determine the regulatory factors for landing according to the applicable operational requirements.~~	X	X						
032 03 03 00		**Use of aeroplane performance data**								

FOR INFORMATION ONLY

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
032 03 03 01		***Take-off***								
~~LO (01)~~		~~Find take-off field-length data.~~	~~X~~	~~X~~						
(02)		~~Calculate~~ Determine the field-length-limited take-off mass and take-off speeds, given de-factored distance, configuration, pressure altitude, temperature and headwind/tailwind component.	X	X						
(03)		Determine ~~Find~~ the accelerate-go distance and ~~as well the~~ accelerate-stop distance data.	X	X						
(04)		Determine ~~Find~~ the ground-roll distance and take-off distance from graphs.	X	X						
~~LO (05)~~		~~Calculate the maximum effort take-off data.~~	~~X~~	~~X~~						
(06)		Determine ~~Calculate~~ all-engine- and critical-engine-out take-off climb data.	X	X						
(07)		Determine ~~Calculate~~ NTOFP ~~obstacle clearance take-off climb data~~ for a MEP aeroplane of given mass and given airfield conditions, and calculate the obstacle clearance based on the NTOFP.	X	X						
(08)		Determine ~~Find~~ the minimum headwind or maximum tailwind ~~wind~~ component required for take-off for a given mass and airfield conditions.	X	X						
(09)		Given take-off run available (TORA), TODA and ASDA, slope and surface conditions, calculate the de-factored distance to be used for commercial air transport, using the appropriate take-off graphs.	X	X						
(10)		Calculate the minimum TORA or TODA for commercial air transport, given the de-factored take-off distance or run, runway surface and slope.	X	X						

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
032 03 03 02		***Climb***								
(01)		Determine ~~Find~~ rate of climb ~~and climb gradient~~.	X	X						
~~LO (02)~~		~~Calculate single engine service ceiling.~~	~~X~~	~~X~~						
(03)		Calculate obstacle clearance climb data.	X	X						
(04)		Determine the still-air and flight-path gradients for given IAS, altitude, temperature, aeroplane weight and, if relevant, wind component.	X	X						
032 03 03 03		***~~Cruise and descent~~ Intentionally left blank***								
~~LO (01)~~		~~Find power settings, cruise true airspeed (TAS) and fuel consumption.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Calculate range and endurance data.~~	~~X~~	~~X~~						
032 03 03 04		***Landing***								
(03)		~~Find landing field-length data.~~ Determine the field-length-limited landing mass and landing speeds, given de-factored distance, configuration, pressure altitude, temperature and headwind or tailwind component.	X	X						
(04)		Determine ~~Find~~ landing climb data in the event of balked landing.	X	X						
(05)		Determine ~~Find~~ landing distance and ground-roll distance for given flap position, aeroplane weight and airfield data.	X	X						
~~LO (06)~~		~~Find short-field landing distance and ground-roll distance.~~	~~X~~	~~X~~						

FOR INFORMATION ONLY

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(07)		Calculate, given the landing distance available (LDA), slope and surface type and condition, the de-factored distance to be used for commercial air transport, using the appropriate landing graphs.	X	X						
(08)		Calculate the minimum landing distance (LD) that must be available for commercial air transport, given the de-factored landing distance, runway surface and slope.	X	X						
032 04 00 00		**CS-25/EU-OPS PERFORMANCE CLASS A — THEORY**								
032 04 01 00		**Take-off**								
~~(01)~~	~~X~~	~~Explain the essential forces affecting the aeroplane during the take-off run.~~	~~X~~							
~~(02)~~	~~X~~	~~State the effects of thrust-to-weight ratio and flap-setting on ground roll.~~	~~X~~							
032 04 01 01		***Take-off performance, ~~D~~definitions of and relationships between ~~of~~ terms ~~used~~***								
(01)	X	Explain the ~~essential~~ forces affecting the aeroplane during the take-off run.	X							
(02)	X	State the effects of thrust-to-weight ratio and flap-setting on ground roll.	X							
(03)		Describe the European Union airworthiness requirements according to CS-25 relating to aeroplane performance general aeroplane and take-off (SUBPART B — FLIGHT PERFORMANCE: CS25.101 to CS-25.109 inclusive, and CS-25.113).	X							

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~(01)~~(04)		Describe ~~Define~~ the terms 'a~~A~~ircraft c~~C~~lassification n~~N~~umber' (ACN)~~'~~ and 'p~~P~~avement c~~C~~lassification n~~N~~umber' (PCN)~~'~~, and the requirements and hazards of operating on aerodrome surfaces with PCNs less than an ACN.	X							

FOR INFORMATION ONLY

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~(02)~~(05)		Define and explain the following speeds in accordance with CS-25 or CS-Definitions: — reference stall speed (V_{SR}); ~~— reference stall speed in the landing configuration (V_{SR0});~~ — reference stall speed in a specific configuration (V_{SR1}); — 1-g stall speed at which the aeroplane can develop a lift force (normal to the flight path) equal to its weight (V_{S1g}); — minimum control speed with critical engine inoperative (V_{MC}); — minimum control speed on or near the ground (V_{MCG}); — minimum control speed at take-off climb (V_{MCA}); — engine failure speed (V_{EF}); — take-off decision speed (V_1); — rotation speed (V_R); — minimum take-off safety speed (V_{2MIN}); — minimum unstick speed (V_{MU}); — lift-off speed (V_{LOF}); — maximum brake energy speed (V_{MBE}); — maximum tyre speed ($V_{Max\ Tyre}$)~~;~~. ~~— reference landing speed (V_{REF});~~ ~~— minimum control speed, approach and landing (V_{MCL}).~~	X							
~~(03)~~(06)		Explain the interdependence between the above-mentioned speeds where relevant ~~if there is any~~.	X							

FOR INFORMATION ONLY

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
~~(04)~~(07)		Define the following distances in accordance with CS-25: — take-off run with all engines operating and one-engine-inoperative; — take-off distance with all engines operating and one-engine-inoperative; — accelerate-stop distance with all engines operating and one-engine-inoperative.	X							
~~(05)~~ (08)		Explain how loss of TORA due to alignment is accounted for.	X							
~~LO (06)~~		~~Define the term 'Aeroplane-Specific Fuel Consumption (ASFC)'.~~ ~~*Remark: Engine-specific fuel consumption is covered in subject 021.*~~	~~X~~							
~~(07)~~ (09)		Explain the effect of the interdependency of relevant speeds in 032 04 01 01 (05) and the situations in which these independencies can cause speed and performance restrictions.	X							
032 04 01 02		***Take-off distances***								
(01)		Explain the effects of the following runway (RWY) variables on take-off distances: — RWY slope; — RWY surface conditions: dry, wet and contaminated; — RWY elevation.	X							

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(02)		Explain the effects of the following aeroplane variables on take-off distances~~s~~: — aeroplane mass; — take-off configuration; — bleed-air configurations.	X							
(03)		Explain the effects of the following meteorological variables on take-off distances: — wind; — temperature; — pressure altitude.	X							
(04)		Explain the consequence ~~influence~~ of errors in rotation technique on take-off distance: — early and late rotation; — too high and too low rotation angle; — too high and too low rotation rate.	X							
(05)		~~Explain~~ Compare the take-off distances for specified conditions and configuration for all engines operating and one-engine-inoperative.	X							
(06)		Explain the effect of using clearway on the ~~take-off distance required~~ field-length-limited take-off mass.	X							
(07)		Explain the influence of aeroplane mass, air density and flap settings on V_1 and V_{2MIN} and thereby take-off distance.	X							
~~LO (08)~~		~~Explain the time interval allowed for between engine failure and recognition when assessing the TOD.~~	~~X~~							

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(09)		Explain the effect of an error in~~ miscalculation of~~ V_1 on the resulting one-engine-out take-off distance ~~required~~.	X							
032 04 01 03		***Accelerate-stop distance***								
(01)		Explain how the accelerate-stop distance is affected by given ~~for specified~~ conditions and configuration for all engines operating and one-engine-inoperative.	X							
(02)		Explain the effect of using a stopway on the ~~accelerate-stop distance required~~ field-length-limited take-off mass.	X							
(03)		Explain the effect of an error in ~~miscalculation of~~ V_1 on the resulting accelerate-stop distance ~~required~~.	X							
(04)		Explain the effect of runway slope or wind component on the accelerate-stop distance.	X							
(05)		Explain how the ~~additional time allowance for~~ accelerate-stop distance is determined ~~allowance determination~~ and discuss the deceleration procedure.	X							
(06)		Explain how the accelerate-stop distance is affected by the use of brakes, anti-skid, ~~use of~~ reverse thrust, ground spoilers ~~or~~ (lift dumpers) —and by brake energy absorption limits, delayed temperature rise and brake temperature indication ~~and tyre limitations~~.	X							
(07)	X	Explain the hazards of rejecting a take-off from high ground speed or high take-off mass, and how to manage these hazards.	X							
032 04 01 04		***Balanced field length concept***								
(01)	X	Define the term 'balanced field length'.	X							

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(02)		Describe ~~Understand~~ the relationship between take-off distance and accelerate-stop distance and identify on a diagram the balanced field length and balanced V_1 ~~when using a balanced field~~.	X							
(03)	X	Describe the applicability of a balanced field length.	X							
032 04 01 05		***Unbalanced field length concept***								
~~LO (01)~~		~~Define the term 'unbalanced field length'.~~	~~X~~							
(02)	X	Describe the applicability of an unbalanced field length.	X							
(03)		Explain the effect of ~~a~~ additional stopway on the allowed take-off mass and appropriate V_1 when using an unbalanced field.	X							
(04)		Explain the effect of ~~a~~ additional clearway on the allowed take-off mass and appropriate V_1 when using an unbalanced field.	X							
032 04 01 06		***Field ~~Runway~~ length-~~l~~Limited ~~t~~Take-~~o~~Off ~~m~~Mass (F~~R~~LLTOM)***								
(01)		~~Define~~ Explain the factors that affect the ~~runway length limited take-off mass~~FLLTOM~~for balanced and unbalanced field length~~;	X							
(02)		Explain the concept of a 'range of V_1' and explain reasons for the placement of the designated V_1 towards the faster or slower end of the range.	X							
032 04 01 07		***Contaminated runways***								
(01)		Define a 'contaminated runway', ~~a 'damp runway',~~ a 'wet runway', and a 'dry runway'.	X	X						

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(02)		Describe ~~List~~ the different types of contamination: ~~damp,~~ wet or water patches, rime or frost-covered, dry snow, wet snow, slush, ice, compacted or rolled snow, frozen ruts or ridges. ***Source:*** **~~(~~ICAO Annex 15, Appendix 2~~)~~**	X	X						
(03)	X	Identify the difference between friction coefficient and estimated surface friction. ***Source:*** **~~(~~ICAO Annex 15, Appendix 2~~)~~**	X	X						
(04)		State that when friction coefficient is 0.40 or higher, the expected braking action is good. ***Source:*** **~~(~~ICAO Annex 15, Appendix 2~~)~~**	X	X						
(05)		Define the different types of hydroplaning. ***Source****:* **~~(~~NASA TM-85652/Tire friction performance/pp. 6 to 9~~)~~**	X	X						
(06)		~~Calculate~~ ~~Compute~~ Explain the difference between the two dynamic hydroplaning speeds and state which of them is the most limiting for an aircraft operating on a wet runway ~~using the following formulas:~~ ~~Spin-down speed (rotating tire) (kt) = 9 square root (pressure in PSI).~~ ~~Spin-up speed (non-rotating tire) (kt) = 7.7 square root (pressure in PSI).~~ ***Source:*** **~~(~~NASA TM-85652/Tire friction performance /p. 8~~)~~**	X	X						
~~(07)~~		~~State that it is the spin-up speed rather than the spin-down speed which represents the actual tire situation for aircraft touchdown on flooded runways.~~ ~~(NASA TM-85652/Tire friction performance/p. 8)~~	~~X~~	~~X~~						

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(08)		State that some wind limitations may apply in case of contaminated runways. Those limitations are to be found in Part B of the Operations Manual — Limitations.	~~X~~	~~X~~						
(09)		State that the procedures associated with take-off and landing on contaminated runways are to be found in Part B of the Operations Manual — Normal procedures.	~~X~~	~~X~~						
(10)		State that the performance~~s~~ associated with contaminated runways is~~are~~ to be found in Part B of the Operations Manual — Performance.	~~X~~	~~X~~						
032 04 01 0~~7~~8		***Take-off climb***								
~~LO (01)~~		~~Define the segments of the actual take-off flight path.~~	~~X~~							
(02)		Explain the difference between the flat-rated and non-flat-rated part in performance charts.	X							
~~LO (03)~~		~~Determine the changes in the configuration, power, thrust and speed in the take-off flight-path segments.~~	~~X~~							
(04)		State ~~Determine~~ the differences in climb-gradient requirements for two-, three- and four-engined aeroplanes.	X							
~~LO (05)~~		~~State the maximum bank angle when flying at V_2.~~	~~X~~							
(06)		Explain the effects of aeroplane configuration and meteorological conditions on the take-off climb.	X							
~~LO (07)~~		~~Describe the influence of airspeed selection, acceleration and turns on the climb gradients, best rate-of-climb speed and best angle-of-climb speed.~~	~~X~~							

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(08)		Determine the climb-limited take-off mass.	X							
032 04 01 0~~8~~9		***Obstacle-limited take-off***								
(01)		Describe the operational regulations for obstacle clearance in the net take-off flight path (NTOFP).	X							
(02)		Define the actual and NTOFP~~net take-off flight path~~ with one-engine-inoperative in accordance with CS-25.	X							
(03)		Explain ~~Determine~~ the effects of aeroplane configuration and meteorological conditions on the ~~determination of~~ obstacle-limited take-off mass.	X							
~~LO (04)~~		~~Determine the obstacle-limited take-off mass~~	X							
(05)		Describe ~~Define~~ the segments of the actual take-off flight path.	X							
(06)		Describe ~~Determine~~ the changes in the configuration, power, thrust and speed in the NTOFP ~~flight path~~ climb segments.	X							
(07)		State the standard maximum bank angle(s) in the first and second segment, ~~when flying at V_2,~~ and determine the effect on the stall speed and implication on V_2.	X							
(08)		Explain ~~Describe~~ the influence of airspeed selection, acceleration and turns on the climb gradient~~s, best rate-of-climb speed and best angle-of-climb speed~~.	X							
(09)		Describe the European Union airworthiness requirements according to CS-25 relating to aeroplane performance take-off climb and flight path (SUBPART B — FLIGHT PERFORMANCE: CS-25.111, CS-25.115, CS-25.117 and CS-25.121)	X							

TE INFORMATION ONLY

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
032 04 01 ~~09~~10		***Performance-limited take-off mass (PLTOM) and regulated take-off mass ~~weight~~ (RTOM) tables***								
(01)		Define PLTOM~~performance-limited take-off mass~~ and RTOM.	X							
(02)	X	Describe the use of RTOM tables or similar to find PLTOM and how this can also be done using an EFB.	X							
(03)		Interpret what take-off limitation (field length, obstacle, climb, structural, etc.) is restricting a particular RTOM as it is presented in RTOM tables or similar.	X							
(04)		Describe why data from an EFB can from ~~to~~ data derived from RTOM tables or similar.	X							
032 04 01 ~~10~~11		***Take-off performance on wet and contaminated runways***								
(01)		Explain the differences between the take-off performance determination on a wet or contaminated runway and on a dry runway.	X							
(02)		Describe a wet V_1 and explain the consequences of using a wet V_1.	X							
(03)		Describe the hazards, effects and management of operating from a contaminated runway.	X							
(04)		Describe displacement drag, impingement drag, and methods to monitor acceleration.	X							
(05)		Explain the benefits and implications of using a derated take-off on a contaminated runway.	X							
032 04 01 ~~11~~12		***Use of reduced (flexible or flex) and derated thrust***								

FOR INFORMATION ONLY

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)		Explain the advantages and disadvantages of using reduced (flex) and derated thrust.	X							
(02)		Explain the difference between and principles behind reduced (flex) and derated thrust.	X							
(03)		Explain when reduced (flex) and derated thrust may and may not be used.	X							
(04)		Explain the effect of using reduced (flex) and derated thrust on take-off performance including take-off speeds, take-off distance, climb performance and obstacle clearance.	X							
(05)		Explain the assumed temperature method for determining reduced (flex) thrust performance.	X							
032 04 01 ~~12~~13		***Take-off performance using different take-off flap settings***								
(01)		Explain the advantages and disadvantages of using different take-off flap settings to optimise the performance-limited take-off mass.	X							
(02)		Determine the optimum flap position and PLTOM from given figures.	X							
032 04 01 ~~13~~14		***Take-off performance using increased V_2 speeds ('improved climb performance')***								
(01)		Explain the advantages and disadvantages of the ~~using~~ increased V_2 ~~speeds~~ procedure.	X							
(02)		Explain under what circumstances this procedure can be used.	X							
(03)		Explain the hazards of the fast V_1 and V_{LOF} speeds associated with the increased V_2 procedure and how they can be managed.	X							
032 04 01 ~~14~~15		***Brake-energy and tyre-speed limit***								

FOR INFORMATION ONLY

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)		Explain the effects on take-off performance of brake-energy and tyre-speed limits.	X							
(02)		Explain under what ~~which~~ conditions ~~this~~ they are more likely to become~~s~~ limiting.	X							
~~032 04 01 15~~		***~~Use of aeroplane flight data~~***								
~~LO (01)~~		~~Determine the maximum masses that satisfy all the regulations for take-off from the aeroplane performance data sheets.~~	~~X~~							
~~LO (02)~~		~~Determine the relevant speeds for specified conditions and configuration from the aeroplane performance data sheets.~~	~~X~~							
032 04 02 00		**Climb**								
032 04 02 01		***Climb techniques***								
(01)		Explain the effect of climbing ~~with~~ at constant IAS on: — TAS; — Mach number; — climb gradient; — rate of climb.	X							
(02)		Explain the effect of climbing ~~with~~ at constant Mach number on: — TAS; — IAS; — climb gradient; — rate of climb.	X							

FOR INFORMATION ONLY

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(03)		Explain the correct sequence of climb speeds for turbojet transport aeroplanes.	X							
(04)		Determine the effect on TAS when climbing in and above the troposphere at constant Mach number. ~~Explain the term 'cross over altitude' which occurs during the climb speed schedule (IAS–Mach number). x~~	X							
032 04 02 02		***Influence of variables on climb performance***								
~~LO (01)~~		~~Explain the effect of aeroplane mass on the rate of climb (ROC).~~								
~~LO (02)~~		~~Explain the effect of meteorological variables on ROC.~~								
~~(03)~~		~~Explain the effect of aeroplane acceleration during a climb with constant IAS or Mach number.~~	~~X~~							
(04)		Explain the effect on the operational speed limit when climbing at constant IAS and at constant Mach number.	X							
(05)		Explain the term 'crossover altitude' which occurs during the climb speed schedule (IAS–Mach number).	X							
~~***032 04 02 03***~~		~~***Use of aeroplane flight data***~~								
~~LO (01)~~		~~Explain the term 'cross over altitude' which occurs during the climb speed schedule (IAS–Mach number).~~	~~X~~							
~~LO (02)~~		~~Calculate the time to climb.~~	~~X~~							
032 04 03 00		**Cruise**								
032 04 03 01		~~***Cruise techniques***~~ ***Intentionally left blank***								

FOR INFORMATION ONLY

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~LO (01)~~		~~Define the cruise procedures 'maximum endurance' and 'maximum range'.~~	X							
032 04 03 02		***~~Maximum endurance~~ Intentionally left blank***								
~~LO (01)~~		~~Explain fuel flow in relation to TAS and thrust.~~	~~X~~							
~~LO (02)~~		~~Find the speed for maximum endurance.~~	~~X~~							
032 04 03 03		***~~Maximum range~~ Intentionally left blank***								
~~LO (01)~~		~~Define the term 'maximum range'.~~	~~X~~							
032 04 03 04		***Long-range cruise***								
(01)		Define the term 'long-range cruise'.	X							
(02)		Explain differences between flying at the speed for long range and maximum range with regard to fuel-flow and speed stability.	X							
032 04 03 05		***~~Influence of variables on cruise performance~~ Intentionally left blank***								
~~LO (01)~~		~~Explain the effect and CG position and actual mass of aircraft on range and endurance.~~	~~X~~							
~~LO (02)~~		~~Explain the effect of altitude on range and endurance.~~	~~X~~							
~~LO (03)~~		~~Explain the effect of meteorological variables on range and endurance.~~	~~X~~							
032 04 03 06		***Cruise altitudes***								
(01)	X	Define the term 'optimum altitude'.	X							
(02)		Explain the factors that~~which~~ affect the ~~choice of~~ optimum altitude.	X							

FOR INFORMATION ONLY

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(03)		Explain the factors that can ~~which might~~ affect or limit the maximum operating altitude.	X							
(04)		Explain the purpose of, and operational reasons for, a step climb and when a climb would be initiated for optimum range. ~~Explain the advantages and restriction necessity for step climbs~~	X							
(05)		Describe the buffet onset boundary (BOB) and determine the high- and low-speed buffet (speed/Mach number only). ~~high and low-speed buffet (speed/Mach number only).~~.	X							
(06)		Analyse the influence of bank angle, mass and the 1.3g buffet margin on a step climb.	X							
(07)		Describe that the high-speed buffet can occur at speeds slower or faster than M_{MO}.	X							
(08)		Explain the reasons why a step climb may not be used (e.g. for short sectors, advantageous winds, avoiding turbulence and due to traffic restrictions).	X							
032 04 03 07		***Cost ~~i~~Index (CI)***								
(01)		Describe ~~the Define the term~~ 'cost index'.	X							
(02)		Describe ~~Understand~~ the reason for economical cruise speed.	X							
(03)		Describe the effect of cost index on climb, cruise and descent speeds.	X							
~~***032 04 03 08***~~		~~***Use of aeroplane flight data***~~								

FOR INFORMATION ONLY

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~LO (01)~~		~~Determine the all-engines operating power settings and speeds from the aeroplane performance data sheets for:~~ — ~~maximum range;~~ — ~~maximum endurance;~~ — ~~high-speed and normal cruise;~~ — ~~high and low-speed buffet (speed/Mach number only).~~	X							
~~LO (02)~~		~~Determine the selection of cruise technique considering cost indexing and passenger requirements against company requirements.~~	X							
~~LO (03)~~		~~Determine the fuel consumption from the aeroplane performance data sheets for various cruise configurations, holding, approach and transit to an alternate in normal conditions and after an engine failure.~~	~~X~~							
032 04 04 00		**En-route one-engine-inoperative**								
032 04 04 01		***Drift down***								
(01)		Describe the determination of en-route flight-path data with one-engine-inoperative in accordance with CS 25.123.	X							
(02)		Describe ~~Determine~~ the minimum obstacle-clearance height prescribed in the applicable operational requirements.	X							
(03)		Describe ~~Define~~ the optimum speed that the pilot should select during drift down.	X							
(04)		Explain the influence of deceleration on the drift-down profiles.	X							

FOR INFORMATION ONLY

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
032 04 04 02		***Influence of variables on the en-route one-engine-inoperative performance***								
(01)		Describe and explain ~~Identify~~ the factors which affect the en-route net drift-down flight path.	X							
~~***032 04 04 03***~~		~~***Use of aeroplane flight data***~~								
~~LO (01)~~		~~Find one-engine-out and given highest obstacle and data the heaviest mass that service ceiling, range and endurance from given engine inoperative charts.~~	~~X~~							
~~LO (02)~~		~~Determine the one-engine out net drift~~	~~X~~							
~~LO (03)~~		~~Find the maximum continuous power/thrust settings from given engine inoperative charts.~~	~~X~~							
032 04 05 00		**Descent**								
032 04 05 01		***Descent techniques***								
(01)		Explain the effect of descending at constant Mach number.	X							
(02)		Explain the effect of descending at constant IAS.	X							
(03)		Explain the correct sequence of descent speeds for turbojet transport aeroplanes.	X							
(04)		Determine the effect on TAS when descending in and above the troposphere at constant Mach number.	X							
(05)		Describe the following limiting speeds for descent: — maximum operating speed (V_{MO}); — maximum Mach number (M_{MO}).	X							

FOR INFORMATION ONLY

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(06)		Explain the effect of a descent at constant Mach number on the margin to low- and high-speed buffet.	X							
032 04 05 02		***~~Influence of variables on descent performance~~Energy management in the descent***								
~~LO (01)~~		~~Explain the influence of mass, configuration and altitude on rate of descent and glide angle.~~	~~X~~							
(02)		Explain the advantages and principle of a continuous descent.	X							
(03)	X	Describe energy management in terms of chemical, potential and kinetic energy.	X							
(04)		Describe the effect of increasing/decreasing headwind and tailwind on profile management.	X							
(05)		Describe the effect of the Mach number to IAS transition (speed conversion) on profile management.	X							
(06)		Describe situations during the descent and approach in which a pilot could find an aeroplane high or fast, and explain how the pilot can manage descent angle/excess energy.	X							
~~032 04 05 03~~		***~~Use of aeroplane flight data~~***								
~~LO (01)~~		~~Determine the following information for all-engines operating and one engine inoperative from the aeroplane performance data sheets:~~ — ~~descent rates;~~ — ~~time and distance for descent;~~ — ~~fuel used during descent.~~	X							

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
032 04 06 00		**Approach and landing**								
032 04 06 01		***Approach requirements***								
(01)		Describe the CS-25 requirements for the approach climb (CS-25.121).	X							
(02)		Describe the CS-25 requirements for the landing climb.	X							
(03)		Explain the effect of temperature and pressure altitude on approach and landing-climb performance.	X							
032 04 06 02		***Landing-field-length and landing-speed requirements***								
(01)	X	Describe the landing distance determined according to CS-25.125 ('demonstrated' landing distance).	X							
(02)		Describe ~~Recall~~ the landing-field-length requirements for dry, wet and contaminated runways and the applicable operational requirements.	X							
(03)	X	Define the 'l~~L~~anding d~~D~~istance a~~A~~vailable' (LDA)~~'~~.	X							
(04)		Define and explain the following speeds in accordance with CS-25 or CS-Definitions: — reference stall speed in the landing configuration (V_{SR0}); — reference landing speed (V_{REF}); — minimum control speed, approach and landing (V_{MCL}).	X							
032 04 06 03		***Influence of variables on landing performance***								

FOR INFORMATION ONLY

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)		Explain the effect of runway slope, surface conditions and wind on the maximum landing mass for a given ~~runway length~~ landing distance available in accordance with the applicable operational requirements.	X							
(02)		Explain the effect on landing distance and maximum allowable landing mass of the following devices affecting deceleration: — ~~deceleration;~~ — reverse; — anti-skid; — ground spoilers or lift dumpers; — autobrakes.	X							
(03)		Explain the effect of temperature and pressure altitude on the maximum landing mass for a given ~~runway length~~ landing distance available.	X							
(04)		Explain the effect of hydroplaning on landing distance required and methods of managing landing on contaminated or wet runways.	X							
032 04 06 04		***Quick turnaround limit***								
~~032 04 06 04~~ (01)		~~Define the 'quick turnaround limits' and explain their purpose~~ Describe how break temperature limits the turnaround times.	X							
~~032 04 06 05~~		***~~Use of aeroplane flight data~~***								
~~LO (01)~~		~~Determine the field length required for landing with a given landing mass from the aeroplane performance data sheets in accordance with the applicable operational requirements.~~	~~X~~							

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~LO (02)~~		~~Determine the landing and approach climb-limited landing mass from the aeroplane performance data sheets.~~	~~X~~							
~~LO (03)~~		~~Determine the landing-field length-limited landing mass from the aeroplane performance data sheets.~~	~~X~~							
~~LO (04)~~		~~Find the structural-limited landing mass from the aeroplane performance data sheets.~~	~~X~~							
~~LO (05)~~		~~Calculate the maximum allowable landing mass as the lowest of:~~ — ~~approach climb and landing climb-limited landing mass;~~ — ~~landing-field length-limited landing mass;~~ — ~~structural-limited landing mass.~~	~~X~~							
~~LO (06)~~		~~Determine the maximum quick turnaround mass and time under given conditions from the aeroplane performance data sheets.~~	~~X~~							
~~LO (07)~~		~~Determine the limiting landing mass in respect of PCN.~~	~~X~~							
032 05 00 00		**CS-25/EU-OPS PERFORMANCE CLASS A — USE OF AEROPLANE PERFORMANCE DATA**	X							
032 05 01 00		**Take-off**								
032 05 01 01		***Take-off (performance data)***								
(01)		Determine from given graphs the field-lenght-limited take-off mass (FLLTOM) and describe situations in which this limitation could be most restrictive for take-off.	X							
(02)		Determine from given graphs the climb-limited take-off mass and describe situations in which this limitation could be most restrictive for take-off.	X							

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(03)		Determine from given graphs the obstacle-limited mass and describe situations in which this limitation could be most restrictive for take-off.	X							
(04)		Determine from given graphs the tyre-speed limited take-off mass.	X							
(05)		Determine from given graphs the maximum brake-energy-limited take-off mass.	X							
(06)		Determine the take-off V speeds for the actual take-off mass.	X							
(07)		Determine the maximum take-off mass using given RTOM tables.	X							
(08)		Using RTOM tables determine the take-off V speeds for the actual take-off weight using appropriate corrections.	X							
(09)		Determine the assumed/flex temperature and take-off V speeds using the RTOM tables.	X							
(10)		Calculate the break cooling time following a rejected take-off given appropriate data.	X							
032 05 02 00		**Drift down and stabilising altitude**								
032 05 02 01		***Drift down and stabilising altitude (performance data)***								
(01)		Determine the ~~Find~~ one-engine-out ~~service~~ net stabilising altitude (level-off altitude) from given graphs/tables ~~service ceiling, range and endurance from given engine inoperative charts~~.	X							
(02)		Determine the maximum mass at which the net stabilising altitude with one-engine-out clears the highest relevant obstacle by the required clearance margin.	X							

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Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(03)		Determine, using drift-down graphs, fuel used, time and distance travelled in a descent from a cruise flight level to a given altitude.	X							
032 05 03 00		**Landing**								
032 05 03 01		***Landing (performance data)***								
(01)		Determine the field length required for landing with a given landing mass from the aeroplane performance data sheets ~~in accordance with the applicable operational requirements~~.	X							
(02)		Determine the landing and approach climb-limited landing mass from the aeroplane performance data sheets.	X							
(03)		Calculate the maximum allowable landing mass as the lowest of: — approach-climb- and landing-climb-limited landing mass; — landing-field-length-limited landing mass; — structural-limited landing mass.	X							
(04)		Determine the ~~maximum quick turnaround mass~~ brake cooling time for different landing masses ~~under given conditions from~~ using the aeroplane performance data sheets.	X							
~~(05)~~		~~Determine the maximum 'quick turnaround mass'.~~	~~X~~							

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Appendix to Annex I to ED Decision 2018/001/R

'Acceptable Means of Compliance (AMCs) and Guidance Material (GM) to Part-FCL Amendment 4'

Appendix
'SUBJECT 033 — FLIGHT PERFORMANCE AND PLANNING — FLIGHT PLANNING AND MONITORING'
to
AMC1 FCL.310; FCL.515(b); FCL.615(b)
'Theoretical knowledge examinations'
of Annex I

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This document is meant purely as a documentation tool and EASA does not assume any liability for its contents.

FOR INFORMATION ONLY

SUBJECT 033 — FLIGHT PERFORMANCE AND PLANNING — FLIGHT PLANNING AND MONITORING

General Student Pilot Route Manual (GSPRM)

This document shall be referred to as the General Student Pilot Route Manual (GSPRM) and should contain as a minimum:

1. a table of contents and a list of effective pages;
2. introduction with the instrument flight rules (IFR) charts' legends;
3. 1:500 000 visual flight rule (VFR) aeronautical chart of Germany;
4. en-route low- and high-altitude IFR charts to cover the airspace above all EU Member States plus Norway, Switzerland, Liechtenstein and the Balkans;
5. en-route high-altitude chart of the North Pole (a polar stereographic projection) to illustrate current polar routes;
6. a plotting chart of the North Atlantic (with information on extended range operations with two-engined aeroplanes (ETOPS));
7. area, aerodrome/heliport, aerodrome ground movement, standard instrument departure (SID), standard instrument arrival (STAR) and instrument approach charts (IACs) for Alicante Elche, Amsterdam Schiphol, Dubrovnik Čilipi, London Heathrow, Nantes/Atlantique, Santorini and Stuttgart for aeroplane operations, and Aberdeen, De Kooy and Tromso for helicopter operations;
8. microwave landing system (MLS) approach chart for Galbraith Lake Alaska;
9. an example of a completed air traffic service (ATS) flight plan (with instructions on how to complete it), including the ICAO model flight plan form;
10. introduction with the VFR charts' legends, aerodrome directories for Croatia, France, Germany, Spain and United Kingdom, and area, aerodrome/heliport and visual approach charts (VACs) for Aberdeen Dyce, Alicante Elche, Dubrovnik Čilipi, Friedrichshafen, Gloucestershire and Nantes/Atlantique.

The charts should have a frozen date (e.g. 01.01.2017), and be reissued on a regular basis (e.g. every 4–5 years).

The charts listed above will form the basis for the questions in licensing examinations.

There will be no obligation for any student or approved training organisation (ATO) to buy, use or issue the GSPRM (nor will it have any other subject-matter material in it), but the content will be the basis for charts which may appear in Part-FCL exams. Any chart provider (Lido, Jeppesen, Navtech, etc.) may provide the GSPRM, but the students will not be expected to learn non-ICAO standard symbology or chart requirements.

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SUBJECT 033 — FLIGHT PERFORMANCE AND PLANNING — FLIGHT PLANNING AND MONITORING

~~(1) For mass definitions, please refer to Chapter D.~~
Note that the term ‘mass’ is used to describe a quantity of matter, and ‘weight’ when describing the force. However, the term ‘weight’ is normally used in aviation to colloquially describe mass. The professional pilot should always note the units to determine if the term ‘weight’ is being used to describe a force (e.g. unit newton) or quantity of matter (e.g. unit kilogram).

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
030 00 00 00		**FLIGHT PERFORMANCE AND PLANNING**								
033 00 00 00		**FLIGHT PLANNING AND MONITORING**								
033 01 00 00		**FLIGHT PLANNING FOR VFR FLIGHTS** *Remark: Using the GSPRM ~~training route manual~~ VFR charts ~~or the European Central Question Bank (ECQB) annexes.~~*								
033 01 01 00		**VFR navigation plan**								
033 01 01 01		***~~Routes, airfields, heights and altitudes from VFR charts~~*** ***Airspace, communication, visual and radio-navigation data from VFR charts***								
(01)		Select routes ~~and altitudes~~ taking the following criteria into account: — classification of airspace; — ~~controlled airspace;~~ — ~~uncontrolled airspace;~~ — restricted areas;	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		— ~~minimum safe altitude;~~ — VFR semicircular rules; — visually conspicuous points; — radio-navigation aids.								
~~LO (02)~~		~~Calculate the minimum pressure or true altitude from minimum grid-area altitude using OAT and QNH.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~Calculate the vertical and/or horizontal distance and time to climb to a given level or altitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (04)~~		~~Calculate the vertical and/or horizontal distance and time to descend from a given level or altitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(05)		Find the frequenc~~y~~ies ~~and/~~or identifiers of radio navigation aids from charts.	X	X	X	X	X			
(06)		Find the communication frequencies and call signs for the following: — control agencies and service facilities; — f~~F~~light i~~I~~nformation s~~S~~ervice~~s~~ (FIS); — weather information stations; — a~~A~~utomatic t~~T~~erminal i~~I~~nformation s~~S~~ervice (ATIS).	X	X	X	X	X			
033 01 01 02		***Planning ~~C~~courses, distances and cruising levels ~~from~~ with VFR charts***								
(01)		Choose visual waypoints in accordance with specified criteria (large, unique, contrast, vertical extent, etc.).	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		Measure courses and distances from a VFR chart. ~~Calculate, or obtain from the chart, courses and distances.~~	X	X	X	X	X			
(03)		Find the highest obstacle within a given distance on either side of the course.	X	X	X	X	X			
(04)		Find the following data from ~~the~~ a VFR chart and transfer them to ~~the~~ a navigation plan: — waypoints ~~and/~~or turning points; — distances; — true/magnetic courses.	X	X	X	X	X			
(05)		Calculate the minimum pressure altitude with a given obstacle clearance or true altitude from a given altitude or pressure altitude from minimum grid-area altitude using outside air temperature (OAT) and QNH.	X	X	X	X	X			
(06)		Calculate the vertical ~~and/~~or horizontal distance and time to climb or descend to/from a given level or altitude with given data.	X	X	X	X	X			
(07)		Explain how to determine the position of a significant VFR point for insertion into a global navigation satellite system (GNSS) flight plan, using the distance and bearing from an existing significant point and using coordinates.	X	X	X	X	X			
033 01 01 03		***Aerodrome charts and aerodrome directory***								
(01)	X	Explain the reasons for studying the visual departure procedures and the available approach procedures.	X	X	X	X	X			
(02)		Find all visual procedures which can be expected at the	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		departure, destination and alternate ~~airfields~~aerodromes.								
(03)		Find all relevant aeronautical and regulatory information required for VFR flight planning ~~the following data~~ from aerodrome the charts or aerodrome directory~~:~~. — ~~aerodrome regulations and opening hours;~~ — ~~terrain high points and man-made structures;~~ — ~~altitudes;~~ — ~~courses and radials;~~ — ~~helipads (for helicopters only);~~ — ~~any other relevant information.~~	X	X	X	X	X			
~~***033 01 01 04***~~		~~***Communications and radio-navigation planning data***~~								
~~LO (01)~~		~~Find the communication frequencies and call signs for the following:~~ — ~~control agencies and service facilities;~~ — ~~Flight Information Services (FIS);~~ — ~~weather information stations;~~ — ~~Automatic Terminal Information Service (ATIS).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~Find the frequency and/or identifier of the appropriate radio-navigation aids.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
033 01 01 05		***Completion of navigation plan***								
~~LO (01)~~		~~Complete the navigation plan with the courses and distances as taken from charts.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (02)~~		~~Find the departure and arrival routes.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~Determine the position of Top of Climb (TOC) and Top of Descend (TOD) from given appropriate data~~.	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (04)~~		~~Determine variation and calculate magnetic courses.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(05)		Calculate the t~~T~~rue a~~A~~irspeed (TAS) from given aircraft performance data, altitude and ~~Outside Air Temperature (~~OAT~~)~~.	X	X	X	X	X			
(06)		Calculate w~~W~~ind c~~C~~orrection a~~A~~ngles (WCAs), ~~and~~ d~~D~~rift and g~~G~~round s~~S~~peeds (GS).	X	X	X	X	X			
(07)		Calculate individual and accumulated times for each leg to destination and alternate ~~airfields~~aerodromes.	X	X	X	X	X			
033 02 00 00		**FLIGHT PLANNING FOR IFR FLIGHTS** *Remark: Using the GSPRM ~~training route manual~~ IFR charts.*								
033 02 01 00		**IFR navigation plan**								
033 02 01 01		***~~Airways and routes~~ Air traffic service (ATS) routes***								
(01)		Identify suitable routings by identifying all relevant aeronautical and regulatory information (including information published in the national aeronautical information publication (AIP)) required for IFR flight planning. ~~Select the preferred airway(s) or route(s) considering:~~ — ~~altitudes and flight levels;~~ — ~~standard routes;~~	X		X			X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— ~~ATC restrictions;~~ — ~~shortest distance;~~ — ~~obstacles;~~ — ~~any other relevant data.~~								
(02)		Identify and describe ATS routes (conventional, area navigation (RNAV), required navigation performance (RNP), conditional routes (CDRs), and direct routes).	X		X			X	X	
033 02 01 02		***Courses and distances from en-route charts***								
(01)		Determine courses and distances.	X		X			X	X	
(02)		Determine bearings and distances of waypoints from radio navigation aids.	X		X			X	X	
033 02 01 03		***Altitudes***								
(01)		Define the following minimum altitudes: — m~~M~~inimum e~~E~~n-route a~~A~~ltitude (MEA); — m~~M~~inimum o~~O~~bstacle c~~C~~learance a~~A~~ltitude (MOCA); — minimum sector altitude (MSA) ; — Minimum Off-Route Altitude (MORA); — Grid Minimum Off-Route Altitude (Grid MORA); — Maximum Authorised Altitude (MAA); — Minimum Crossing Altitude (MCA); — Minimum Holding Altitude (MHA).	X		X			X	X	
(02)		Extract the following minimum altitudes from the chart(s):	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— Minimum En-sroute Altitude (MEA); — Minimum Obstacle Clearance Altitude (MOCA); — MSA ; — Minimum Off-Route Altitude (MORA); — Grid Minimum Off-Route altitude (Grid MORA); — Maximum Authorised Altitude (MAA); — Minimum Crossing Altitude (MCA); — Minimum Holding Altitude (MHA).								
(03)		State who is responsible for terrain separation during IFR flight inside and outside controlled airspace.	X		X			X	X	
(04)		State the minimum obstacle clearance requirements for en-route IFR flight inside and outside controlled airspace.	X		X			X	X	
(05)		State when a temperature error correction must be applied by either the pilot or ATC.	X		X			X	X	
(06)		Identify and explain the use of minimum radar vectoring altitudes.	X		X			X	X	
(07)		Calculate the minimum pressure altitude required with a given obstacle clearance, magnetic track, OAT, QNH and reduced vertical separation minimum (RVSM)/non-RVSM information.	X		X			X	X	
(08)		Calculate true altitude from a given pressure altitude and obstacle elevation using OAT and QNH.	X		X			X	X	
033 02 01 04		***Standard ~~i~~Instrument ~~d~~Departure~~s~~ (SID~~s~~) and ~~s~~Standard***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		instrument aArrival (STAR) r~~R~~outes ~~(STARs)~~								
(01)	X	State ~~Explain~~ the reasons for studying SID and STAR charts.	X		X			X	X	
(02)	X	State ~~the reasons why~~ that SID and STAR charts show procedures only in a pictorial presentation style which ~~is not to scale~~ may not be true to scale.	X		X			X	X	
(03)		Interpret all data and information represented on SID and STAR charts, particularly: — r~~R~~outings~~,~~; — d~~D~~istances~~,~~; — c~~C~~ourses~~,~~; — r~~R~~adials~~,~~; — altitudes/levels~~,~~; — frequencies~~,~~; — restrictions~~,~~; — RNAV waypoints and non-RNAV intersection; — fly-over and fly-by waypoints.	X		X			X	X	
(04)		Identify SID~~s~~ and STAR~~s~~ charts which might be relevant ~~to~~ for a planned flight.	X		X			X	X	
(05)		Define SID and STAR for RNAV only.	X		X			X	X	
(06)		Describe the difference between SID/STAR, RNAV SID/STAR and RNAV SID/STAR overlay.	X		X			X	X	
033 02 01 05		***Instrument-approach charts***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)	X	State the reasons for being familiar with instrument-approach procedures (IAPs) and appropriate data for departure, destination and alternate ~~airfields~~aerodromes.	X		X			X	X	
(02)		Select ~~instrument-approach procedures~~ (IAPs) appropriate for departure, destination and alternate ~~airfields~~aerodromes.	X		X			X	X	
(03)		Interpret all procedures, data and information represented on instrument-approach charts, particularly: — courses and radials; — distances; — altitudes/levels/heights; — restrictions; — obstructions; — frequencies; — speeds and times; — d~~D~~ecision a~~A~~ltitudes/h~~H~~eights (DAs/Hs); — (DA/H) and m~~M~~inimum d~~D~~escent a~~A~~ltitudes/h~~H~~eights (MDAs/Hs); — visibility and r~~R~~unway v~~V~~isual r~~R~~anges (RVRs); — approach-light systems.	X		X			X	X	
(04)		Explain the following IAPs terms: — type A and B; — 2D and 3D;	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		— CAT I, II and III; — precision approach (conventional and ground-based augmentation system (GBAS)); — non-precision approach (conventional and required navigation performance approach (RNP APCH) (lateral navigation (LNAV), LNAV/vertical navigation (VNAV), localiser performance (LP), localiser performance with vertical guidance (LPV), and required navigation performance authorisation required approach (RNP AR APCH)); — approach procedure with vertical guidance (APV) (APV Baro and APV satellite-based augmentation system (SBAS)).								
033 02 01 06		***Communications and radio-navigation planning data***								
(01)		Find the communication frequencies and call signs for aeronautical services for IFR flights from en-route charts. ~~the following:~~ — ~~control agencies and service facilities;~~ — ~~Flight Information Services (FIS);~~ — ~~weather information stations;~~ — ~~Automatic Terminal Information Service (ATIS).~~	X		X			X	X	
(02)		Find the frequency ~~and/~~or identifiers of radio-navigation aids for IFR flights from en-route charts.	X		X			X	X	
033 02 01 07		***Completion of a manual navigation plan***								

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
(01)		Complete ~~the~~ a navigation plan with the courses, distances and frequencies taken from charts.	X		X			X	X	
(02)		Find the ~~Standard Instrument Departure~~ SID and ~~Arrival Routes~~ STAR routes to be flown ~~and/~~or to be expected.	X		X			X	X	
(03)		Determine the position of t~~T~~op of c~~C~~limb (TO~~o~~C) and t~~T~~op of d~~D~~escent (TO~~o~~D) from given appropriate data.	X		X			X	X	
(04)		Determine variation and calculate magnetic/true courses.	X		X			X	X	
(05)		Calculate ~~True Airspeed (~~TAS~~)~~ from given aircraft performance data, altitude and ~~Outside Air Temperature (~~OAT~~)~~.	X		X			X	X	
(06)		Calculate w~~W~~ind c~~C~~orrection a~~A~~ngles (WCAs)/d~~D~~rift and g~~G~~round s~~S~~peeds (GSs).	X		X			X	X	
~~LO (07)~~		~~Determine all relevant altitudes/levels, and particularly MEA, MOCA, MORA, MAA, MCA, MRA and MSA~~.	~~X~~		~~X~~			~~X~~	~~X~~	
(08)		Calculate individual and accumulated times for each leg to destination and alternate ~~airfields~~aerodromes.	X		X			X	X	
(09)		Describe the advantages of global navigation satellite system/flight management computer (GNSS/FMC) equipment regarding: — automatic calculation and display of tracks and leg distances; — additional route information in the database (minimum altitudes, approach procedures); — time and fuel estimates over waypoints;	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— ability to adjust speed to arrive over a waypoint at a defined time; — time and fuel revisions based on predicted and actual wind.								
(10)		Describe the limitations of using GNSS/FMC equipment: — pilot-inputted errors (flight levels, wind, temperature, fuel); — the effect of other than predicted wind on fuel and time estimates; — the effect of aircraft's non-standard configuration on flight management system (FMS) predictions.	X		X			X	X	
033 03 00 00		**FUEL PLANNING — CAT.OP.MPA.106 and CAT.OP.MPA.150 plus AMC 1, 2 and 3.**								
033 03 01 00		**General**								
033 03 01 01		***Fuel planning (general)***								
(01)		Convert to volume, mass and density given in different units which are commonly used in aviation.	X	X	X	X	X	X	X	
(02)		Determine relevant data ~~from the Flight Manual~~, such as fuel capacity, fuel flow/consumption at different power/thrust settings, altitudes and atmospheric conditions, from the flight manual.	X	X	X	X	X	X	X	
(03)		Calculate the attainable flight time/range from given average fuel flow/consumption and available amount of fuel.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		Calculate the required fuel from given average fuel flow/consumption and required time/range to be flown.	X	X	X	X	X	X	X	
(05)		Calculate the required fuel for a VFR or IFR flight from given ~~expected~~ forecast meteorological conditions ~~and expected delays under defined conditions~~.	X	X	X	X	X	X	X	
~~LO (06)~~		~~Calculate the required fuel for an IFR flight from given expected meteorological conditions and expected delays under defined conditions.~~	~~X~~		~~X~~			~~X~~		
(07)		State the minimum amount of remaining fuel required on arrival at the destination and alternate aerodromes/heliports.	X	X	X	X	X	X	X	
(08)		Explain and describe how to calculate nautical air miles (NAM) from nautical ground miles (NGM).	X	X	X	X	X	X	X	
033 03 02 00		**Pre-flight fuel planning for commercial flights**								
033 03 02 01		***Taxi~~ing~~ fuel***								
(01)		Determine the fuel required for engine start and taxiing by consulting the fuel-usage tables ~~and/~~or graphs from the f~~F~~light m~~M~~anual taking into account all the relevant conditions.	X	X	X	X	X			
033 03 02 02		***Trip fuel***								
(01)		Define trip fuel and name the segments of flight for which the trip fuel is relevant.	X	X	X	X	X			
(02)		Determine the trip fuel for the flight by using data from the ~~navigation plan and~~ fuel tables ~~and/~~or graphs from the	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		f~~F~~light m~~M~~anual.								
033 03 02 03		***Reserve fuel and its components***								
		Contingency fuel								
(01)		Explain the reasons for having contingency fuel.	X	X	X	X	X			
~~LO (02)~~		~~State and explain the requirements for contingency fuel according to the applicable operational requirements.~~	~~X~~	~~X~~						
(03)		Calculate the contingency fuel ~~by using requirements~~ according to the applicable operational requirements.	X	X	X	X	X			
~~LO (04)~~		~~State and explain the requirements for contingency fuel according to the applicable operational requirements.~~			~~X~~	~~X~~	~~X~~			
~~LO (05)~~		~~Calculate the contingency fuel by using requirements according to the applicable operational requirements for IFR flights.~~			~~X~~					
~~LO (06)~~		~~Calculate the contingency fuel by using requirements according to the applicable operational requirements for VFR flights in a hostile environment.~~			~~X~~	~~X~~	~~X~~			
~~LO (07)~~		~~Calculate the contingency fuel by using requirements according to the applicable operational requirements for VFR flights in a non-hostile environment.~~			~~X~~	~~X~~	~~X~~			
		Alternate fuel								
(08)		Explain the reasons and regulations for having alternate fuel and name the segments of flight for which the alternate fuel is relevant.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(09)		Calculate the alternate fuel in accordance with the applicable operational requirements and relevant data from the navigation plan and the f~~F~~light m~~M~~anual.	X	X	X	X	X			
~~LO (10)~~		~~Calculate the alternate fuel in accordance with the applicable operational requirements and relevant data from the navigation plan and the Flight Manual~~.			~~X~~	~~X~~	~~X~~			
		Final reserve fuel								
(11)		Explain the reasons and regulations for having final reserve fuel.	X	X	X	X	X			
(12)		Calculate the final reserve fuel for an ~~aeroplane~~ aircraft ~~with piston engines and for an aeroplane with turbine power units~~ in accordance with the applicable operational requirements and by using relevant data from the f~~F~~light m~~M~~anual.	X	X	X	X	X			
~~LO (13)~~		~~Calculate the final reserve fuel for a VFR flight (by day with reference to visual landmarks) in accordance with the applicable operational requirements and by using relevant data from the Flight Manual.~~			~~X~~	~~X~~	~~X~~			
~~LO (14)~~		~~Calculate the final reserve fuel for a IFR flight in accordance with the applicable operational requirements and by using relevant data from the Flight Manual.~~			~~X~~					
		Additional fuel								
(15)		Explain the reasons and regulations for having additional fuel.	X	X	X	X	X			

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
(16)		Calculate the additional fuel for a ~~an IFR~~ flight ~~without a destination alternate~~ in accordance with the applicable operational requirements ~~for an isolated aerodrome or heliport~~.	X	X	X	X	X			
~~LO (17)~~		~~Calculate the additional fuel for a flight to an isolated heliport in accordance with the applicable operational requirements.~~			~~X~~	~~X~~	~~X~~			
033 03 02 04		***Extra fuel***								
(01)		Explain the reasons and regulations for having extra fuel in accordance with the applicable operational requirements.	X	X	X	X	X			
~~LO (02)~~		~~Explain the reasons and regulations for having extra fuel in accordance with the applicable operational requirements.~~			~~X~~	~~X~~	~~X~~			
(03)		Calculate the possible extra fuel under given conditions.	X	X	X	X	X			
(04)		Explain the fuel penalty incurred when loading extra fuel (i.e. the additional fuel consumption due to increased mass).	X	X	X	X	X			
033 03 02 05		***Calculation of total fuel and completion of the fuel section of the navigation plan (fuel ~~log~~ plan)***								
(01)		Calculate the total fuel required for a given flight.	X	X	X	X	X			
(02)		Complete the fuel ~~log~~ plan.	X	X	X	X	X			
033 03 03 00		**Specific fuel-calculation procedures**								
033 03 03 01		***~~Decision-point procedure~~ Reduced contingency fuel procedure***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)	X	Explain the reasons and regulations for reduced contingency fuel ~~the decision-point procedure~~ as stated in the applicable operational requirements.	X							
(02)		Calculate the contingency fuel and trip fuel required in accordance with the reduced contingency fuel ~~decision point~~ procedure.	X							
033 03 03 02		***Isolated aerodrome or heliport procedure***								
(01)	X	Explain the basic procedures for an isolated aerodrome or heliport as stated in the applicable operational requirements.	X		X	X				
(02)		Calculate the additional fuel for aeroplanes or helicopters ~~with reciprocating engine~~s according to the isolated aerodrome or heliport procedures.	X		X	X				
~~LO (03)~~		~~Calculate the additional fuel for aeroplanes with turbine engines according to the isolated-aerodrome procedures.~~	~~X~~							
033 03 03 03		***Predetermined point procedure***								
(01)	X	Explain the basic idea of the predetermined-point procedure as stated in the applicable operational requirements.	X							
~~LO (02)~~		~~Calculate the additional fuel for aeroplanes with reciprocating engines according to the predetermined-point procedure~~.	~~X~~							
~~LO (03)~~		~~Calculate the additional fuel for aeroplanes with turbine engines according to the predetermined-point procedure~~.	~~X~~							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
033 03 03 04		***Fuel-tankering***								
(01)		Explain the basic idea of fuel-tankering procedures.	X							
~~LO (02)~~		~~Explain that there is an optimum fuel quantity to be tankered (as a function of the fuel-price ratio between departure and destination airports and air distance to fly).~~	~~X~~							
(03)		Calculate how much fuel to tank ~~tankered fuel~~ by using given appropriate graphs, tables ~~and/~~or data.	X							
033 03 03 05		***~~Isolated heliport procedure~~ Intentionally left blank***								
~~LO (01)~~		~~Explain the basic idea of the isolated-heliport procedures as stated in the applicable operational requirements.~~			~~X~~	~~X~~				
~~LO (02)~~		~~Calculate the additional fuel according to the isolated-heliport procedures as stated in the applicable operational requirements for flying IFR.~~			~~X~~					
~~LO (03)~~		~~Calculate the additional fuel according to the isolated-heliport procedures as stated in the applicable operational requirements for flying VFR and navigating by means other than by reference to visual landmarks.~~			~~X~~	~~X~~				
033 04 00 00		**PRE-FLIGHT PREPARATION**								
033 04 01 00		**Notice to airmen (NOTAM) briefing**								
033 04 01 01		***Ground and satellite-based facilities and services***								
(01)		Check that the ground and satellite-based facilities and services required for the planned flight are available and adequate.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
033 04 01 02		***Departure, destination and alternate aerodromes***								
(01)		Find and analyse the latest state at the departure, destination and alternate aerodromes, in particular for: — opening hours; — w~~W~~ork in p~~P~~rogress (WIP); — special procedures due to ~~Work in Progress (~~WIP~~)~~; — obstructions; — changes of frequencies for communications, navigation aids and facilities.	X	X	X	X	X	X	X	
(02)		Check that satellite-based facilities are available during the expected time of use.	X	X	X	X	X	X	X	
(03)		Check that GBAS/SBAS augmentation is available during the expected time of use.	X	X	X	X	X	X	X	
033 04 01 03		***Airway routings and airspace structure***								
(01)		Find and analyse the latest en-route state for: — airway(s) or route(s); — restricted, danger and prohibited areas; — changes of frequencies for communications, navigation aids and facilities.	X	X	X	X	X	X	X	
033 04 01 04		***Pre-flight preparation of GNSS achievability***								
(01)		Define why it is important to check GNSS achievability.	X							
(02)		Define receiver autonomous integrity monitoring (RAIM),	X							

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		NOTAM and notice advisory to NavStar users (NANU) messages.								
(03)		Explain the difference in use of augmented and non-augmented GNSS in connection with the achievability check.	X							
(04)		Explain the difference in planned and unplanned outage of GNSS or SBAS.	X							
033 04 02 00		**Meteorological briefing**								
033 04 02 01		***~~Extraction and analysis of relevant data from meteorological documents~~ Intentionally left blank*** *~~Remark: This item is taught and examined in subject 050.~~*								
033 04 02 02		***Update of navigation plan using the latest meteorological information***								
(01)		Confirm the ~~optimum~~ most fuel-efficient altitude~~/FL~~ from given wind, temperature and aircraft data.	X	X	X	X	X	X	X	
(02)		Confirm true altitudes from given atmospheric data to ensure that statutory minimum clearance is attained.	X	X	X	X	X	X		
(03)		Confirm magnetic headings and GSs~~ground speeds~~.	X	X	X	X	X	X	X	
(04)		Confirm the individual leg times and the total time en route.	X	X	X	X	X	X	X	
(05)		Confirm the total en route for the trip to the destination.	X	X	X	X	X	X	X	
(06)		Confirm the total time from destination to the alternate ~~airfield~~aerodrome.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
033 04 02 03		***~~Update of mass and balance~~*** *~~Remark: This item is taught and examined in subject 031~~.* ***Intentionally left blank***								
033 04 02 04		***~~Update of performance data~~ Intentionally left blank*** *~~Remark: This item is taught and examined in subject 032 for aeroplanes and subject 034 for helicopters.~~*								
033 04 02 05		***Update of fuel ~~log~~ plan***								
(01)		Calculate the revised fuel data in accordance with the changed conditions.	X	X	X	X	X	X		
033 04 03 00		**Point of e~~E~~qual t~~T~~ime (PET) and p~~P~~oint of s~~S~~afe r~~R~~eturn (PSR)**								
033 04 03 01		***Point of ~~E~~equal ~~T~~time (PET)***								
(01)		Define '~~point of equal time' (~~PET~~)~~.	X	X	X	X	X			
~~LO (02)~~		~~Explain the basic idea of determination of PET~~.	~~X~~		~~X~~	~~X~~				
(03)		Calculate the position of a PET and the estimated time of arrival (ETA) at the PET from given relevant data.	X	X	X	X	X			
033 04 03 02		***Point of ~~S~~safe ~~R~~return (PSR)***								
(01)		Define '~~point of safe return' (~~PSR~~)~~.	X	X	X	X	X			
~~LO (02)~~		~~Explain the basic idea of determination of PSR.~~	X	X	X	X	X			
(03)		Calculate the position of a PSR and the ETA at the PSR from given relevant data.	X	X	X	X	X			

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
033 05 00 00		**ICAO FLIGHT PLAN (ATS f~~F~~light p~~P~~lan (FPL))**								
033 05 01 00		**Individual f~~F~~light p~~P~~lan**								
033 05 01 01		***Format of f~~F~~light p~~P~~lan***								
(01)	X	State the reasons for a fixed format of an ICAO ATS ~~Flight Plan (~~FPL).	X	X	X	X	X	X	X	
(02)		Determine the correct entries to complete an ATS FPL plus decode and interpret the entries in a completed ATS FPL, particularly for the following: — aircraft identification (Item 7); — flight rules and type of flight (Item 8); — number and type of aircraft and wake-turbulence category (Item 9); — equipment (Item 10); — departure aerodrome and time (Item 13); — route (Item 15); — destination aerodrome, total estimated elapsed time and alternate aerodrome (Item 16); — other information (Item 18); — supplementary information (Item 19).	X	X	X	X	X	X	X	
033 05 01 02		***~~Completion of an ATS Flight Plan (FPL)~~*** ***Intentionally left blank***								
~~LO (01)~~		~~Complete the FPL by using the information from the~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~following:~~ — ~~navigation plan;~~ — ~~fuel plan;~~ — ~~operator's records for basic aircraft information.~~								
033 05 02 00		**Repetitive ~~f~~Flight ~~p~~Plan (RPL)**								
033 05 02 01		***Repetitive flight plan (RPL)***								
(01)	X	Explain the difference between an ~~Individual Flight Plan (~~FPL~~)~~ and a ~~Repetitive Flight Plan (~~RPL~~)~~.	X		X	X				
~~LO (02)~~		~~Explain the basic idea of an RPL and state the general requirements for its use.~~	~~X~~		~~X~~	~~X~~				
~~**033 05 03 00**~~		~~**Submission of an ATS Flight Plan (FPL)**~~ ~~*Remark: This item is taught and examined in subject 010.*~~								
~~LO (01)~~		~~Explain the requirements for the submission of an ATS Flight Plan.~~							~~X~~	
~~LO (02)~~		~~Explain the actions to be taken in case of Flight Plan changes.~~							~~X~~	
~~LO (03)~~		~~State the actions to be taken in case of inadvertent changes to Track, TAS and time estimate affecting the current Flight Plan.~~							~~X~~	
~~LO (04)~~		~~Explain the procedures for closing a Flight Plan.~~							~~X~~	
033 06 00 00		**FLIGHT MONITORING AND IN-FLIGHT REPLANNING**								
033 06 01 00		**Flight monitoring**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
033 06 01 01		***Monitoring of track and time***								
(01)		State the reasons for possible deviations ~~to~~ from the planned track and planned timings.	X	X	X	X	X	X		
~~LO (02)~~		~~Assess deviations from the planned course, headings (by maintaining desired courses) and times.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(03)		Calculate ~~the ground speed~~GS by using actual in-flight parameters.	X	X	X	X	X	X		
(04)		Calculate the expected leg times by using actual in-flight parameters.	X	X	X	X	X	X		
~~(05)~~		~~Calculate revised GS to reach a waypoint at a specific time.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~(06)~~		~~Calculate the average GS based on two observed fixes.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~(07)~~		~~Calculate the track angle error given course from A to B and an off-course fix, using the 1:60 rule.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~(08)~~		~~Calculate the heading change at an off-course fix to directly reach the next waypoint using the 1:60 rule.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~(09)~~		~~Calculate the average drift angle based upon an off-course fix observation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~(10)~~		~~Enter revised navigational en-route data, for the legs concerned, into the flight plan (e.g. updated wind and GS and correspondingly losses or gains in time and fuel consumption).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(11)		Enter, in the progress of flight, at the checkpoint or turning point, the ‘actual time-over’ and the ‘estimated time-over’	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		for the next checkpoint into the flight plan.								
(12)		State that it is necessary to determine the position of the aircraft accurately before commencing descent in order to ensure safe ground clearance.	X	X	X	X	X			
~~(13)~~		~~Estimate average climb/descent gradient (%) or glide path degrees according to the following rule of thumb:~~ ~~Gradient in degrees = (vertical distance (ft) / 100) / ground distance (nm))~~ ~~Gradient in % = (vertical distance (ft) / 60) / ground distance (nm))~~ ~~*N.B. These rules of thumb approximate 1 nm to 6 000 ft and are based on the 1:60 rule.*~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~(14)~~		~~Calculate rate of descent (ROD) on a given glide-path angle or gradient using the following rule of thumb formulae:~~ ~~ROD (ft/min) = GP° × GS (nm/min) × 100~~ ~~ROD (ft/min) = GP% × GS (kt)~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(15)		Calculate revised ETA based on changes to the pre-flight plan, including changes of W/V, cruise level, OAT, distances, Mach number and calibrated airspeed (CAS).	X	X	X	X	X			
033 06 01 02		***In-flight fuel management***								
(01)		Explain why fuel checks must be carried out in flight at regular intervals and why relevant fuel data must be recorded.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(02)		Assess deviations of actual fuel consumption from planned consumption.	X	X	X	X	X	X		
~~LO (03)~~		~~State the reasons for possible deviations~~.	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(04)		Calculate ~~the~~ fuel quantiti~~es~~y used, fuel consumption and fuel remaining at navigation checkpoints/waypoints.	X	X	X	X	X	X		
(05)		Compare the actual with the planned fuel consumption by means of calculation ~~or flight-progress chart~~.	X	X	X	X	X	X		
(06)		Determine ~~Assess~~ the remaining range and endurance by means of calculation ~~or flight-progress chart~~.	X	X	X	X	X	X		
(07)		Calculate the revised fuel consumption based on changes to the pre-flight plan, including changes of W/V, cruise level, OAT, distances, Mach number and CAS.	X	X	X	X	X	X		
~~***033 06 01 03***~~		~~***Monitoring of primary flight parameters***~~								
~~LO (01)~~		~~Explain the methodology for monitoring of primary flight parameters during the application of the procedures requiring a high flight crew workload within a short time frame (including monitoring of primary flight parameters, in particular pitch, thrust and speed~~).	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
033 06 02 00		***In-flight replanning~~in case of deviation from planned data~~***								
033 06 02 01		***Deviation from planned data***								
(01)		State ~~Justify~~ that the commander is responsible for ensuring that, even in case of diversion the remaining fuel is not less than the fuel required to proceed to an aerodrome where a safe landing can be made, with final reserve fuel remaining.	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (02)~~		~~Perform in-flight updates, if necessary, based on the results of in-flight monitoring, specifically by:~~ — ~~selecting a new destination/alternate aerodrome;~~ — ~~adjusting flight parameters and power settings~~.	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(03)		Explain ~~why~~ that, in the case of an in-flight update, the commander has to check the following: — the suitability of the new destination ~~and/~~or alternate aerodrome; — meteorological conditions on revised routing and at revised destination ~~and/~~or alternate aerodrome; — the aircraft must be able to land with the prescribed final reserve fuel.	X	X	X	X	X			
(04)		Calculate ~~Assess~~ the revised destination/alternate aerodrome landing mass from given latest data.	X	X	X	X	X			

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Appendix to Annex I to ED Decision 2018/001/R

'Acceptable Means of Compliance (AMCs) and Guidance Material (GM) to Part-FCL Amendment 4'

Appendix
'SUBJECT 034 — FLIGHT PERFORMANCE AND PLANNING — PERFORMANCE — HELICOPTERS'
to
AMC1 FCL.310; FCL.515(b); FCL.615(b)
'Theoretical knowledge examinations'
of Annex I

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~~SUBJECT 034 — PERFORMANCE (HELICOPTER)~~

SUBJECT 034 — FLIGHT PERFORMANCE AND PLANNING — PERFORMANCE — HELICOPTERS

~~(1) For mass definitions, please refer to Chapter D.~~

Note that the term 'mass' is used to describe a quantity of matter, and 'weight' when describing the force. However, the term 'weight' is normally used in aviation to colloquially describe mass. The professional pilot should always note the units to determine whether the term 'weight' is being used to describe a force (e.g. unit newton) or quantity of matter (e.g. unit kilogram).

Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
030 00 00 00		**FLIGHT PERFORMANCE AND PLANNING**								
034 00 00 00		**PERFORMANCE — HELICOPTERS**								
034 01 00 00		**GENERAL**								
034 01 01 00		**Performance legislation**								
_034 01 01 01_		**_Airworthiness requirements_**								
(01)		Interpret the airworthiness requirements ~~in~~ of CS-27 and CS-29 ~~as related to helicopter performance~~.			X	X	X			
(02)		Name the general differences between helicopters ~~as~~ certified according to CS-27 and CS-29.			X	X	X			
_034 01 01 02_		**_Operational regulations_**								
(01)		State that the person responsible ~~responsibility~~ ~~to~~for complying with ~~the~~ operational procedures is the commander.			X	X	X			
~~LO (02)~~		~~Interpret the European Union regulation on operations.~~			~~X~~	~~X~~	~~X~~			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)		Use and interpret diagrams and tables associated with CAT A and CAT B procedures in order to select and develop C~~c~~lass 1, 2 and 3 performance profiles according to available heliport size and location (surface or elevated).			X	X				
~~LO (04)~~		~~Use and interpret diagrams and tables associated with CAT B procedures in order to select and develop Performance Class 3 single-engine helicopter performance profiles according to available heliport size and location (surface or elevated).~~					~~X~~			
(05)		Interpret the charts showing minimum clearances associated with CAT~~Category~~ A ~~&~~ and CAT B procedures.			X	X				
034 01 02 00		**General performance theory**								
034 01 02 01		***~~Stages~~ Phases of flight***								
(01)		Explain the following ~~stages~~ phases of flight: — take-off; — climb; — level flight; — descent; — approach and landing.			X	X	X			
(02)		Describe the necessity for different take-off and landing procedures.			X	X	X			
034 01 02 02		***Definitions and terms***								

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
(01)		Define the following terms: — CAT~~Category~~ A; — CAT~~Category~~ B; — p~~P~~erformance c~~C~~lass 1, 2 and 3; — congested area; — elevated heliport; — helideck; — heliport; — hostile environment; — maximum ~~approved~~ operational passenger seating configuration (MOPSC); — non-hostile environment; — obstacle; — rotor r~~R~~adius (R); — take-off mass; — t~~T~~ouchdown and l~~L~~ift-o~~O~~ff a~~A~~rea (TLOF); — safe forced landing; — speed for best rate of climb (V_y); — never exceed speed (V_{NE}); — velocity landing gear extended (V_{LE}); — velocity landing gear operation (V_{LO}); — cruising speed and maximum cruising speed.			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		Define the following terms: — reported headwind component; — t~~T~~ake-off d~~D~~ecision p~~P~~oint (TDP); — d~~D~~efined p~~P~~oint a~~A~~fter t~~T~~ake-o~~O~~ff (DPATO); — t~~T~~ake-o~~O~~ff d~~D~~istance r~~R~~equired helicopter (TODRH); — t~~T~~ake-o~~O~~ff d~~D~~istance a~~A~~vailable helicopter (TODAH); — d~~D~~istance r~~R~~equired (DR); — r~~R~~ejected t~~T~~ake-o~~O~~ff d~~D~~istance r~~R~~equired (helicopter) (RTODRH); — r~~R~~otation p~~P~~oint (RP); — c~~C~~ommittal p~~P~~oint (CP); — d~~D~~efined p~~P~~oint b~~B~~efore l~~L~~anding (DPBL); — l~~L~~anding d~~D~~ecision p~~P~~oint (LDP); — l~~L~~anding d~~D~~istance a~~A~~vailable helicopter (LDAH); — l~~L~~anding d~~D~~istance r~~R~~equired helicopter (LDRH); — ~~Take-off safety speed (V_1);~~ — ~~Take-off safety speed for Cat A rotorcraft (V_{TOSS})(V_2).;~~ — ditching (see operations).			X	X				
(03)		Understand the meaning and significance of the acronyms AEO and OEI.			X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		Define the terms ‘climb angle’ and ‘climb gradient’.			X	X				
(05)		Define the terms ‘flight-path angle’ and ‘flight-path gradient’.			X	X				
(06)		Define ‘$V_{maxRange}$’ (speed for maximum range) and V_{maxEnd} (speed for maximum endurance).			X	X	X			
(07)		Define and calculate the gradient by using power, wind and helicopter mass.			X	X				
(08)		Explain the terms ‘operational ceiling’ and ‘absolute ceiling’.			X	X	X			
(09)		Explain the term ‘service ceiling OEI’.			X	X	X			
(10)		~~Understand~~ Explain the difference between h~~H~~overing i~~I~~n g~~G~~round e~~E~~ffect (HIGE) and h~~H~~overing out of g~~G~~round e~~E~~ffect (HOGE).			X	X	X			
034 01 02 03		***Power required/power available curves***								
(01)		Understand and interpret the ~~graph~~ power required /power available versus TAS graphs.			X	X	X			
034 01 02 04		***~~Critical~~ Height~~–~~-v~~V~~elocity graphs***								
(01)		Understand and interpret ~~the critical~~ height~~–~~-velocity graphs.			X	X	X			
034 01 02 05		***Influencing variables on performance***								
(01)		Explain how the following factors a~~e~~ffect helicopter performance:			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— pressure altitude; — humidity; — temperature; — wind; — helicopter mass; — helicopter configuration; — helicopter centre of gravity (CG).								
034 02 00 00		**PERFORMANCE CLASS 3 — SINGLE-ENGINE HELICOPTERS ~~ONLY~~**								
034 02 01 00		**Effect of variables on single-engine (SE) helicopter performance**								
034 02 01 01		***Effect of variables on SE helicopter performance***								
(01)		Determine wind component, altitude and temperature for hovering, take-off and landing.			X	X	X			
(02)		Explain that operations are to be conducted only from/to heliports and over such routes, areas and diversions contained in a non-hostile environment where a safe forced landing can be carried out (point CAT.OP.MPA.137 of the EU Regulation on air operations, except when the helicopter is approved to operate in accordance with point CAT.POL.H.420). (Consider the exception: Operations may be conducted in a hostile environment. ~~when approved.~~ Ground level exposure - and exposure for elevated final approach and take-off areas (FATOs) or helidecks in non-hostile			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		environments - is allowed for operations approved under CAT.POL.H.305, during the take-off and landing phases.)								
(03)		Explain the effect of temperature, wind and altitude on climb, cruise and descent performance.			X	X	X			
034 02 02 00		**Take-off and landing**								
034 02 02 01		***Take-off and landing (including hover)***								
(01)		Explain the take-off and landing requirements.			X	X	X			
(02)		Explain the maximum allowed take-off and landing mass.			X	X	X			
(03)		Explain that mass has to be restricted to HIGE.			X	X	X			
(04)		Explain that if HIGE is unlikely to be achieved (for example, blocked by an obstruction), then mass must be restricted to HOGE.			X	X	X			
034 02 03 00		**Climb, cruise and descent**								
034 02 03 01		***Climb, cruise and descent (capabilities)***								
(01)		State that the helicopter must be capable of flying its intended track without flying below the appropriate minimum flight altitude and be able to perform a safe forced landing.			X	X	X			
(02)		Explain the effect of altitude on the maximum endurance speed.			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
034 02 04 00		**Use of helicopter performance data**								
034 02 04 01		***Take-off (including hover)***								
(01)		Find the maximum wind component.			X	X	X			
(02)		Find the maximum allowed take-off mass for certain conditions.			X	X	X			
(03)		Find the ~~critical~~ height–~~-~~velocity parameters.			X	X	X			
034 02 04 02		***Climb***								
(01)		Find the time, distance and fuel required to climb for certain conditions.			X	X	X			
(02)		Find the rate of climb under given conditions and the best rate-of-climb speed V_Y.			X	X	X			
034 02 04 03		***Cruise***								
(01)		Find the cruising speed and fuel consumption for certain conditions.			X	X	X			
(02)		Calculate the range and endurance under given conditions.			X	X	X			
034 02 04 04		***Landing (including hover)***								
(01)		Find the maximum wind component.			X	X	X			
(02)		Find the maximum allowed landing mass for certain conditions.			X	X	X			
(03)		Find the ~~critical~~ height–~~-~~velocity parameters.			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
034 03 00 00		**PERFORMANCE CLASS 2**								
		General remark: The Learning Objectives for Performance Class 2 are principally identical with those ~~of~~ for Performance Class 1. (See 034 04 00 00) *Additional Learning Objectives are shown below.*								
034 03 01 00		**Operations without an assured safe forced landing capability**								
034 03 01 01		***Responsibility for operations without an assured safe forced landing capability***								
(01)		State the responsibility of the operator ~~in order to assure a~~ for assuring safe forced landings (point CAT.POL.H.305 of the EU Regulation on air operations).			X	X				
034 03 02 00		**Take-off**								
034 03 02 01		***Take-off requirements***								
(01)		State the climb and other requirements for take-off.			X	X				
034 03 03 00		**Take-off f~~F~~light p~~P~~ath**								
034 03 03 01		***Take-off flight path requirements***								
(01)		State the height above the take-off surface at which at least the requirements for the take-off flight path for Performance Class 1 are to be met.			X	X				
034 03 04 00		**Landing**								
034 03 04 01		***Landing requirements***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		State the requirements for the climb capability ~~for~~when OEI.			X	X				
(02)		State the options for a Performance Class 2 operation in the case of a critical power-unit failure at any point in the approach path.			X	X				
(03)		State the limitations for operations to/from a helideck.			X	X				
034 04 00 00		**PERFORMANCE CLASS 1 — HELICOPTERS CERTIFIED~~CERTIFICATED~~ ACCORDING TO CS-29 ONLY**								
034 04 01 00		**Take-off**								
034 04 01 01		***Take-off distances***								
(01)		Explain the effects of the following variables on the flight-path and take-off distances: — take-off with HIGE or HOGE; — take-off procedure; — obstacle clearances both laterally and vertically; — take-off from non-elevated heliports; — take-off from elevated heliports or helidecks; — take-off from a ~~Touchdown and Lift-Off Area (~~TLOF~~)~~.			X	X				
(02)		Explain the effects of the following variables on take-off distances: — mass; — take-off configuration;			X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— bleed-air configurations.								
(03)		Explain the effects of the following meteorological conditions ~~variables~~ on take-off distances: — wind; — temperature; — pressure altitude.			X	X				
(04)		Explain the take-off distances for specified conditions and configuration for AEO and OEI.			X	X				
(05)		Explain the effect of obstacles on the take-off distance required.			X	X				
(06)		~~Explain the influence of V_1 and V_{TOSS} speeds on the take-off distance.~~			~~X~~	~~X~~				
(07)		State the assumed reaction time between engine failure and recognition.			X	X				
~~LO (08)~~		~~Explain the effect of calculation of TDP and V_1 on the take-off distance required.~~			~~X~~	~~X~~				
(09)		Explain that the flight must be carried out visually up to TDP.			X	X				
034 04 01 02		***Rejected take-off distance required (helicopter) (RTODR(H))***								
(01)		Explain RTODR(H)~~the rejected take-off distance required~~ for specified conditions and configuration for AEO and OEI.			X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (02)~~		~~Explain the effect of calculation of V_1 on the rejected take-off distance required.~~			~~X~~	~~X~~				
(03)		Explain the time-to-decide allowance (decision time) and deceleration procedure.			X	X				
034 04 01 03		***~~Landing distance from TDP with V_1 to a complete stop on the ground~~ Intentionally left blank***								
~~LO (01)~~		~~Understand the relationship of take-off distance and landing distance from TDP with V_1 to a complete ground stop.~~			~~X~~	~~X~~				
034 04 01 04		***Take-off climb***								
(01)		Define the segments of the take-off flight path.			X	X				
(02)		Explain the effect of changes in the configuration on power and speed in the segments.			X	X				
(03)		Explain the climb-gradient requirements for OEI.			X	X				
(04)		State the minimum altitude over the take-off path when flying at ~~V_1 to~~ the take-off safety speed in a Category A helicopter (V_{TOSS}).			X	X				
(05)		Describe the influence of airspeed selection, acceleration and turns on the climb gradient and best rate-of-climb speed.			X	X				
034 04 01 05		***Obstacle-limited take-off***								
(01)		Describe the operational regulations for obstacle clearance of the take-off flight path in the departure			X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		sector with OEI.								
034 04 01 06		***Use of helicopter ~~flight~~ performance data***								
(01)		Determine from ~~the~~helicopter performance data sheets the maximum mass~~es~~ that satisf~~y~~ies ~~all~~ the operational regulations for take-off in terms of regulated take-off mass, TODRH and minimum gradients for climb and obstacle clearance.			X	X				
034 04 02 00		**Climb**								
034 04 02 01		***Climb techniques***								
(01)		Explain the effect of climbing with best rate-of-climb speed (V_Y).			X	X				
(02)		Explain the influence of altitude on V_Y.			X	X				
034 04 02 02		***Use of helicopter flight data***								
(01)		Find the rate of climb and calculate the time to climb to a given altitude.			X	X				
034 04 03 00		**Cruise**								
034 04 03 01		***Cruise techniques***								
(01)		Explain the cruise procedures for 'maximum endurance' and 'maximum range'.			X	X				
034 04 03 02		***Maximum endurance***								
(01)		Explain fuel flow in relation to true airspeed (TAS).			X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		Explain the speed for maximum endurance.			X	X				
034 04 03 03		***Maximum range***								
(01)		Explain the speed for maximum range.			X	X				
034 04 03 04		***Maximum cruise***								
(01)		Explain the speed for maximum cruise.			X	X				
034 04 03 05		***Cruise altitudes***								
(01)		Explain the factors which might affect or limit the operating altitude.			X	X				
(02)		Understand the relation between power setting, fuel consumption, cruising speed and altitude.			X	X				
034 04 03 06		***Use of helicopter ~~flight~~performance data***								
(01)		Determine the fuel consumption from the helicopter performance data sheets in accordance with altitude and helicopter mass.			X	X				
034 04 04 00		**En-route one engine inoperative (OEI)**								
034 04 04 01		***Requirements for en-route flights ~~for~~ with OEI***								
(01)		State the flight-path clearance requirements.			X	X				
(02)		Explain ~~the~~ drift-down techniques.			X	X				
(03)		State the reduction in the flight-path width when navigational accuracy can be achieved.			X	X				
034 04 04 02		***Use of helicopter flight data***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Find the single-engine service ceiling, range and endurance from given engine-inoperative charts.			X	X				
(02)		Find ~~the maximum continuous power settings~~OEI operating data from ~~given engine-inoperative~~suitable charts.			X	X				
(03)		Find the amount of fuel to be jettisoned in order to reduce helicopter mass.			X	X				
(04)		Calculate the relevant parameters for drift-down procedures.			X	X				
034 04 05 00		**Descent**								
034 04 05 01		***Use of helicopter flight data***								
(01)		Find the rate of descent and calculate the time to descen~~t~~d to a given altitude.			X	X				
034 04 06 00		**Landing**								
034 04 06 01		***Landing requirements***								
(01)		State the requirements for landing.			X	X				
034 04 06 02		***Landing procedures***								
(01)		Explain the procedure for critical power-unit failure ~~prior to~~ before and after the landing decision point.			X	X				
(02)		Explain that the portion of flight after the landing decision point must be carried out visually.			X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)		Explain the procedures and required obstacle clearances for landings ~~on~~ at different heliports/helidecks.			X	X				
034 04 06 03		***Use of helicopter ~~flight~~performance data***								
(01)		Determine from ~~the~~helicopter performance data sheets the maximum mass~~es~~ that ~~satisfy~~ satisfies~~all~~ the operational regulations for landing in terms of regulated landing mass, LDRH and minimum gradients for climb and obstacle clearance.			X	X				

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Appendix to Annex I to ED Decision 2018/001/R

'Acceptable Means of Compliance (AMCs) and Guidance Material (GM) to Part-FCL Amendment 4'

Appendix
'SUBJECT 040 — HUMAN PERFORMANCE AND LIMITATIONS'
to
AMC1 FCL.310; FCL.515(b); FCL.615(b)
'Theoretical knowledge examinations'
of Annex I

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SUBJECT 040 — HUMAN PERFORMANCE AND LIMITATIONS

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
040 00 00 00		**HUMAN PERFORMANCE AND LIMITATIONS**								
040 01 00 00		**HUMAN FACTORS: BASIC CONCEPTS**								
040 01 01 00		**Human factors in aviation**								
040 01 01 01		***Becoming a competent pilot***								
(01)		State that competen~~cy~~ce is based on knowledge, skills and ~~abilities~~ attitudes of the individual pilot and list the ICAO eight core competencies: — application of procedures; — communication; — aircraft flight path management, automation; — aircraft flight path management, manual control; — leadership and teamwork; — problem solving and decision making; — situation awareness; — workload management.	X	X	X	X	X	X		
~~(02)~~		~~Outline the factors in training that will ensure the future competency of the individual pilot.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
040 01 02 00		**~~Accident statistics~~ Intentionally left blank**								
~~(01)~~		~~Give an estimate of the accident rate in commercial~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~aviation in comparison to other means of transport.~~								
~~(02)~~		~~State in general terms the percentage of aircraft accidents which are caused by human factors.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~Summarise the accident trend in modern aviation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~Identify the role of accident in developing a strategy for future improvements to flight safety.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
040 01 03 00		**Flight safety concepts**								
040 01 03 01		***Threat and error management (TEM) model and SHELL model***								
(01)		Explain the three components of the ~~(~~TEM~~)~~ model.	X	X	X	X	X	X	X	
(02)		Explain and give examples of latent threats.	X	X	X	X	X	X	X	
(03)		Explain and give examples of environmental threats.	X	X	X	X	X	X	X	
(04)		Explain and give examples of organisational threats.	X	X	X	X	X	X	X	
(05)		Explain and give a definition of 'error' according to the TEM model of ICAO ~~Annex 1~~ Doc 9683 (Part II, Chapter 2).	X	X	X	X	X	X	X	
(06)		Give examples of different countermeasures which may be used in order to manage threats, errors and undesired aircraft states.	X	X	X	X	X	X	X	
(07)		Explain and give examples of procedural error, communication errors, and aircraft handling errors.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(08)		Explain and give examples of 'undesired aircraft states'.	X	X	X	X	X	X		
(09)		~~Describe and compare~~ State the ~~elements~~ components of the SHELL model.	X	X	X	X	X	X		
(10)		~~Summarise~~ State the relevance of the SHELL model to the work in the cockpit.	X	X	X	X	X	X		
~~(11)~~		~~Analyse the interaction between the various components of the SHELL model.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(12)~~		~~Explain how the interaction between individual crew members can affect flight safety.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (13)~~		~~Identify and explain the interaction between flight crew and management as a factor in flight safety.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
040 01 04 00		**Safety culture**								
040 01 04 01		***Safety culture and safety management***								
(01)		Distinguish between 'open cultures' and 'closed cultures'.	X	X	X	X	X	X	X	
(02)		Illustrate how safety culture is reflected in national culture.	X	X	X	X	X	X	X	
(03)		~~Question~~ Discuss the established expression 'safety first' in a commercial entity.	X	X	X	X	X	X		
(04)		Explain James Reason's 'Swiss Cheese Model'.	X	X	X	X	X	X	X	
(05)		State the important factors that promote a good safety	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		culture.								
(06)		Distinguish between 'just culture' and 'non-punitive culture'.	X	X	X	X	X	X	X	
(07)		Name the five components which form safety culture (according to James Reason: informed culture, reporting culture, learning culture, just culture, flexible culture).	X	X	X	X	X	X	X	
(08) New		Name the basic concepts of safety management system (SMS) (including hazard identification and risk management) and its relationship with safety culture in order to: — define how the organisation is set up to manage risks; — identify workplace risk and implement suitable controls; — implement effective communication across all levels of the organisation.	X	X	X	X	X	X	X	
040 02 00 00		**Basics of aviation physiology and health maintenance**								
040 02 01 00		**Basics of flight physiology**								
040 02 01 01		***The atmosphere***								
~~LO (01)~~		~~State the units used in measuring total and partial pressures of the gases in the atmosphere.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (02)~~		~~State in terms of % and mm Hg the values of oxygen,~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~nitrogen and other gases present in the atmosphere.~~								
(03)		State that the volume percentage of the gases in ambient air will remain constant ~~for~~ at all altitudes at which conventional aircraft operate.	X	X	X	X	X	X		
~~LO (04)~~		~~State the physiological significance of the following laws:~~ ~~— Boyle's Law;~~ ~~— Dalton's Law;~~ ~~— Henry's Laws;~~ ~~— the General Gas Law.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (05)~~		~~State the ICAO standard temperature at Mean Sea Level and the Standard Temperature Lapse Rate.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(06)~~		~~State at what approximate altitudes in the standard atmosphere the atmospheric pressure will be ¼, ½ and ¾ of MSL pressure.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(07)~~		~~State the effects of increasing altitude on the overall pressure and partial pressures of the various gases in the atmosphere.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (08)~~		~~Explain the differences in gas expansion between alveolar and ambient air when climbing.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (09)~~		~~State the condition required for human beings to be able to survive at any given altitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (10)~~		~~State and explain the importance of partial pressure.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
040 02 01 02		***Respiratory and circulatory system***								
(01)		List the main components of the respiratory system and their function.	X	X	X	X	X	X		
(02)		Identify the different volumes of air in the lungs and state the normal respiratory rate.	X	X	X	X	X	X		
~~(03)~~		~~State how oxygen and carbon dioxide are transported throughout the body.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~Explain the process by which oxygen is transferred to the tissues and carbon dioxide is eliminated from the body and the oxygen requirement of tissues.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(05)		Explain the role of carbon dioxide in the control and regulation of respiration.	X	X	X	X	X	X		
(06)		Describe the basic processes of external respiration and internal respiration.	X	X	X	X	X	X		
(07)		List the factors that determine~~ing~~ pulse rate.	X	X	X	X	X	X		
(08)		Name the major components of the circulatory system and describe their function.	X	X	X	X	X	X		
(09)		State the values for a normal pulse rate and the average cardiac output (heart rate × stroke volume) of an adult at rest.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~(10)~~		~~Name the four chambers of the heart and state the function of the individual chambers.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(11)~~		~~Differentiate between arteries, veins and capillaries in their structure and function.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(12)~~		~~State the functions of the coronary arteries and veins.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(13)		Define 'systolic' and 'diastolic' blood pressure.	X	X	X	X	X	X		
(14)		State the normal blood pressure ranges and units of measurement.	X	X	X	X	X	X		
~~(15)~~		~~State that in an average pilot blood pressure will rise slightly with age as the arteries lose their elasticity.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(16)		List the main constituents of ~~the~~ blood and describe their functions.	X	X	X	X	X	X		
(17)		Stress the function of haemoglobin in the circulatory system.	X	X	X	X	X	X		
(18)		Define 'anaemia' and state its common causes.	X	X	X	X	X	X		
(19)		Indicate the effect of increasing altitude on haemoglobin oxygen saturation.	X	X	X	X	X	X		
		Hypertension and hypotension								
(20)		Define 'hypertension' and 'hypotension'.	X	X	X	X	X	X		
(21)		List the effects that high and low blood pressure will have on some normal functions of the human body.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(22)		State that both hypotension and hypertension may disqualify ~~the~~ a pilot from obtaining ~~a~~ medical clearance to fly.	X	X	X	X	X	X		
(23)		List the factors which can lead to hypertension ~~in~~ for an individual.	X	X	X	X	X	X		
(24)		State the corrective actions that may be taken to reduce high blood pressure.	X	X	X	X	X	X		
(25)		Stress that hypertension is the major factor of strokes in the general population.	X	X	X	X	X	X		
		Coronary artery disease								
(26)		Differentiate between 'angina' and 'heart attack'.	X	X	X	X	X	X		
(27)		Explain the major risk factors for coronary disease.	X	X	X	X	X	X		
(28)		State the role ~~played by~~ physical exercise plays in reducing the chances of developing coronary disease.	X	X	X	X	X	X		
		Hypoxia								
(29)		Define the two major forms of hypoxia (hypoxic and anaemic), and the common causes of both.	X	X	X	X	X	X		
(30)		State the symptoms of hypoxia.	X	X	X	X	X	X		
~~LO (31)~~		~~State why living tissues require oxygen.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(32)		State that healthy people are able to compensate for altitudes up to approximately 10 000–12 000 ft.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(33)		Name the three physiological thresholds and allocate the corresponding altitudes for each of them~~.~~: — reaction threshold (7 000 ft); — disturbance threshold (10–12 000 ft); and — critical threshold (22 000 ft).	X	X	X	X	X	X		
(34)		State the altitude at which short-term memory begins to be affected by hypoxia.	X	X	X	X	X	X		
(35)		Define the terms ‘time of useful consciousness’ (TUC) and ‘effective performance time’ (EPT).	X	X	X	X	X	X		
(36)		State that TUC varies ~~between~~among individuals, but the approximate values for a person seated (at rest) are: 20 000 ft 30 min 30 000 ft 1–2 min 35 000 ft 30–90 s~~ec~~ 40 000 ft ~~a)~~ 15–20 s~~ec~~	X	X	X	X	X	X		
~~(37)~~		~~Explain the dangers of flying above 10 000 ft without using additional oxygen or being in a pressurised cabin.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(38)		List the factors that determine~~ing~~ the severity of hypoxia.	X	X	X	X	X	X		
~~(39)~~		~~State the precautions to be taken when giving blood.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(40)		State the equivalent altitudes when breathing ambient	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		air and 100 % oxygen ~~for~~ at mean sea level (MSL) and at approximately 10 000, 30 000 and 40 000 ft.								
		Hyperventilation								
(41)		Describe the role of carbon dioxide in hyperventilation.	X	X	X	X	X	X		
(42)		Define the term 'hyperventilation'.	X	X	X	X	X	X		
(43)		List the factors that cause~~ing~~ hyperventilation.	X	X	X	X	X	X		
(44)		State that hyperventilation may be caused by psychological or physiological reasons.	X	X	X	X	X	X		
(45)		List the signs and symptoms of hyperventilation.	X	X	X	X	X	X		
~~LO (46)~~			~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(47)		List the measures which may be taken to counteract hyperventilation: breath slowly, close one opening of the nose, speak loudly, place a paper bag over nose and mouth.	X	X	X	X	X	X		
		Decompression sickness/illness								
(48)		State the normal range of cabin pressure altitude in pressurised commercial air transport aircraft and describe its protective function for aircrew and passengers.	X	X	X	X	X	X		
(former 55)		List the vital actions the crew has to perform when cabin pressurisation is lost (oxygen mask on, emergency descent, land as soon as possible, and no further flight for the next minimum 24 hours). State	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		that decompression sickness symptoms can occur up to 24 hours later.								
(49)		Identify the causes of decompression sickness in flight operation.	X	X	X	X	X	X		
(50)		State how decompression sickness can be prevented.	X	X	X	X	X	X		
~~LO (51)~~		~~State the threshold for the onset of decompression sickness in terms of altitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (52)~~		~~State the approximate altitude above which decompression sickness is likely to occur.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(53)		List the symptoms of decompression sickness (bends, creeps, chokes, staggers).	X	X	X	X	X	X		
(54)		Indicate how decompression sickness may be treated.	X	X	X	X	X	X		
~~(55)~~		~~List the vital actions the crew has to perform when cabin pressurisation is lost.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(56)		Define the hazards of diving and flying, and give the recommendations associated with these activities.	X	X	X	X	X	X		
		Acceleration								
(57)		Define ‘linear acceleration’ and ‘angular acceleration’ ~~and ‘radial acceleration’~~.	X	X	X	X	X	X	X	
(58)		Describe the effects of z-acceleration on the circulation and blood volume distribution.	X	X	X	X	X	X	~~X~~	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(59)		List magnitude, duration and onset as ~~the~~ factors that determine~~ing~~ the effects of acceleration on the human body.	X	X	X	X	X	X	X	
~~(60)~~		~~Describe the measures which may be taken to increase tolerance to positive acceleration.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(61)		List the effects of positive acceleration with respect to type, sequence and ~~the~~ corresponding G-load.	X	X	X	X	X	X	~~X~~	
		Carbon monoxide								
(62)		State how carbon monoxide ~~may be~~is produced.	X	X	X	X	X	X		
(63)		State how the presence of carbon monoxide in the blood affects the distribution of oxygen.	X	X	X	X	X	X		
(64)		List the signs and symptoms of carbon-monoxide poisoning.	X	X	X	X	X	X		
(65)		~~Indicate how~~ Explain immediate countermeasures on suspicion of carbon-monoxide poisoning and how poisoning can be treated later on the ground ~~and countermeasures that can be adopted.~~	X	X	X	X	X	X		
040 02 01 03		***High-altitude environment***								
		~~Ozone~~								
(01)		State how an increase in altitude may change the proportion of ozone in the atmosphere and that aircraft can be equipped with special ozone removers.	X		~~X~~	~~X~~				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (02)~~		~~List the possible harmful effects of ozone.~~	~~X~~		~~X~~	~~X~~				
		Radiation								
(03)		State the sources of radiation at high altitude.	X		~~X~~	~~X~~				
(04)		List the effects of excessive exposure to radiation.	X		~~X~~	~~X~~				
~~LO (05)~~		~~State the effect of sun storms on the amount of radiation at high altitude.~~	~~X~~		~~X~~	~~X~~				
~~LO (06)~~		~~List the harmful effects that may result from the extra radiation that may be generated as the result of a sun storm (solar flares).~~	~~X~~		~~X~~	~~X~~				
~~LO (07)~~		~~List the methods of reducing the effects of extra radiation that may be generated as the result of a sun storm (solar flares).~~	~~X~~		~~X~~	~~X~~				
		Humidity								
~~(08)~~		~~Define the terms 'humidity' and 'relative humidity'.~~	~~X~~		~~X~~	~~X~~				
(09)		List the factors ~~which~~that affect the relative humidity of both the atmosphere and cabin air.	X		~~X~~	~~X~~				
~~LO (10)~~		~~State the methods of reducing the effects of insufficient humidity.~~	~~X~~		X	X				
(11)		~~List the physiological effects of dry cabin air on the human body and indicate measures to diminish these effects. Stress the effects that low humidity can have on the efficient functioning of the eye.~~ List the effects	X		X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		of low humidity on the human body to be spurious thirst, dry eyes, skin and mucous membranes and indicate measures that can be taken: drinking water, using eye drops and aqueous creams.								
		~~***Extreme temperatures***~~								
~~LO (12)~~		~~Explain the change in the need for oxygen of the human body when exposed to extreme environmental temperatures.~~	~~X~~		~~X~~	~~X~~				
040 02 02 00		**~~Man~~People and the environment: the sensory system**								
040 02 02 01		***The different senses***								
(01)		List the different senses.	X	X	X	X	X	X	X	
~~LO (02)~~		~~State the multisensory nature of human perception.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
040 02 02 ~~01~~02		***Central, peripheral and autonomic nervous systems***								
~~(01)~~		~~Name the main parts of the central nervous system.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~State the basic functions of the central nervous system (CNS), the peripheral nervous system (PNS), and the autonomic (vegetative) nervous system (ANS).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~Discuss broadly how information is processed by the nervous system and the role of reflexes.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~Define the division of the peripheral nerves into sensory and motor nerves.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
~~(05)~~		~~State that a nerve impulse is an electrochemical phenomenon.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(06)		Define the term ‘sensory threshold’.	X	X	X	X	X	X		
(07)		Define the term ‘sensitivity’, especially in the context of vision.	X	X	X	X	X	X		
(08)		Give examples of sensory adaptation.	X	X	X	X	X	X		
(09)		Define the term ‘habituation’ and state its implication for flight safety.	X	X	X	X	X	X		
~~(10)~~		~~Define the biological control systems as neurohormonal processes that are highly self-regulated in the normal environment.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
040 02 02 ~~02~~03		***Vision***								
		Functional anatomy								
(01)		Name the most important parts of the eye and the pathway to the visual cortex.	X	X	X	X	X	~~X~~		
(02)		State the basic functions of the parts of the eye.	X	X	X	X	X	X		
(03)		Define ‘accommodation’.	X	X	X	X	X	X		
(04)		Distinguish between the functions of the rod and cone cells.	X	X	X	X	X	X		
(05)		Describe the distribution of rod and cone cells in the retina and explain their relevance to~~n~~ vision.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~Visual~~ The foveal~~l~~ (fovea centralis) and peripheral vision								
(06)		Explain the terms 'visual acuity', 'visual field', 'central vision', 'peripheral vision' and 'the fovea', and explain their function in the process of vision.	X	X	X	X	X	X		
(07)		List the factors ~~which~~that may degrade visual acuity and the importance of 'lookout'.	X	X	X	X	X	X		
(08)		State the limitations of night vision and the different scanning techniques ~~by~~at both night and day~~ (regularly spaced eye movements each covering an overlapping sector of about 10°)~~.	X	X	X	X	X	X		
~~(09)~~		~~Explain the adaptation mechanism in vision to cater for reduced and increased levels of illumination.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(10)		State the time necessary for the eye to adapt both to dark and bright light.	X	X	X	X	X	X		
(11)		State the effect of hypoxia, ~~and~~ smoking and altitude in excess of 5 000 ft on night vision.	X	X	X	X	X	X		
(12)		Explain the nature of colour blindness. ~~and the significance of the 'blind spot' on the retina in detecting other traffic in flight.~~	X	X	X	X	X	X		
		Binocular and monocular vision								
(13)		Distinguish between monocular and binocular vision.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(14)		Explain the basis of depth perception and its relevance to flight performance.	X	X	X	X	X	X		
(15)		List the possible monocular cues for depth perception.	X	X	X	X	X	X		
(16)		~~State the problems of vision associated with higher energy blue light and ultraviolet rays.~~ State that for high energy blue light and UV rays sunglasses can prevent damage to the retina	X	X	X	X	X	X		
		Defective vision								
(17)		Explain long-sightedness, short-sightedness and astigmatism.	X	X	X	X	X	X		
(18)		List the causes of and the precautions that may be taken to reduce the probability of vision loss due to: — presbyopia~~,~~; — cataracts~~,~~; — glaucoma.	X	X	X	X	X	X		
(19)		List the types of sunglasses ~~which~~that could cause perceptional problems in flight.	X	X	X	X	X	X		
(20)		List the measures ~~which~~that may be taken to protect oneself from flash blindness.	X	X	X	X	X	X		
(21)		State the possible problems associated with contact lenses.	X	X	X	X	X	X		
(22)		State the current rules/regulations governing the	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		wearing of corrective spectacles and contact lenses when operating as a pilot.								
(023)		Explain the significance of the 'blind spot' on the retina in detecting other traffic in flight.	X	X	X	X	X	X		
040 02 02 ~~03~~04		***Hearing***								
		Descriptive and functional anatomy								
~~LO (01)~~		~~State the audible range of the human ear.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~State the unit of measure for the intensity of sound.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~Name the most important parts of the ear and the associated neural pathway.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(04)		State the basic parts and functions of the outer, the middle and the inner ear. ~~different parts of the auditory system.~~	X	X	X	X	X	X		
(05)		Differentiate between the functions of the vestibular apparatus and the cochlea in the inner ear.	X	X	X	X	X	X		
~~(06)~~		~~State the role of the Eustachian tube in equalising pressure between the middle ear and the environment.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(07)~~		~~Indicate the effects of colds flu on the ability to equalise pressure in the above.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
		Hearing loss								
(08)		Define the main causes of the following hearing	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		defects/loss: — 'conductive deafness'; — 'n~~N~~oise-i~~I~~nduced h~~H~~earing l~~L~~oss' (NIHL); — 'presbycusis'.								
(09)		Summarise the effects of environmental noise on hearing.	X	X	X	X	X	X		
(10)		State the decibel level of received noise that will cause NIHL.	X	X	X	X	X	X		
~~LO (11)~~		~~Indicate the factors, other than noise level, which may lead to NIHL.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(12)		Identify the potential occupational risks ~~which~~that may cause hearing loss.	X	X	X	X	X	X		
(13)		List the main sources of hearing loss in the flying environment.	X	X	X	X	X	X		
(14)		List the precautions that may be taken to reduce the probability of onset of hearing loss.	X	X	X	X	X	X		
040 02 02 ~~04~~05		***Equilibrium***								
		Functional anatomy								
(01)		List the main elements of the vestibular apparatus.	X	X	X	X	X	X	~~X~~	
(02)		State the functions of the vestibular apparatus on the ground and in flight.	X	X	X	X	X	X	~~X~~	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)		Distinguish between the component parts of the vestibular apparatus in the detection of linear and angular acceleration as well as on gravity.	X	X	X	X	X	X	~~X~~	
(04)		Explain how the semicircular canals are stimulated.	X	X	X	X	X	X	~~X~~	
		Motion sickness								
(05)		Describe air sickness and its accompanying symptoms.	X	X	X	X	X	X	X	
~~(06)~~		~~Indicate that vibration can cause undesirable human responses because of the resonance of the skull and the eyeballs.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(07)		List the causes of ~~motion~~air sickness.	X	X	X	X	X	X	X	
(08)		Describe the necessary actions to be taken to counteract the symptoms of ~~motion~~air sickness.	X	X	X	X	X	X		
040 02 02 ~~05~~06		***Integration of sensory inputs***								
(01)		State the interaction between vision, equilibrium, proprioception and hearing to obtain spatial orientation in flight.	X	X	X	X	X	X	X	
(02)		Define the term ‘illusion’.	X	X	X	X	X	X	X	
(03)		Give examples of visual illusions based on shape constancy, size constancy, aerial perspective, atmospheric perspective, the absence of focal or ambient cues, autokinesis, vectional false horizons, field myopia and surface planes.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		Relate these illusions to problems that may be experienced in flight and identify the danger attached to them.	X	X	X	X	X	X	X	
~~(05)~~		~~State the conditions which cause the 'black-hole' effect and 'empty-field myopia'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(06)		~~Give examples of approach and landing illusions, state the danger involved and give recommendations to avoid or counteract these problems.~~ List approach and landing illusions for slope of the runway, black-hole approach, and terrain around runway, and state the danger involved with recommendations to avoid or counteract the problems with high or low approach or flare at the wrong time.	X	X	X	X	X	X	X	
(07)		State the problems associated with flickering lights (strobe lights, anti-collision lights, propellers and rotors under certain light conditions, etc.).	X	X	X	X	X	X	X	
(08)		~~Give examples of vestibular illusions such as somatogyral (the Leans), Coriolis, somatogravic and G-effect illusions.~~ Describe vestibular illusions caused by the angular accelerations (the Leans, Coriolis) and linear accelerations (somatogravic, G-effect).	X	X	X	X	X	X	X	
(09)		Relate the above-mentioned vestibular illusions to problems encountered in flight and state the dangers involved.	X	X	X	X	X	X	X	
~~(10)~~		~~List and describe the function of the proprioceptive~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~senses ('seat-of-the-pants' sense).~~								
~~LO (11)~~		~~Relate illusions of the proprioceptive senses to the problems encountered during flight.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(12)		State that the 'seat-of-the-pants' sense is completely unreliable when visual contact with the ground is lost or when flying in instrument meteorological conditions (IMC) or with a poor visual horizon.	X	X	X	X	X	X	X	
(13)		Differentiate between vertigo, Coriolis effect and spatial disorientation.	X	X	X	X	X	X	X	
~~(14)~~		~~Explain the flicker effect (stroboscopic effect) and discuss the countermeasures.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~(15)~~		~~Explain how spatial disorientation can result from a mismatch in sensory input and information processing.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(16)		List the measures to prevent ~~and/~~or overcome spatial disorientation.	X	X	X	X	X	X	X	
040 02 03 00		**Health and hygiene**								
040 02 03 01		~~***Personal hygiene***~~ ***Intentionally left blank***								
~~LO (01)~~		~~Summarise the role of personal hygiene as a factor in human performance.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
040 02 03 02		***Body rhythm and sleep***								
(01)		Name some internal body rhythms and their relevance to sleep. Explain that the most important of which is	X	X	X	X	~~X~~			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		body temperature.								
(02)		Explain the term 'circadian rhythm'.	X	X	X	X	X			
(03)		State the approximate duration of a 'free-running' rhythm.	X	X	X	X	X			
(04)		Explain the significance of the 'internal clock' in regulating the normal circadian rhythm.	X	X	X	X	X			
(05)		State the effect of the circadian rhythm of body temperature on an individual's performance standard and ~~the effect~~ on an individual's sleep patterns.	X	X	X	X	X			
(06)		List and describe the stages of a sleep cycle.	X	X	X	X	X			
(07)		Differentiate between rapid eye movement (REM) and non-REM sleep.	X	X	X	X	X			
(08)		Explain the function of sleep and describe the effects of insufficient sleep on performance.	X	X	X	X	X			
(09)		Explain the simple calculations for the sleep/wake credit/debit situation.	X	X	X	X	X			
(10)		Explain how sleep debit can become cumulative.	X	X	X	X	X			
(11)		State the time formula for the adjustment of body rhythms to the new local time scale after crossing time zones.	X	X	X	X	X			
(12)		State the problems caused by circadian disrhythmia (jet lag) with regard to an individual's performance and	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		sleep.								
(13)		Differentiate between the effects of westbound and eastbound travel.	X	X	X	X	X			
(14)		Explain the interactive effects of circadian rhythm and vigilance on a pilot's performance during flight as the duty day elapses.	X	X	X	X	X			
(15)		Describe the main effects of lack of sleep on an individual's performance.	X	X	X	X	X			
(16)		List the possible ~~coping~~ strategies to cope with ~~for~~ jet lag.	X	X	X	X	X			
040 02 03 03		***Problem areas for pilots***								
		Common minor ailments								
(01)		State the role of the Eustachian tube in equalising pressure between the middle ear and the environment.	X	X	X	X	X	X		
(02)		State that the in-flight environment may increase the severity of symptoms which may be minor while on the ground.	X	X	X	X	X	X		
(03)		List the negative effects of suffering from colds or flu on flight operations especially with regard to the middle ear, the sinuses, and the teeth.	X	X	X	X	X	X		
~~(04)~~		~~Indicate the effects of colds or flu on the ability to equalise pressure between the middle ear and the~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~environment.~~								
(05)		State when a pilot should seek medical advice from an aeromedical examiner (AME) or aeromedical center (AeMC)~~, and when the aeromedical section of an authority should be informed~~.	X	X	X	X	X	X		
(06)		Describe the measures to prevent ~~and/~~or clear problems due to pressure changes during flight.	X	X	X	X	X	X		
		Entrapped gases and barotrauma								
(07)		Define 'barotrauma'.	X	X	X	X	X	X		
(08)		Differentiate between otic, sinus, gastrointestinal and aerodontalgia (of the teeth) barotraumas and explain avoidance strategies.	X	X	X	X	X	X		
(09)		Explain why the effects of otic barotrauma can be worse in the descent.	X	X	X	X	X	X		
		Gastrointestinal upsets								
(10)		State the effects of gastrointestinal upsets that may occur during flight.	X	X	X	X	X	X		
(11)		List the precautions that should be observed to reduce the occurrence of gastrointestinal upsets.	X	X	X	X	X	X		
(12)		Indicate the major sources of gastrointestinal upsets.	X	X	X	X	X	X		
		Obesity								

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
(13)		Define 'obesity'.	X	X	X	X	X	X		
~~(14)~~		~~State the cause of obesity.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(15)		State the following harmful effects ~~of~~ obesity ~~on the following~~ can cause: — possibility of developing coronary problems; — increased chances of developing diabetes; — reduced ability to withstand G-forces; — ~~the~~ development of problems with the joints of the limbs; — general circulatory problems; — reduced ability to cope with hypoxia ~~and/~~or decompression sickness — sleep apnoea.	X	X	X	X	X	X		
~~(16)~~		~~State the relationship between obesity and body mass index (BMI).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(17)~~		~~Calculate the BMI of an individual (given weight in kilograms and height in metres) and state whether this BMI indicates that the individual is underweight, overweight, obese or within the normal range of body weight.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(18)		Describe the problems associated with Type 2 (mostly adult) diabetes:	X	X	X	X	X	X		

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— risk factors; — insulin resistance; — complications (vascular, neurological) and the consequences for the medical licence; — pilots are not protected from Type 2 diabetes more than other people.								
		~~***Back pain***~~								
(19)		Describe the typical back problems (unspecific back pain, slipped disc) that pilots have. Explain also the ways of preventing and treating these problems: — good sitting posture; — lumbar support; — good physical condition; — in-flight exercise, if possible; — physiotherapy.	X	X	X	X	X	X		
		Food hygiene								
~~LO (20)~~		~~Explain the significance of food hygiene with regard to general health.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(21)		Stress the importance of and methods to be adopted by aircrew especially when travelling abroad to avoid contaminated food and liquids.	X	X	X	X	X	X		
(22)		List the major contaminating sources in foodstuffs.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(23)		State the major constituents of a healthy diet.	X	X	X	X	X	X		
(24)		State the measure to avoid hypoglycaemia.	X	X	X	X	X	X		
~~LO (25)~~		~~State the role vitamins and trace elements are playing in a healthy diet.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(26)		State the importance of adequate hydration.	X	X	X	X	X	X		
	~~1.1.1.~~	~~1.1.1.1.1.2~~ **Tropical climates**								
(27)		List the problems associated with operating in tropical climates.	X	X	X	X	X			
(28)		State the possible causes/sources of incapacitation in tropical ~~or poorly developed~~ countries with reference to: — standards of hygiene; — quality of water supply; — insectborne diseases; — parasitic worms; — rabies or other diseases that may be spread through~~by~~ contact with animals; — sexually transmitted diseases.	X	X	X	X	X			
(29)		State the precautions to be taken to reduce the risks of developing problems in tropical areas.	X	X	X	X	X			
		Infectious diseases								

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
(30)		State the major infectious diseases that may ~~kill or~~ severely incapacitate or kill individuals.	X	X	X	X	X	X		
~~LO (31)~~		~~State which preventative hygienic measures, vaccinations, drugs and other measures reduce the chances of catching these diseases.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(32)		State the precautions ~~which~~ that must be taken to ensure that disease-carrying insects are not transported between areas.	X	X	X	X	X	X		
040 02 03 04		***Intoxication***								
		Tobacco								
(01)		State the harmful effects of tobacco on: — the respiratory system; — the cardiovascular system; — the ability to resist hypoxia; — the ability to ~~tolerate~~ withstand G-forces; — night vision.	X	X	X	X	X	X		
		Caffeine								
(02)		Indicate the level of caffeine dosage at which performance is degraded.	X	X	X	X	X	X		
(03)		Besides coffee, indicate other beverages containing caffeine.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Alcohol								
(04)		State the maximum acceptable limit of alcohol for flight crew according to the applicable regulations.	X	X	X	X	X	X		
(05)		State the effects of alcohol consumption on: — the ability to reason; — inhibitions and self-control; — vision; — the sense of balance and sensory illusions; — sleep patterns; — hypoxia.	X	X	X	X	X	X		
(06)		State the effects alcohol may have if consumed together with other drugs.	X	X	X	X	X	X		
(07)		List the signs and symptoms of alcoholism.	X	X	X	X	X	X		
(08)		List the factors ~~which~~ that may be associated with the development of alcoholism.	X	X	X	X	X	X		
(09)		Define the 'unit' of alcohol and state the approximate elimination rate from the blood.	X	X	X	X	X	X		
(10)		State the maximum daily and weekly intake of units of alcohol which may be consumed without causing damage to the organs and systems ~~in~~of the human body.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(11)		Discuss the actions that might be taken if a crew member is suspected of being an alcoholic.	X		X	X				
~~(12)~~		~~State the reasons why aviation professions are particularly vulnerable to the excessive use of alcohol.~~	~~X~~		~~X~~	~~X~~				
		Prescription and non-prescription ~~D~~drugs and self-medication								
(13)		State the dangers associated with the use of non-prescription drugs.	X	X	X	X	X	X		
(14)		State the side effects of common non-prescription drugs used to treat colds, flu, hay fever and other allergies, especially medicines containing antihistamine preparations.	X	X	X	X	X	X		
(15)		Interpret the rules relevant to using (prescription or non-prescription) drugs that the pilot has not used before.	X	X	X	X	X	X		
(16)		Interpret the general rule that 'if a pilot is so unwell that they require any medication, then they should consider themselves unfit to fly'.	X	X	X	X	X	X		
		Toxic materials								
(17)		List those materials present in an aircraft which may, when uncontained, cause severe health problems.	X	X	X	X	X	X		
(18)		List those aircraft-component parts which if burnt may	X	X	X	X	X	X		

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		give off toxic fumes.								
(19) New		Describe a fume event and the possible incapacitating effects on those exposed to it.	X	X	X	X	X	X		
040 02 03 05		***Incapacitation in flight***								
(01)		State that incapacitation is most dangerous when its onset is insidious.	X	X	X	X	X	X		
(02)		List the major causes of in-flight incapacitation.	X	X	X	X	X	X		
(03)		State the importance of crew to be able to recognise and promptly react upon incapacitation of other crew members, should it occur in flight.	X		X	X				
(04)		Explain ~~coping~~ methods and procedures to cope with incapacitation in flight.	X	X	X	X	X	X		
040 03 00 00		**BASIC AVIATION PSYCHOLOGY**								
040 03 01 00		**Human information processing**								
040 03 01 01		***Attention and vigilance***								
(01)		Differentiate between 'attention' and 'vigilance'.	X	X	X	X	X	X		
(02)		Differentiate between 'selected' and 'divided' attention.	X	X	X	X	X	X		
(03)		Define 'hypovigilance'.	X	X	X	X	X	X		
(04)		Identify the factors ~~which~~ that may affect the state of vigilance.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(05)		List the factors that may forestall hypovigilance during flight.	X	X	X	X	X	X		
(06)		Indicate the signs of reduced vigilance.	X	X	X	X	X	X		
(07)		~~Name~~ List the factors that affect a person's level of attention.	X	X	X	X	X	X		
040 03 01 02		***Perception***								
(01)		Name the basis of the perceptual process.	X	X	X	X	X	X		
(02)		Describe the mechanism of perception ('bottom-up'/'top-down' process).	X	X	X	X	X	X		
(03)		Illustrate why perception is subjective and state the relevant factors ~~which~~ that influence interpretation of perceived information.	X	X	X	X	X	X		
(04)		Describe some basic perceptual illusions.	X	X	X	X	X	X		
(05)		Illustrate some basic perceptual concepts.	X	X	X	X	X	X		
(06)		Give examples where perception plays a decisive role in flight safety.	X	X	X	X	X	X		
(07)		Stress how persuasive and believable mistaken perception can manifest itself both ~~on~~ for an individual and a group.	X	X	X	X	X	X		
040 03 01 03		***Memory***								
(01)		Explain the link between the types of memory (to	X	X	X	X	X	X		

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		include sensory, working/short-term and long-term memory.								
(02)		Describe the differences between the types of memory in terms of capacity and retention time.	X	X	X	X	X	X		
(03)		Justify the importance of sensory-store memories in processing information.	X	X	X	X	X	X		
(04)		State the average maximum number of separate items that may be held in working memory (5 ± 2).	X	X	X	X	X	X		
(05)		Stress how interruption can affect short-term/working memory.	X	X	X	X	X	X		
(06)		Give examples of items that are important for pilots to hold in working memory during flight.	X	X	X	X	X	X		
(07)		Describe how the capacity of the working-memory store may be increased.	X	X	X	X	X	X		
(08)		State the subdivisions of long-term memory and give examples of their content.	X	X	X	X	X	X		
(09)		Explain that skills are kept primarily in the long-term memory.	X	X	X	X	X	X		
(10)		Describe amnesia and how it affects memory.	X	X	X	X	X	X		
(11)		Name the common problems with both the long- and short-term memories and the best methods to try to counteract them.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
040 03 01 04		***Response selection***								
		Learning principles and techniques								
(01)		Explain and distinguish between the following basic forms of learning: — classic and operant conditioning (behaviouristic approach); — learning by insight (cognitive approach); — learning by imitating (modelling).	X	X	X	X	X	X		
(02)		~~Find~~ Recognise pilot-related examples as behaviouristic, cognitive or modelling forms of ~~for each of these~~ learning ~~forms~~.	X	X	X	X	X	X		
(03)		State the factors ~~which~~that are necessary for and promote the quality of learning: — intrinsic motivation; — good mental health; — rehearsals for improvement of memory; — consciousness; — vigilance; — application in practical exercises.	X	X	X	X	X	X		
(04)		Explain ways to facilitate the memorisation of information with the following learning techniques: — mnemonics;	X	X	X	X	X	X		

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— mental training.								
(05)		Describe the advantage of planning and anticipation of future actions: — define the term ‘skills’; — state the three phases of learning a skill (Anderson: cognitive, associative and autonomous phase).	X	X	X	X	X	X		
(06)		Explain the term ‘motor programme’ or ‘mental schema’.	X	X	X	X	X	X		
(07)		Describe the advantages and disadvantages of mental ~~schemata~~ schemas.	X	X	X	X	X	X		
(08)		Explain the Rasmussen model which describes the guidance of a pilot’s behaviour in different situations.	X	X	X	X	X	X		
(09)		State the possible problems or risks associated with skill~~-based~~, rule~~-based~~ and knowledge-based behaviour.	X	X	X	X	X	X		
~~LO (10)~~		~~Explain the following phases in connection with the acquisition of automated behaviour:~~ ~~— cognitive phase;~~ ~~— associative phase;~~ ~~— automatic phase.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
		Motivation								

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
(11)		Define 'motivation'.	X	X	X	X	X	X		
~~LO (12)~~		~~Explain the influences of different levels of motivation on performance taking into consideration task difficulty.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (13)~~		~~Explain the 'Model of human needs' (Maslow) and relate this to aviation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(14)		Explain the relationship between motivation and learning.	X	X	X	X	X	X		
(15)		Explain the problems of over-motivation, especially in the context of the extreme need ~~of~~to achieve~~ment~~.	X	X	X	X	X	X		
040 03 02 00		**Human error and reliability**								
040 03 02 01		***Reliability of human behaviour***								
(01)		Name and explain the factors ~~which~~that influence human reliability.	X	X	X	X	X	X		
040 03 02 02		***Mental models and situation awareness***								
(01)		Define the term 'situation awareness'.	X	X	X	X	X	X	X	
(02)		List the cues ~~which~~that indicate loss of situation awareness and name the steps to regain it.	X	X	X	X	X	X	X	
(03)		List the factors ~~which~~that influence one's situation awareness both positively and negatively, and stress the importance of situation awareness in the context of	X	X	X	X	X	X	X	

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		flight safety.								
(04)		Define the term 'mental model' in relation to a surrounding complex situation.	X	X	X	X	X	X	X	
(05)		Describe the advantages/disadvantages of mental models.	X	X	X	X	X	X	X	
(06)		Explain the relationship between personal 'mental models' and the creation of cognitive illusions.	X	X	X	X	X	X	X	
040 03 02 03		***Theory and model of human error***								
~~(01)~~		~~Define the term 'error'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(02)		Explain the concept of the 'error chain'.	X	X	X	X	X	X	X	
(03)		Differentiate between an isolated error and an error chain.	X	X	X	X	X	X	X	
(04)		Distinguish between the main forms/types of errors (i.e. slips, faults, omissions and violations).	X	X	X	X	X	X	X	
(05)		Discuss the above errors and their relevance in flight.	X	X	X	X	X	X	X	
(06)		Distinguish between an active and a latent error, and give examples.	X	X	X	X	X	X	X	
040 03 02 04		***Error generation***								
(01)		Distinguish between internal and external factors in error generation.	X	X	X	X	X	X	X	
(02)		Identify possible sources of internal error generation.	X	X	X	X	X	X	X	

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)		Define and discuss the two errors associated with motor programmes (action slip and environmental capture).	X	X	X	X	X	X	X	
(04)		List the three main sources of external error generation in the ~~cockpit~~ flight crew compartment.	X	X	X	X	X	X	X	
(05)		Give examples to illustrate the following factors in external error generation in the ~~cockpit~~ flight crew compartment: — ergonomics~~,~~; — economics~~,~~; — social environment.	X	X	X	X	X	X	X	
(06)		Name the major goals in the design of human-centred human–machine interfaces.	X	X	X	X	X	X	X	
(07)		Define the term 'error tolerance'.	X	X	X	X	X	X	X	
(08)		List ~~(~~and describe~~)~~ the strategies ~~which~~that are used to reduce human error.	X	X	X	X	X	X	X	
(09)		Describe the advantage of planning and the anticipation of future actions.	X	X	X	X	X	X	X	
040 03 03 00		**Decision-making**								
040 03 03 01		***Decision-making concepts***								
(01)		Define the terms 'deciding' and 'decision-making'.	X	X	X	X	X	X	X	

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		Describe the major factors on which decision-making should be based during the course of a flight.	X	X	X	X	X	X	X	
(03)		Describe the main human attributes with regard to decision-making.	X	X	X	X	X	X	X	
(04)		Discuss the nature of bias and its influence on the decision-making process.	X	X	X	X	X	X	X	
(05)		Describe the main error sources and limits in an individual's decision-making mechanism.	X	X	X	X	X	X	X	
(06)		State the factors upon which an individual's risk assessment is based.	X	X	X	X	X	X	X	
(07)		Explain the relationship between risk assessment, commitment and pressure of time in ~~on~~ decision-making strategies.	X	X	X	X	X	X	X	
(08)		Explain the risks associated with dispersion ~~and/~~or channelised attention during the application of procedures requiring a high workload within a short time frame (e.g. a go-around).	X	X	X	X	X	X		
(09)		Describe the positive and negative influences exerted by other group members on an individual's decision-making process (risky shift).	X	X	X	X	X	X	X	
(10)		Explain the general idea behind the creation of a model for decision-making based upon:	X	X	X	X	X	X	X	

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— definition of the aim; — collection of information; — risk assessment; — development of options; — evaluation of options; — decision; — implementation; — consequences; — review and feedback.								
040 03 04 00		**Avoiding and managing errors: cockpit management**								
_040 03 04 01_		**_Safety awareness_**								
(01)		Justify the need for being aware of not only one's own performance but that of others before and during a flight and the possible consequences ~~and/~~or risks.	X	X	X	X	X	X	X	
~~LO (02)~~		~~Stress the overall importance of constantly and positively striving to monitor for errors and thereby maintaining situation awareness.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
_040 03 04 02_		**_Coordination (multi-crew concepts)_**								
(01)		Name the objectives of the multi-crew concept.	X		X	X				
(02)		State and explain the elements of multi-crew concepts.	X		X	X				
(03)		Describe the concepts of 'standard operating	X	X	X	X	X			

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			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
		procedures' (SOPs), checklists and crew briefings.								
(04)		Describe the purpose of and procedure ~~of~~for crew briefings.	X		X	X				
(05)		Describe the purpose of and procedure ~~of~~for checklists.	X	X	X	X	X			
(06)		Describe the function of communication in a coordinated team.	X		X	X				
(07) New		Explain the advantages of SOPs.	X	X	X	X	X			
(08) New		Explain how SOPs contribute to avoiding, reducing and managing threats and errors.	X	X	X	X	X			
(09) New		Explain potential threats of SOPs, for example during company or type conversion (e.g. motor programmes, company culture, hazardous attitudes, developed habits).	X	X	X	X	X			
040 03 04 03		***Cooperation***								
(01)		Distinguish between cooperation and coaction.	X	X	X	X	X			
(02)		Define the term 'group'.	X	X	X	X	X			
(03)		Illustrate the influence of interdependence in a group.	X	X	X	X	X			
(04)		List the advantages and disadvantages of teamwork.	X	X	X	X	X			
(05)		Explain the term 'synergy'.	X	X	X	X	X			
(06)		Define the term 'cohesion'.	X	X	X	X	X			

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
(07)		Define the term 'groupthink'.	X	X	X	X	X			
(08)		State the essential conditions for good teamwork.	X	X	X	X	X			
(09)		Explain the function of role and norm in a group.	X	X	X	X	X			
(10)		Name the different role patterns which occur in a group situation.	X	X	X	X	X			
(11)		Explain how behaviour can be affected by the following factors: — persuasion~~,~~; — conformity~~,~~; — compliance~~,~~; — obedience.	X	X	X	X	X			
(12)		Distinguish between status and role.	X	X	X	X	X			
(13)		Stress the inherent dangers of a situation where there is a mix of role and status within the ~~cockpit~~ flight crew compartment.	X	X	X	X	X			
(14)		Explain the terms 'leadership' and 'followership'.	X	X	X	X	X			
(15)		Describe the trans-cockpit authority gradient and its affiliated leadership styles (i.e. autocratic, laissez-faire and synergistic).	X	X	X	X	X			
(16)		Name the most important attributes of a positive leadership style.	X	X	X	X	X			

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
040 03 04 04		***Communication***								
~~LO (01)~~		~~Explain the function of 'information'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(02)		Define the term 'communication'.	X	X	X	X	X	X		
(03)		List the most basic components of interpersonal communication.	X	X	X	X	X	X		
(04)		Explain the advantages of in-person two-way communication as opposed to one-way communication.	X	X	X	X	X	X		
~~LO (05)~~		~~Explain Watzlawick's statement 'One cannot not communicate'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(06)		~~Distinguish between verbal and non-verbal communication.~~ Explain the four elements of a great speech: — a great person; — a noteworthy event; — a compelling message; — a masterful delivery.	X	X	X	X	X	X		
(07)		Name the ~~functions~~ importance of non-verbal communication.	X	X	X	X	X	X		
(08)		Describe the general aspects of non-verbal communication.	X	X	X	X	X	X		

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
(09)		Describe the advantages/disadvantages of implicit and explicit communication.	X	X	X	X	X	X		
(10)		Describe ~~State~~ the advantages ~~attributes~~ and possible problems of using 'social' and 'professional' language in high- and low-workload situations.	X	X	X	X	X	X		
(11)		Name and explain the major obstacles to effective communication.	X	X	X	X	X	X		
~~LO (12)~~		~~Give examples of aircraft accidents arising from poor communication.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(13)		Explain the difference between intrapersonal and interpersonal conflict.	X	X	X	X	X	X		
(14)		Describe the escalation process in human conflict.	X	X	X	X	X	X		
(15)		List the typical consequences of conflicts between crew members.	X	X	X	X	X	X		
(16)		Explain the following terms as part of the communication practice with regard to preventing or resolving conflicts: — inquiry~~,~~; — active listening~~,~~; — advocacy~~,~~; — feedback~~,~~; — metacommunication~~,~~;	X	X	X	X	X	X		

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— negotiation.								
(17)		Describe the limitations of communication in situations of high workload in the flight crew compartment in view of listening, verbal, non-verbal and visual effects.	X	X	X	X	X	X		
040 03 05 00		**Human behaviour**								
040 03 05 01		***Personality, attitude and behaviour***								
(01)		Describe the factors ~~which~~that determine an individual's behaviour.	X	X	X	X	X	X		
(02)		Define and distinguish between 'personality', 'attitude' and 'behaviour'.	X	X	X	X	X	X		
(03)		State the origin of personality and attitude~~s~~.	X	X	X	X	X	X		
(04)		State that with behaviour~~s~~ good and bad habits can be formed.	X	X	X	X	X	X		
(05)		Explain how behaviour is generally a product of personality, ~~and~~ attitude and the environment to which one was exposed at significant moments (childhood, schooling and training).	X	X	X	X	X	X		
(06)		~~Discuss some~~ State ~~effects~~ that personality differences and selfish attitude~~s~~ may have effects on flight crew performance.	X	X	X	X	X	X		
040 03 05 02		***Individual differences in personality and motivation***								

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Describe the individual differences in personality by means of a common trait model (e.g. Eysenck's personality factors) and use it to describe today's ideal pilot.	X	X	X	X	X	X		
		Self-concept								
(02)		Define the term 'self-concept' and the role it plays in any change of personality.	X	X	X	X	X	X		
(03)		Explain how a self-concept of underconfidence may lead to an outward show of aggression and self-assertiveness.	X	X	X	X	X	X		
		Self-discipline								
(04)		Define 'self-discipline' and justify its importance for flight safety.	X	X	X	X	X	X		
040 03 05 03		***Identification of hazardous attitudes (error proneness)***								
(01)		Explain dangerous attitudes in aviation: — anti-authority; — macho; — impulsivity; — invulnerability; — complacency; — resignation.	X	X	X	X	X			
(02)		Describe the personality, attitude and behaviour	X	X	X	X	X			

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		patterns of an ideal crew member.								
(03)		Summarise how a person's attitude influences their work in the ~~cockpit~~ flight crew compartment.	X	X	X	X	X			
040 03 06 00		**Human overload and underload**								
040 03 06 01		***Arousal***								
(01)		Explain the term 'arousal'.	X	X	X	X	X	X		
(02)		Describe the relationship between arousal and performance.	X	X	X	X	X	X		
(03)		Explain the circumstances under which underload may occur and its possible dangers.	X	X	X	X	X	X		
040 03 06 02		***Stress***								
~~LO (01)~~		~~Explain the term 'homeostasis'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(02)		Explain the term 'stress' and why stress is a natural human reaction.	X	X	X	X	X	X		
(03)		State that the physiological response to stress is generated by the 'fight or flight' response.	X	X	X	X	X	X		
(04)		Describe the function of the autonomic nervous system (ANS) in stress response.	X	X	X	X	X	X		
~~(05)~~		~~Explain the biological reaction to stress by means of the 'general adaptation syndrome' (GAS).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(06)		Explain the relationship between arousal and stress.	X	X	X	X	X	X		

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
(07)		State the relationship between stress and performance.	X	X	X	X	X	X	X	
(08)		State the basic categories of stressors.	X	X	X	X	X	X	X	
(09)		List and discuss the major environmental sources of stress in the ~~cockpit~~ flight crew compartment.	X	X	X	X	X	X	X	
(10)		Discuss the concept of ‘break point’ with regard to stress, overload and performance.	X	X	X	X	X	X	X	
(11)		Name the principal causes of domestic stress.	X	X	X	X	X	X		
(12)		State that the stress experienced as a result of particular demands varies ~~between~~ among individuals.	X	X	X	X	X	X		
(13)		Explain the factors ~~which~~that lead to differences in the levels of stress experienced by individuals.	X	X	X	X	X	X	X	
(14)		List the factors that influence~~ing~~ the tolerance of stressors.	X	X	X	X	X	X		
(15)		~~Explain a simple model of stress.~~ State that stress is a result of perceived demands and perceived ability	X	X	X	X	X	X		
(16)		Explain the relationship between stress and anxiety.	X	X	X	X	X	X	X	
(17)		Describe the effects of anxiety on human performance.	X	X	X	X	X	X	X	
(18)		State the general effect of acute stress on people ~~the human system.~~	X	X	X	X	X	X	X	
~~(19)~~		~~Name the three phases of GAS.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~(20)~~		~~Name the symptoms of stress relating to the different~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~phases of GAS.~~								
(21)		Describe the relationship between stress, arousal and vigilance.	X	X	X	X	X	X		
(22)		State the general effect of chronic stress ~~on the human system~~ and the biological reaction by means of the three stages of the general ddaptation syndrome (Selye): alarm, resistance and exhaustion stages.	X	X	X	X	X	X		
(23)		Explain the differences between psychological, psychosomatic and somatic stress reactions.	X	X	X	X	X	X		
(24)		Name the typical common physiological and psychological symptoms of human overload.	X	X	X	X	X	X		
(25)		Describe the effects of stress on human behaviour.	X	X	X	X	X	X		
(26)		Explain how stress is cumulative and how stress from one situation can be transferred to a different situation.	X	X	X	X	X	X	X	
(27)		Explain how successful completion of a stressful task will reduce the amount of stress experienced when a similar situation arises in the future.	X	X	X	X	X	X	X	
(28)		Describe the effect of human underload/overload on effectiveness in the ~~cockpit~~ flight crew compartment.	X	X	X	X	X	X	X	
(29)		List sources and symptoms of human underload.	X	X	X	X	X	X	X	
040 03 06 03		***Intentionally left blank***								
040 03 06 04		***Intentionally left blank***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
040 03 06 05		***Fatigue and stress management***								
(01)		Explain the term ‘fatigue’ and differentiate between the two types of fatigue (short-term and chronic fatigue).	X	X	X	X	X	X		
(02)		Name the causes ~~for~~of ~~both types~~short-term and chronic fatigue.	X	X	X	X	X	X		
(03)		Identify the symptoms and describe the effects of fatigue.	X	X	X	X	X	X		
(04)		List the strategies ~~which~~that prevent or delay the onset of fatigue and hypovigilance.	X	X	X	X	X	X		
(05)		List and describe ~~coping~~ strategies for ~~dealing~~coping with stress factors and stress reactions.	X	X	X	X	X	X		
(06)		Distinguish between short-term and long-term methods of stress management.	X	X	X	X	X	X		
(07)		Give examples of short-term methods of stress management.	X	X	X	X	X	X		
(08)		Give examples of long-term methods of coping with stress.	X	X	X	X	X	X		
(09)		Describe the fatique risk management system (FRMS) as follows: a data-driven means of continuously monitoring and managing fatigue-related safety risks, based upon scientific principles	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		and knowledge as well as operational experience that aims to ensure relevant personnel are performing at adequate levels of alertness.								
040 03 07 00		**Advanced cockpit automation**								
040 03 07 01		***Advantages and disadvantages***								
(01)		~~Define and explain the basic concept of automation.~~ Compare the two basic concepts of automation: as per Boeing, where the pilot remains the last operator, and as per Airbus, where automated systems can correct erroneous pilot action.	X	X	X	X	X	X	X	
(02)		~~List the advantages/disadvantages of automation in the cockpit in respect of level of vigilance, attention, workload, situation awareness and crew coordination.~~ Explain the fundamental restrictions of autoflight systems to be lack of creativity in unknown situations, and lack of personal motivation with regard to safety.	X	X	X	X	X	X	X	
(03)		~~State the advantages and disadvantages of the two components of the man–machine system with regard to information input and processing, decision-making and output activities.~~ List the principal strengths and weaknesses of pilot versus autopilot systems to be creativity, decision-making, prioritisation of tasks, safety attitude versus precision, reliability.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		Explain the 'ironies of automation': designers' errors due to wrong interpretation of the data, leaving tasks to the pilot that are too complex to automate, loss of manual and cognitive skills of the pilot. State the necessity for regular training flights as one possible countermeasure.	X	X	X	X	X	X	X	
(05)		~~Give examples of methods to overcome the disadvantages of automation.~~ Describe methods to overcome the drawbacks of autoflight systems to be loss of manual flying capabilities, additional workload through programming, risk of slips during programming and hypovigilance during cruise.	X	X	X	X	X	X	X	
040 03 07 02		***Automation complacency***								
(01)		State the main weaknesses in the monitoring of automatic systems to be hypovigilance during flight, and loss of flying skills.	X	X	X	X	X	X	X	
(02)		Explain some basic flight crew errors and terms that arise with the introduction of automation: ~~the following terms in connection with automatic systems:~~ — passive monitoring; — blinkered concentration; — confusion; — mode awareness.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)		~~Give examples of actions which may be taken to counteract~~ Explain how the method of call outs counteracts ineffective monitoring of automatic systems.	X	X	X	X	X	X	X	
(04)		Define ‘complacency’.	X	X	X	X	X	X	X	
040 03 07 03		***Working concepts***								
(01)		~~Analyse the influence of automation on crew communication and describe the potential disadvantages.~~ Explain that the potential disadvantages of automation on crew communication are loss of awareness of input errors, flight modes, failure detection, failure comprehension, status of the aircraft and aircraft position.	X		X	X				
(02)		~~Summarise how the negative effects of automation on pilots may be alleviated.~~ Explain how the negative effects of automation on pilots may be alleviated by degrading to a lower level of automation to recover comprehesion of the flight status from VNAV/LNAV to ALT/ HDG or even to manual flying.	X	X	X	X	X	X	X	
(03)		Interpret the role of automation with respect to flight safety regarding the basic principle of the use of manual versus autoflight in normal operations, frequent changes in the flight profile, and in	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		abnormal situations.								

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Appendix to Annex I to ED Decision 2018/001/R

'Acceptable Means of Compliance (AMCs) and Guidance Material (GM) to Part-FCL Amendment 4'

Appendix
'SUBJECT 050 — METEOROLOGY'
to
AMC1 FCL.310; FCL.515(b); FCL.615(b)
'Theoretical knowledge examinations'
of Annex I

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SUBJECT 050 — METEOROLOGY

The operation of an aircraft is affected by the weather conditions within the atmosphere. The pilot ~~must~~ should prove that they fulfil the following objectives in order to complete a safe flight safely in given meteorological conditions.

(1) Training aims

(i) Knowledge. After completion of the training, the pilot ~~must~~ should be able to:

— understand the physical processes in the atmosphere;

— interpret the actual and forecast weather conditions in the atmosphere; and

— ~~show~~ demonstrate understanding of the meteorological hazards and their effects on ~~an~~ aircraft.

(ii) Skills. After completion of the training, the pilot ~~must~~ should be able to:

— collect all the weather information which may affect a given flight;

— analyse and evaluate available weather information before flight as well as that collected in flight; and

— ~~apply a solution to~~ resolve any problems presented by the given weather conditions.

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
050 00 00 00		**METEOROLOGY**								
050 01 00 00		**THE ATMOSPHERE**								
050 01 01 00		**Composition, extent, vertical division**								
050 01 01 01		***Structure of the atmosphere***								
(01)		Describe the vertical division of the atmosphere up to flight level (FL) 650, based on the temperature variations with height.	X	X	X	X	X	X	X	
(02)		List the different layers and their main qualitative characteristics up to FL 650.	X	X	X	X	X	X	X	
050 01 01 02		***Troposphere***								
(01)		Describe the troposphere.	X	X	X	X	X	X	X	
(02)		Describe the main characteristics of the tropopause.	X	X	X	X	X	X	X	
(03)		Describe the proportions of the most important gases in the air in the troposphere.	X	X	X	X	X	X	X	
(04)		Describe the variations of the FL and temperature of the tropopause from the poles to the equator.	X	X	X	X	X	X	X	
(05)		Describe the breaks in the tropopause along the boundaries of the main air masses.	X	X	X	X	X	X	X	
(06)		Indicate the variations of the FL of the tropopause with the seasons and the variations of atmospheric pressure.	X		X	X				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
050 01 01 03		***Stratosphere***								
(01)		Describe the stratosphere up to FL 650.	X		~~X~~	~~X~~				
~~(02)~~		~~Describe the main differences of the composition of the air in the stratosphere compared to the troposphere.~~	~~X~~		~~X~~	~~X~~				
~~LO (3)~~		~~Mention the vertical extent of the stratosphere up to the stratopause.~~	~~X~~		~~X~~	~~X~~				
(04)		~~Describe the reason for the temperature increase in the ozone layer.~~ Describe that ozone can occur at jet cruise altitudes and that it constitutes a hazard.	X		X	X				
050 01 02 00		**Air temperature**								
050 01 02 01		***Definition and units***								
(01)		Define 'air temperature' ~~by kinetic gas theory~~.	X	X	X	X	X	X	X	
(02)	X	List the units of measurement of air temperature used in aviation meteorology (Celsius, Fahrenheit, Kelvin). _(Refer to 050 10 01 01)_	X	X	X	X	X	X	X	
050 01 02 02		***Vertical distribution of temperature***								
(01)		Describe the mean vertical distribution of temperature up to ~~20 km~~ FL 650.	X	X	X	X	X	X	X	
(02)		Mention the general causes of the cooling of the air in the troposphere with increasing altitude.	X	X	X	X	X	X	X	
(03)		Calculate the temperature and temperature deviations (in	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		relation to International Standard Atmosphere (ISA)) at specified levels.								
050 01 02 03		***Transfer of heat***								
(01)		Explain how local cooling or warming processes result in transfer of heat.	X	X	X	X	X	X	X	
(02)		Describe radiation.	X	X	X	X	X	X	X	
(03)		Describe solar radiation reaching the Earth.	X	X	X	X	X	X	X	
(04)		Describe the filtering effect of the atmosphere on solar radiation.	X	X	X	X	X	X	X	
(05)		Describe terrestrial radiation.	X	X	X	X	X	X	X	
(06)		Explain how terrestrial radiation is absorbed by some components of the atmosphere.	X	X	X	X	X	X	X	
~~(07)~~		~~Explain the greenhouse effect due to water vapour and some other gases in the atmosphere.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(08)		Explain the effect of absorption and radiation in connection with clouds.	X	X	X	X	X	X	X	
(09)		Explain the process of conduction.	X	X	X	X	X	X	X	
(10)		Explain the role of conduction in the cooling and warming of the atmosphere.	X	X	X	X	X	X	X	
(11)		Explain the process of convection.	X	X	X	X	X	X	X	
(12)		Name the situations in which convection occurs.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(13)		Explain the process of advection.	X	X	X	X	X	X	X	
(14)		Name the situations in which advection occurs.	X	X	X	X	X	X	X	
(15)		Describe the transfer of heat by turbulence.	X	X	X	X	X	X	X	
(16)		Describe the transfer of latent heat.	X	X	X	X	X	X	X	
050 01 02 04		***Lapse rates***								
(01)		Describe qualitatively and quantitatively the temperature lapse rates of the troposphere (mean value 0.65 °C/100 m or 2 °C/1 000 ft and actual values).	X	X	X	X	X	X	X	
050 01 02 05		***Development of inversions, types of inversions***								
(01)		Describe the development and types of inversions.	X	X	X	X	X	X	X	
(02)		Explain the characteristics of inversions and of an isothermal layer concerning stability and vertical motions.	X	X	X	X	X	X	X	
(03)		Explain the reasons for the formation of the following inversions: — ground inversion (nocturnal radiation/ advection), subsidence inversion, frontal inversion, inversion above friction layer, valley inversion.	X	X	X	X	X	X	X	
~~LO (04)~~		~~— Explain the reasons for the formation of the following inversions:~~ ~~— tropopause inversion.~~	~~X~~		~~X~~	~~X~~				
050 01 02 06		***Temperature near the Earth's surface, insolation, surface***								

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		effects, ~~diurnal and seasonal variation,~~ effect of clouds, effect of wind								
(01)		~~Describe how the temperature near the Earth's surface is influenced by seasonal variations.~~ Explain the cooling/warming of the surface of the Earth by radiation.	X	X	X	X	X	X	X	
(02)		Explain the cooling/~~and~~ warming of the air by molecular or turbulent heat transfer to/from ~~on~~ the earth or sea surfaces.	X	X	X	X	X	X	X	
~~LO (03)~~		~~Sketch the diurnal variation of the temperature of the air in relation to the radiation of the sun and of the Earth.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(04)		Describe qualitatively the influence of the clouds on the cooling and warming of the surface and the air near the surface.	X	X	X	X	X	X	X	
~~LO (05)~~		~~Distinguish between the influence of low or high clouds and thick or thin clouds.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	X	
(06)		Explain the influence of the wind on the cooling and warming of the air near the surfaces.	X	X	X	X	X	X	X	
050 01 03 00		**Atmospheric pressure**								
050 01 03 01		***Barometric pressure, isobars***								
(01)		Define 'atmospheric pressure'.	X	X	X	X	X	X	X	
(02)	X	List the units of measurement of the atmospheric pressure used in aviation (hPa, inches of ~~, M~~mercury).	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		(Refer to 050 10 01 01)								
(03)	X	Describe the principle of the barometers (mercury barometer, aneroid barometer).	X	X	X	X	X	X		
(04)		~~Describe~~ Define isobars and identify them on surface weather charts.	X	X	X	X	X	X	X	
(05)		Define 'high', 'low', 'trough', 'ridge', ~~'wedge',~~ 'col'.	X	X	X	X	X	X	X	
050 01 03 02		***Pressure variation with height, contours (isohypses)***								
(01)		Explain the pressure variation with height.	X	X	X	X	X	X	X	
(02)		Describe ~~qualitatively~~ quantitatively the variation of the barometric lapse rate. *Remark: An approximation of ~~T~~the average value for the barometric lapse rate near mean sea level (MSL) is ~~27 ft (8 m)~~ 30 ft (9 m) per 1 hPa~~, at about 5 5003000 m (10000ft) /AMSL is 50 ft (15 m) per 1 hPa~~.*	X	X	X	X	X	X	X	
~~LO (03)~~		~~Describe and interpret contour lines (isohypses) on a constant pressure chart. *(Refer to 050 10 02 03)*~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(04)		State that (under conditions of ISA) pressure is approximately 50 % of MSL at 18 000 ft and density is approximately 50 % of MSL at 22 000 ft and 25 % of MSL at 40 000 ft.	X	X	X	X	X	X	X	
050 01 03 03		***Reduction of pressure to QFF (MSL)***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Define 'QFF'.	X	X	X	X	X	X	X	
(02)		Explain the reduction of measured pressure (QFE) to QFF (MSL).	X	X	X	X	X	X	X	
(03)		Mention the use of QFF for surface weather charts.	X	X	X	X	X	X	X	
050 01 03 04		***Relationship between surface pressure centres and pressure centres aloft***								
(01)		Illustrate with a vertical cross section of isobaric surfaces the relationship between surface pressure systems and upper-air pressure systems.	X	X	X	X	X	X	X	
050 01 04 00		**Air density**								
050 01 04 01		***Relationship between pressure, temperature and density***								
(01)	X	Describe the relationship between pressure, temperature and density.	X	X	X	X	X	X	X	
(02)	X	Describe the vertical variation of the air density in the atmosphere.	X	X	X	X	X	X	X	
~~LO (03)~~		~~Describe the effect of humidity changes on the density of air.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
050 01 05 00		**~~ICAO~~ International Standard Atmosphere (ISA)**								
050 01 05 01		***~~ICAO~~ International Standard Atmosphere (ISA)***								
(01)		Explain the use of standardised values for the atmosphere.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		List the main values of the ISA MSL pressure, MSL temperature, the vertical temperature lapse rate up to ~~20 km~~ FL 650, height and temperature of the tropopause~~)~~.	X	X	X	X	X	X	X	
~~LO (03)~~		~~Calculate the standard temperature in Celsius for a given flight level.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (04)~~		~~Determine a standard temperature deviation by the difference between the given outside-air temperature and the standard temperature.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
050 01 06 00		**Altimetry**								
050 01 06 01		***Terminology and definitions***								
(01)		Define the following terms ~~and acronyms~~ and explain how they are related to each other: height, altitude, pressure altitude, ~~flight level~~FL, pressure level, true altitude, true height, elevation, QNH, QFE, and standard altimeter setting.	X	X	X	X	X	X	X	
(02)		Describe the terms ‘transition altitude’, ‘transition level’, ‘transition layer’, ‘terrain clearance’, ‘lowest usable flight level’.	X	X	X	X	X	X	X	
050 01 06 02		***Altimeter settings***								
(01)		Name the altimeter settings associated to height, altitude, pressure altitude and ~~flight level~~FL.	X	X	X	X	X	X	X	
(02)		Describe the altimeter-setting procedures.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
050 01 06 03		***Calculations***								
(01)		Calculate the different readings on the altimeter when the pilot ~~changes the altimeter setting~~ uses different settings (QNH, 1013.25, QFE).	X	X	X	X	X	X	X	
(02)		Illustrate with a numbered example the changes of altimeter setting and the associated changes in reading when the pilot climbs through the transition altitude or descends through the transition level.	X	X	X	X	X	X	X	
(03)		Derive the reading of the altimeter of an aircraft on the ground when the pilot uses the different settings.	X	X	X	X	X	X	X	
(04)		Explain the influence of the air temperature on the distance between the ground and the level read on the altimeter and between two ~~flight levels~~FLs.	X	X	X	X	X	X	X	
(05)		Explain the influence of pressure areas on true altitude.	X	X	X	X	X	X	X	
(06)		Determine the true altitude/height for a given altitude/height and a given ISA temperature deviation.	X	X	X	X	X	X	X	
(07)		Calculate the terrain clearance and the lowest usable ~~flight level~~FL for given atmospheric temperature and pressure conditions.	X	X	X	X	X	X	X	
(08)		State that the 4 %-rule can be used to calculate true altitude from indicated altidtude, and also indicated altitude from true altitude (not precise but sufficient due to the approximation of the 4%-rule.)	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Remark: The following rules should be considered for altimetry calculations: *a) All calculations are based on rounded pressure values to the nearest lower hPa~~;~~.* *b) ~~The value for the barometric lapse rate near mean sea level is is 27 ft (8 m)30 ft (9m)per 1 hPa;~~* *~~In ISA, and between 1013.25 and 700 hPa, 30 ft/hPa is an acceptable approximation of the barometric lapse rate.~~*The value for the barometric lapse rate between MSL and 700 hPa to be used is 30ft/ hPa as an acceptable approximation of the barometric lapse rate. *c) To determine the true altitude/height, the following rule of thumb, called the '4 %-rule', shall be used: the altitude/height changes by 4 % for each 10 °C temperature deviation from ISA~~;~~.* *d) If no further information is given, the deviation of the outside-air temperature from ISA is considered to be constantly the same given value in the whole layer~~;~~.* *e) The elevation of the ~~airport~~aerodrome has to be taken into account. The temperature correction has to be considered for the layer between the ground and the position of the aircraft.*								
050 01 06 04		***Effect of accelerated airflow due to topography***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Describe qualitatively how the effect of accelerated airflow due to topography (the Bernoulli effect) affects altimetry.	X	X	X	X	X	X	X	
050 02 00 00		**WIND**								
050 02 01 00		**Definition and measurement of wind**								
050 02 01 01		***Definition and measurement***								
(01)		Define 'wind' and 'surface wind'.	X	X	X	X	X	X	X	Both terms are used
(02)		State the units of wind directions (degrees true in reports; degrees magnetic from tower) and speed (kt, m/s~~, km/h~~). ~~*(Refer to 050 10 01 01)*~~	X	X	X	X	X	X	X	
(03)		~~Explain~~ Describe that the reported wind is an average wind derived, from measurements with an anemometer at a height of 10 m over 2 min for local routine and special reports and ATS units, and over 10 min for aerodrome routine meteorological reports (METARs) and aerodrome special meteorological reports (SPECIs).~~how wind is measured in meteorology~~.	X	X	X	X	X	X	X	
050 02 02 00		**Primary cause of wind**								
050 02 02 01		***Primary cause of wind, pressure gradient, Coriolis force, gradient wind***								
(01)		Define the term 'horizontal pressure gradient'.	X	X	X	X	X	X	X	
(02)		Explain how the pressure gradient force acts in relation to the pressure gradient.	X	X	X	X	X	X	X	

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
(03)		Explain how the Coriolis force acts in relation to the wind.	X	X	X	X	X	X	X	
(04)		Explain the development of the geostrophic wind.	X	X	X	X	X	X	X	
(05)		Indicate how the geostrophic wind flows in relation to the isobars/isohypses in the northern and in the southern hemisphere.	X	X	X	X	X	X	X	
(06)		Analyse the effect of changing latitude on the geostrophic wind speed.	X		X	X			X	
(07)		Explain the gradient wind effect and indicate how the gradient wind differs from the geostrophic wind in cyclonic and anticyclonic circulation.	X	X	X	X	X	X		
050 02 02 02		***Variation of wind in the friction layer***								
(01)		Describe why and how the wind changes direction and speed with height in the friction layer in the northern and in the southern hemisphere (rule of thumb).	X	X	X	X	X	X	X	
(02)		State the surface and air-mass conditions that influence the wind in the friction layer (diurnal variation).	X	X	X	X	X	X	X	
(03)		Name terrain, wind-speed and stability as the main factors that influence the vertical extent of the friction layer.	X	X	X	X	X	X	X	
(04)		Explain the relationship between isobars and wind (direction and speed).	X	X	X	X	X	X	X	
		Remark: Approximate value for variation of wind in the								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		friction layer (values to be used in examinations):								

Type of landscape	*Wind speed in friction layer in % of the geostrophic wind*	*The wind in the friction layer blows across the isobars towards the low pressure. Angle between wind direction and isobars.*
over water	*ca 70 %*	*ca 10°*
over land	*ca 50 %*	*ca 30°*

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		WMO N~~O~~o. 266								
050 02 02 03		***Effects of convergence and divergence***								
(01)		Describe atmospheric convergence and divergence.	X	X	X	X	X	X	X	
(02)		Explain the ~~effect of~~ relationship between convergence and divergence on the following: pressure systems at the surface and aloft; wind speed; vertical motion and cloud formation (relationship between upper-air conditions and surface pressure systems).	X	X	X	X	X	X	X	
050 02 03 00		**General global circulation**								
050 02 03 01		***General circulation around the globe***								
(01)		Describe ~~and explain~~ the general global circulation.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		(Refer to 050 08 01 01)								
(02)		Name and sketch or indicate on a map the global distribution of the surface pressure and the resulting wind pattern for all latitudes at low level in January and July.	X		X	X				
(03)		Sketch or indicate on a map the westerly and easterly tropospheric winds at high level in January and July.	X		X	X				
050 02 04 00		**Local winds**								
050 02 04 01		***Anabatic and katabatic winds, mountain and valley winds, Venturi effects, land and sea breezes***								
(01)		Describe and explain anabatic and katabatic winds.	X	X	X	X	X	X	X	
(02)		Describe ~~and explain~~ mountain and valley winds.	X	X	X	X	X	X	X	
(03)		Describe ~~and explain~~ the Venturi effect, convergence in valleys and mountain areas.	X	X	X	X	X	X	X	
(04)		Describe ~~and explain~~ land and sea breezes, and sea-breeze front.	X	X	X	X	X	X	X	
(05)		Describe that local, low-level jet streams can develop in the evening.	X	X	X	X	X	X	X	
050 02 05 00		**Mountain waves (standing waves, lee waves)**								
050 02 05 01		***Origin and characteristics***								
(01)		Explain the origin and formation of mountain waves.	X	X	X	X	X	X	X	
(02)	X	State the conditions necessary for the formation of	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		mountain waves.								
(03)		Describe the structure and properties of mountain waves.	X	X	X	X	X	X	X	
(04)		Explain how mountain waves may be identified by their associated meteorological phenomena.	X	X	X	X	X	X	X	
(05)		Describe that mountain wave effects can exceed the performance or structural capability of aircraft.	X	X	X	X	X	X	X	
(06)		Describe that mountain wave effects can propagate from low to high level, e.g. over Greenland and elsewhere.	X	X	X	X	X	X	X	
050 02 06 00		**Turbulence**								
050 02 06 01		***Description and types of turbulence***								
(01)		Describe turbulence and gustiness.	X	X	X	X	X	X	X	
(02)		List the common types of turbulence (convective, mechanical, orographic, frontal, clear-air turbulence).	X	X	X	X	X	X	X	
050 02 06 02		***Formation and location of turbulence***								
(01)		Explain the formation of convective turbulence, mechanical and orographic turbulence, and frontal turbulence~~, clear-air turbulence~~	X	X	X	X	X	X	X	
(02)		State where turbulence will normally be found (rough-ground surfaces, relief, inversion layers, cumulonimbus (CB), thunderstorm (TS) zones, unstable layers).	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
050 02 06 03		***Clear-air turbulence (CAT) — description, cause and location***								
(01)		Describe ~~the term~~ CAT.	X	X	~~X~~	~~X~~	~~X~~	X	X	
(02)		~~Explain~~ Describe the formation of CAT.	X	X	X	X	X	X	X	
(03)		State where CAT is found in association with jet streams, in high-level troughs and in other disturbed high-level air flows. *(Refer to 050 09 02 02)*	X		~~X~~	~~X~~				
(04)		State that remote sensing of CAT from satellites is not possible and that forecasting is limited.	X	X	~~X~~	~~X~~	~~X~~	X	X	
(05)		State that pilot reports of turbulence are a very valuable source of information as remote measurements are not available.	X	X	X	X	X	X	X	
050 02 07 00		**Jet streams**								
050 02 07 01		***Description***								
(01)		Describe jet streams.	X	X	~~X~~	~~X~~	~~X~~	X	X	
(02)		State the defined minimum speed of a jet stream (60 kt).	X	X	~~X~~	~~X~~	~~X~~	X	X	
(03)		State the typical figures for the dimensions of jet streams.	X	X	~~X~~	~~X~~	~~X~~	X	X	
050 02 07 02		***Formation and properties of jet streams***								
(01)		Explain the formation and state the heights, the speeds,	X	X	~~X~~	~~X~~				

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		the seasonal variations of speeds, the geographical positions, the seasonal occurrence and the seasonal movements of the arctic (front) jet stream, the polar (front) jet stream, the subtropical jet stream, and the tropical (easterly/equatorial) jet stream.								
050 02 07 03		***Location of jet streams and associated CAT areas***								
(01)		Sketch or describe where polar front and arctic jet streams are found in the troposphere in relation to the tropopause and to fronts.	X	X	~~X~~	~~X~~				
~~LO (02)~~		~~Sketch or describe the isotherms, the isotachs, the pressure surfaces and the movements of air in a cross section of a polar front jet stream.~~	~~X~~		~~X~~	~~X~~				
(03)		Describe and indicate the areas of worst wind shear and CAT.	X	X	~~X~~	~~X~~				
050 02 07 04		***~~Jet stream recognition~~ Intentionally left blank***								
~~LO (01)~~		~~State how jet streams may be recognised from their associated meteorological phenomena~~.	~~X~~		~~X~~	~~X~~				
050 03 00 00		**THERMODYNAMICS**								
050 03 01 00		**Humidity**								
050 03 01 01		***Water vapour in the atmosphere***								
(01)		~~Describe humid air.~~ State that the density of moist air is less than the density of dry air.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		Describe the significance for meteorology of water vapour in the atmosphere.	X	X	X	X	X	X	X	
(03)		Indicate the sources of atmospheric humidity.	X	X	X	X	X	X	X	
(04)		Define 'saturation of air by water vapour'.	X	X	X	X	X	X		
050 03 01 02		***~~Mixing ratio~~ Intentionally left blank***								
~~LO (01)~~		~~Define 'mixing ratio' and 'saturation mixing ratio'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (02)~~		~~Name the unit used in meteorology to express the mixing ratio (g/kg).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (03)~~		~~Explain the factors influencing the mixing ratio.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (04)~~		~~Recognise the lines of equal mixing ratio on a simplified diagram (T, P).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (05)~~		~~Define 'saturation of air by water vapour'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (06)~~		~~Illustrate with a diagram (T, mixing ratio) the influence of the temperature on the saturation mixing ratio, at constant pressure.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (07)~~		~~Explain the influence of the pressure on the saturation mixing ratio.~~ *~~Remark: A simplified diagram (T,P) contains:~~* *~~— on the x-axis: temperature (T);~~* *~~— on the y-axis: height corresponding to pressure (P).~~*	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~_The degree of saturation/mixing ratio and stability/instability are shown as functions of temperature change with height (as lines or curves in the diagram)._~~								
_050 03 01 03_		**_Temperature/dew point, relative humidity_**								
(01)		Define ‘dew point’.	X	X	X	X	X	X	X	
~~LO (02)~~		~~Recognise the dew-point curve on a simplified diagram (T, P).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(03)		Define ‘relative humidity’.	X	X	X	X	X	X	X	
(04)		Explain the factors that influence~~ing~~ the relative humidity at constant pressure.	X	X	X	X	X	X	X	
(05)		Explain the diurnal variation of the relative humidity.	X	X	X	X	X	X	X	
~~LO (06)~~		~~Describe the relationship between relative humidity, the amount of water vapour and the temperature~~.	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(07)		Describe the relationship between temperature and dew point.	X	X	X	X	X	X	X	
(08)		Estimate the relative humidity of the air from the difference between dew point and temperature.	X	X	X	X	X	X	X	
050 03 02 00		**Change of state of ~~aggregation~~ water**								
_050 03 02 01_		**_Condensation, evaporation, sublimation, freezing and melting, latent heat_**								
(01)		Define ‘condensation’, ‘evaporation’, ‘sublimation’,	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		'freezing and melting' and 'latent heat'.								
(02)		List the conditions for condensation/evaporation.	X	X	X	X	X	X	X	
(03)		Explain the condensation process.	X	X	X	X	X	X	X	
(04)		Explain the nature of and the need for condensation nuclei.	X	X	X	X	X	X	X	
(05)		Explain the effects of condensation on the weather.	X	X	X	X	X	X	X	
(06)		List the conditions for freezing/melting.	X	X	X	X	X	X	X	
(07)		Explain the process of freezing.	X	X	X	X	X	X	X	
(08)		Explain the nature of and the need for freezing nuclei.	X	X	X	X	X	X	X	
(09)		Define 'supercooled water'. _(Refer to 050 09 01 01)_	X	X	X	X	X	X	X	
(10)		List the conditions for sublimation~~/deposition~~.	X	X	X	X	X	X	X	
(11)		Explain the sublimation~~/deposition~~ process.	X	X	X	X	X	X	X	
(12)		Explain the nature of and the need for sublimation nuclei.	X	X	X	X	X	X	X	
(13)		Describe the absorption or release of latent heat in each change of state of water~~aggregation~~.	X	X	X	X	X	X	X	
~~LO (14)~~		~~Explain the influence of atmospheric pressure, the temperature of the air and of the water or ice on the changes of state of aggregation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(15)		Illustrate all the changes of state of ~~aggregation~~ water with	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		practical examples.								
050 03 03 00		**Adiabatic processes**								
050 03 03 01		***Adiabatic processes, stability of the atmosphere***								
~~LO (01)~~		~~Describe the adiabatic processes~~.	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(02)		Describe the adiabatic process in an unsaturated rising or descending air particle.	X	X	X	X	X	X	X	
(03)		Explain the variation of temperature of an unsaturated rising or descending air particle. ~~with changing altitude.~~	X	X	X	X	X	X	X	
~~LO (04)~~		~~Explain the changes which take place in mixing ratio with changing altitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(05)		~~Explain the changes which take place in relative humidity with changing altitude.~~ Explain the variation of humidity of an unsaturated rising or descending air particle.	X	X	X	X	X	X	X	
~~LO (06)~~		~~Use the dry-adiabatic and mixing-ratio lines on a simplified diagram (T, P) for a climbing or descending air particle.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(07)		Describe the adiabatic process in a saturated rising or descending air particle.	X	X	X	X	X	X	X	
(08)		Explain the variation of temperature of a saturated air particle with changing altitude.	X	X	X	X	X	X	X	
~~LO (09)~~		~~Explain the difference in temperature lapse rate between~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~saturated and unsaturated air.~~								
~~LO (10)~~		~~Explain the influence of different air temperatures on the temperature lapse rate in saturated air.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (11)~~		~~Use the saturated adiabatic lines on a simplified diagram (T, P) for a climbing or descending air particle.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (12)~~		~~Find the condensation level, or base of the clouds, on a simplified diagram (T, P).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(13)		Explain the static stability of the atmosphere using the actual temperature curve with reference to the adiabatic lapse rates.	X	X	X	X	X	X	X	
(14)		Define qualitatively and quantitatively the terms ~~'stability', 'conditional instability', 'instability' and 'indifferent (neutral)'~~ 'stable', 'conditionally unstable', 'unstable' and 'indifferent'.	X	X	X	X	X	X	X	
~~LO (15)~~		~~Explain with a sketch on a simplified diagram (T, P) the different possibilities of atmospheric stability: absolute stability, absolute instability, conditional instability and indifferent (neutral).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (16)~~		~~Illustrate with a sketch of the adiabatic lapse rates and the vertical temperature profile of the atmosphere the effect of an inversion on the vertical motion of air.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (17)~~		~~Illustrate with a schematic sketch of the saturated adiabatic lapse rate and the vertical temperature profile~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~the instability inside a cumuliform cloud.~~								
~~LO (18)~~		~~Illustrate with a schematic sketch the formation of the subsidence inversion.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(19)		Illustrate with a schematic sketch the formation of Foehn.	X	X	X	X	X	X	X	
(20)		~~Explain the effect on the stability of the air caused by advection of air (warm or cold).~~ Explain the effect of the advection of air (warm or cold) on the stability of the air. *Remark: Dry adiabatic lapse rate = 1 °C/100 m or 3 °C/1 000 ft; average value at lower levels for saturated adiabatic lapse rate = 0.6 °C/100 m or 1.8 °C/1 000 ft (values to be used in examinations).*	X	X	X	X	X	X	X	
050 04 00 00		**CLOUDS AND FOG**								
050 04 01 00		**Cloud formation and description**								
050 04 01 01		***Cloud formation***								
(01)		Explain cloud formation by adiabatic cooling, conduction, advection and radiation.	X	X	X	X	X	X	X	
(02)		Describe cloud formation based on the following lifting processes: unorganised lifting in thin layers and turbulent mixing; forced lifting at fronts or over mountains; free convection.	X	X	X	X	X	X	X	
~~LO (03)~~		~~Determine cloud base and top in a simplified diagram~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~(temperature, pressure, humidity).~~								
~~LO (04)~~		~~Explain the influence of relative humidity on the height of the cloud base.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (05)~~		~~Illustrate in a thermodynamic diagram the meaning of convective temperature (temperature at which formation of cumulus starts).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(06)		List cloud types typical for stable and unstable air conditions.	X	X	X	X	X	X	X	
(07)		Summarise the conditions for the dissipation of clouds.	X	X	X	X	X	X	X	
050 04 01 02		***Cloud types and cloud classification***								
(01)		Describe the different cloud types and ~~cloud~~ their classification.	X	X	X	X	X	X	X	
(02)		Identify by shape cirriform, cumuliform and stratiform clouds.	X	X	X	X	X	X	X	
(03)		Identify by shape and typical level the 10 cloud types (general).	X	X	X	X	X	X	X	
(04)		Describe and identify by shape the following species and supplementary features: *castellanus, lenticularis, ~~fractus, humilis, mediocris,~~congestus, calvus, capillatus* and *virga*.	X	X	X	X	X	X	X	
(05)		Distinguish between low-, medium- and high-level clouds according to the World Meteorological Organization's (WMO) 'cloud etage'. ~~(including heights): for mid latitudes.~~	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (06)~~		~~— Distinguish between low, medium and high-level clouds according to the WMO 'cloud etage' (including heights):~~ ~~— for all latitudes.~~	~~X~~		~~X~~	~~X~~				
(07)		Distinguish between ice clouds, mixed clouds and pure-water clouds.	X	X	X	X	X	X	X	
050 04 01 03		***Influence of inversions on cloud development***								
(01)		Explain the influence of inversions on vertical movements in the atmosphere.	X	X	X	X	X	X	X	
(02)		Explain the influence of an inversion on the formation of stratus clouds.	X	X	X	X	X	X	X	
(03)		Explain the influence of ground inversion on the formation of fog.	X	X	X	X	X	X	X	
~~(04)~~		~~Determine on a simplified diagram the top of a cumulus cloud caused by an inversion.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(05)		Describe the role of the tropopause inversion with regard to the ~~formation~~ vertical development of clouds.	X	X	X	X	X			
050 04 01 04		***Flying conditions in each cloud type***								
(01)		Assess the 10 cloud types for icing and turbulence.	X	X	X	X	X	X	X	
050 04 02 00		**Fog, mist, haze**								
050 04 02 01		***General aspects***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Define 'fog', 'mist' and 'haze' with reference to the WMO standards of visibility range.	X	X	X	X	X	X	X	
(02)		Explain briefly the formation of fog, mist and haze ~~in general~~.	X	X	X	X	X	X	X	
(03)		Name the factors that generally contribut~~inge~~ ~~in general~~ to the formation of fog and mist.	X	X	X	X	X	X	X	
(04)		Name the factors that contribut~~inge~~ to the formation of haze.	X	X	X	X	X	X	X	
(05)		Describe freezing fog and ice fog.	X	X	X	X	X	X	X	
050 04 02 02		***Radiation fog***								
(01)		Explain the formation of radiation fog.	X	X	X	X	X	X	X	
~~LO (02)~~		~~Explain the conditions for the development of radiation fog.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(03)		Describe the significant characteristics of radiation fog, and its vertical extent.	X	X	X	X	X	X	X	
(04)		Summarise the conditions for the dissipation of radiation fog.	X	X	X	X	X	X	X	
050 04 02 03		***Advection fog***								
(01)		Explain the formation of advection fog.	X	X	X	X	X	X	X	
~~LO (02)~~		~~Explain the conditions for the development of advection fog.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)		Describe the different possibilities of advection-fog formation (over land, sea and coastal regions).	X	X	X	X	X	X	X	
(04)		Describe the significant characteristics of advection fog.	X	X	X	X	X	X	X	
(05)		Summarise the conditions for the dissipation of advection fog.	X	X	X	X	X	X	X	
050 04 02 04		***~~Steam fog~~ Sea smoke***								
(01)		Explain the formation of ~~steam fog~~ sea smoke.	X	X	X	X	X	X	X	
(02)		Explain the conditions for the development of ~~steam fog~~ sea smoke.	X	X	X	X	X	X	X	
~~LO (03)~~		~~Describe the significant characteristics of steam fog.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(04)		Summarise the conditions for the dissipation of ~~steam fog~~ sea smoke.	X	X	X	X	X	X	X	
050 04 02 05		***Frontal fog***								
(01)		Explain the formation of frontal fog.	X	X	X	X	X	X	X	
~~LO (02)~~		~~Explain the conditions for the development of frontal fog.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(03)		Describe the significant characteristics of frontal fog.	X	X	X	X	X	X	X	
(04)		Summarise the conditions for the dissipation of frontal fog.	X	X	X	X	X	X	X	
050 04 02 06		***Orographic fog (hill fog)***								
(01)		Summarise the features of orographic fog.	X	X	X	X	X	X	X	
~~LO (02)~~		~~Explain the conditions for the development of orographic~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~fog.~~								
(03)		Describe the significant characteristics of orographic fog.	X	X	X	X	X	X	X	
(04)		Summarise the conditions for the dissipation of orographic fog.	X	X	X	X	X	X	X	
050 05 00 00		**PRECIPITATION**								
050 05 01 00		**Development of precipitation**								
050 05 01 01		***Process of development of precipitation***								
(01)		~~Distinguish between the two following processes by which precipitation is formed.~~ Describe the two basic processes of forming precipitation (The Wegener–Bergeron–Findeisen process, Coalescence).	X	X	X	X	X	X	X	
(02)		Summarise the outlines of the ice-crystal process ~~(Wegener-Bergeron-Findeisen).~~(The Wegener–Bergeron–Findeisen process, Coalescence).	X	X	X	X	X	X	X	
(03)		Summarise the outlines of the ~~C~~coalescence process.	X	X	X	X	X	X	X	
~~LO (04)~~		~~Describe the atmospheric conditions that favour either process.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(05)		Explain the development of snow, rain, drizzle and hail.	X	X	X	X	X	X	X	
050 05 02 00		**Types of precipitation**								
050 05 02 01		***Types of precipitation, relationship with cloud types***								
(01)		List and describe the types of precipitation given in the aerodrome forecast (TAF) and METAR codes (drizzle, rain,	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		snow, snow grains, ice pellets, hail, small hail, snow pellets, ice crystals, freezing drizzle, freezing rain).								
(02)		State the ICAO/WMO approximate diameters for cloud, drizzle and rain drops.	X	X	X	X	X	X	X	
(03)		~~State the approximate weights and diameters for hailstones.~~ State that, because of their size, hail stones can cause significant damage to ~~aeroplanes~~ aircraft.	X	X	X	X	X	X	X	
(04)	X	Explain the mechanism for the formation of freezing precipitation.	X	X	X	X	X	X	X	
(05)		Describe the weather conditions that give rise to freezing precipitation.	X	X	X	X	X	X	X	
(06)		Distinguish between the types of precipitation generated in convective and stratiform clouds.	X	X	X	X	X	X	X	
(07)		Assign typical precipitation types and intensities to different cloud types.	X	X	X	X	X	X	X	
(08)		Explain the relationship between moisture content and visibility during different types of winter precipitation (e.g. large vs small snowflakes).	X	X	X	X	X	X	X	
050 06 00 00		**AIR MASSES AND FRONTS**								
050 06 01 00		**Air masses**								
050 06 01 01		***Description, classification and source regions of air masses***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Define the term 'air mass'.	X	X	X	X	X	X	X	
(02)		Describe the properties of the source regions.	X	X	X	X	X	X	X	
(03)		Summarise the classification of air masses by source regions.	X	X	X	X	X	X	X	
(04)		State the classifications of air masses by temperature and humidity at source.	X	X	X	X	X	X	X	
(05)		State the characteristic weather in each of the air masses.	X	X	X	X	X	X	X	
(06)		Name the three main air masses that affect Europe.	X	X	X	X	X	X	X	
(07)		Classify air masses on a surface weather chart.	X	X	X	X	X	X	X	
		Remark: Names and abbreviations of air masses used in examinations: — *first letter: humidity* • *continental (c)~~,~~* • *maritime (m~~,~~* — *second letter: type of air mass* • *Arctic (A)~~,~~* • *Polar (P)~~,~~* • *Tropical (T)~~,~~* • *Equatorial (E),* — *third letter: temperature* • *cold (c)~~,~~*								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		• *warm (w).*								
050 06 01 02		***Modifications of air masses***								
(01)		List the environmental factors that affect the final properties of an air mass.	X	X	X	X	X	X	X	
(02)		Explain how maritime and continental tracks modify air masses.	X	X	X	X	X	X	X	
(03)		Explain the effect of passage over cold or warm surfaces.	X	X	X	X	X	X	X	
(04)		Explain how air-mass weather is affected by the season, the air-mass track and by orographic and thermal effects over land.	X	X	X	X	X	X	X	
(05)		Assess the tendencies of the stability ~~for~~of an air mass and describe the typical resulting air-mass weather including the hazards for aviation.	X	X	X	X	X	X	X	
050 06 02 00		**Fronts**								
050 06 02 01		***General aspects***								
(01)		Describe the boundaries between air masses (fronts).	X	X	X	X	X	X	X	
(02)	X	Define ‘front’ and ~~frontal surface (~~‘frontal zone’~~)~~.	X	X	X	X	X	X	X	
(03)	X	Name the global frontal systems (polar front, arctic front).	X	X	X	X	X	X		
(04)		State the approximate seasonal latitudes and geographic positions of the polar front and the arctic front.	X	X	X	X	X	X		
050 06 02 02		***Warm front, associated clouds and weather***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)	X	Define a 'warm front'.	X	X	X	X	X	X	X	
(02)		Describe the cloud, weather, ground visibility and aviation hazards at a warm front depending on the stability of the warm air.	X	X	X	X	X	X	X	
(03)		Explain the seasonal differences in the weather at warm fronts.	X	X	X	X	X	X	X	
(04)		Describe the structure, slope and dimensions of a warm front.	X	X	X	X	X	X	X	
(05)		Sketch a cross section of a warm front showing weather, cloud and aviation hazards.	X	X	X	X	X	X	X	
050 06 02 03		***Cold front, associated clouds and weather***								
(01)		Define a 'cold front'.	X	X	X	X	X	X	X	
(02)		Describe the cloud, weather, ground visibility and aviation hazards at a cold front depending on the stability of the warm air.	X	X	X	X	X	X	X	
(03)		Explain the seasonal differences in the weather at cold fronts.	X	X	X	X	X	X	X	
(04)		Describe the structure, slope and dimensions of a cold front.	X	X	X	X	X	X	X	
(05)		Sketch a cross section of a cold front showing weather, cloud and aviation hazards.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
050 06 02 04		***Warm sector, associated clouds and weather***								
(01)		~~Define~~ Describe fronts and air masses associated with the warm sector.	X	X	X	X	X	X	X	
(02)		Describe the cloud, weather, ground visibility and aviation hazards in a warm sector.	X	X	X	X	X	X	X	
(03)		Explain the seasonal differences in the weather in the warm sector.	X	X	X	X	X	X	X	
(04)		Sketch a cross section of a warm sector showing weather, cloud and aviation hazards.	X	X	X	X	X	X	X	
050 06 02 05		***Weather behind the cold front***								
(01)		Describe the cloud, weather, ground visibility and aviation hazards behind the cold front.	X	X	X	X	X	X	X	
(02)		Explain the seasonal differences in the weather behind the cold front.	X	X	X	X	X	X	X	
050 06 02 06		***Occlusions, associated clouds and weather***								
(01)	X	Define the term ‘occlusion’ and ‘occluded front’.	X	X	X	X	X	X	X	
~~(02)~~		~~Define a ‘cold occlusion’.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~Define a ‘warm occlusion’.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
LO (04)		Describe the cloud, weather, ground visibility and aviation hazards in a cold occlusion.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
LO (05)		Describe the cloud, weather, ground visibility and aviation hazards in a warm occlusion.	X	X	X	X	X	X	X	
LO (06)		Explain the seasonal differences in the weather at occlusions.	X	X	X	X	X	X	X	
(07)		Sketch a cross section of ~~cold and warm~~ occlusions showing weather, cloud and aviation hazards.	X	X	X	X	X	X	X	
(08)		On a sketch illustrate the development of an occlusion and the movement of the occlusion point.	X	X	X	X	X	X	X	
050 06 02 07		***Stationary front, associated clouds and weather***								
(01)		Define a 'stationary~~ or quasi-stationary~~ front'.	X	X	X	X	X	X	X	
(02)		Describe the cloud, weather, ground visibility and aviation hazards in a stationary ~~or quasi-stationary~~ front.	X	X	X	X	X	X	X	
050 06 02 08		***Movement of fronts and pressure systems, life cycle***								
(01)		Describe the movements of fronts and pressure systems and the life cycle of a mid-latitude depression.	X	X	X	X	X	X	X	
(02)		State the rules for predicting the direction and the speed of movement of fronts.	X	X	X	X	X	X	X	
(03)		~~Explain~~ State the difference ~~between~~in the speed of movement of cold and warm fronts.	X	X	X	X	X	X	X	
(04)		State the rules for predicting the direction and the speed of movement of frontal depressions.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(05)		Describe, with a sketch if required, the genesis, development and life cycle of a frontal depression with associated cloud and rain belts.	X	X	X	X	X	X	X	
050 06 02 09		***Changes of meteorological elements at a frontal wave***								
(01)		Sketch a plan and a cross section of a frontal wave (warm front, warm sector, and cold front) and illustrate the changes of pressure, temperature, surface wind and wind in the vertical axis.	X	X	X	X	X	X	X	
050 07 00 00		**PRESSURE SYSTEMS**								
050 07 01 00		**The principal pressure areas**								
050 07 01 01		***Location of the principal pressure areas***								
(01)		Identify or indicate on a map the principal global high-pressure and low-pressure areas in January and July.	X		X	X				
(02)		Explain how these pressure areas are formed.	X		X	X				
(03)		Explain how the pressure areas move with the seasons.	X		X	X				
050 07 02 00		**Anticyclone**								
050 07 02 01		***Anticyclones, types, general properties, cold and warm anticyclones, ridges and ~~wedges,~~ subsidence***								
(01)		List the different types of anticyclones.	X	X	X	X	X	X	X	
(02)		Describe the effect of high-level convergence in producing areas of high pressure at ground level.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(03)		Describe air-mass subsidence, its effect on the environmental lapse rate, and the associated weather.	X	X	X	X	X	X	X	
(04)		Describe the formation of warm and cold anticyclones.	X	X	X	X	X	X	X	
(05)		Describe the formation of ridges ~~and wedges~~. ~~*(Refer to 050 08 03 02)*~~	X	X	X	X	X	X	X	
(06)		Describe the properties of and the weather associated with warm and cold anticyclones.	X	X	X	X	X	X	X	
(07)		Describe the properties of and the weather associated with ridges ~~and wedges~~.	X	X	X	X	X	X	X	
(08)		Describe the blocking anticyclone and its effects.	X	X	X	X	X	X	X	
050 07 03 00		**Non-frontal depressions**								
050 07 03 01		***Thermal, orographic, polar and secondary depressions; troughs***								
(01)		Describe the effect of high-level divergence in producing areas of low pressure at ground level.	X	X	X	X	X	X	X	
(02)		Describe the formation and properties of thermal, orographic (lee lows), polar and secondary depressions.	X	X	X	X	X	X	X	
(03)		Describe the formation, the properties and the associated weather ~~of~~ at troughs.	X	X	X	X	X	X	X	
050 07 04 00		**Tropical revolving storms**								
050 07 04 01		***Characteristics of tropical revolving storms***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		State the conditions necessary for the formation of tropical revolving storms.	X	X	X	X	X			
(02)		~~Explain~~ State how a tropical revolving storm generally moves ~~during its life cycle~~ in its area of occurrence.	X	X	X	X	X			
(03)		Name the stages of the development of tropical revolving storms (tropical disturbance, tropical depression, tropical storm, severe tropical storm, tropical revolving storm).	X	X	X	X	X			
(04)		Describe the meteorological conditions in and near a tropical revolving storm.	X	X	X	X	X			
(05)		State the approximate dimensions of a tropical revolving storm.	X	X	X	X	X			
(06)		State that the movement of a tropical revolving storm can only rarely be forecast exactly, and that utmost care is necessary near tropical revolving storm.	X	X	X	X	X			
050 07 04 02		***Origin and local names, location and period of occurrence***								
(01)		List the areas of origin and occurrence of tropical revolving storms, and their specified names (hurricane, typhoon, tropical cyclone).	X	X	X	X	X			
(02)		State the expected times of occurrence of tropical revolving storms in each of the source areas, and their approximate frequency.	X	X	X	X	X			
050 08 00 00		**CLIMATOLOGY**								
050 08 01 00		**Climatic zones**								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
050 08 01 01		***General circulation in the troposphere and lower stratosphere***								
(01)	X	Describe the general tropospheric and low stratospheric circulation. *(Refer to 050 02 03 01)*	X	X	X	X	X			
050 08 01 02		***Climatic classification***								
~~LO (01)~~		~~Name the world climate groups according to Koeppen's classification.~~	~~X~~		~~X~~	~~X~~				
(02)		Describe the characteristics of the tropical rain climate, the dry climate, the mid-latitude climate (warm temperate rain climate), the subarctic climate (cold snow forest climate) and the snow climate (polar climate).	X	X	X	X	X			
(03)		Explain how the seasonal movement of the sun generates the transitional climate zones.	X	X	X	X	X			
~~LO (04)~~		~~Describe the typical weather in the tropical transitional climate (savannah climate) and in the temperate transitional climate (Mediterranean climate).~~	~~X~~		~~X~~	~~X~~				
(05)		State the typical locations of each major climatic zone.	X		X	X				
050 08 02 00		**Tropical climatology**								
050 08 02 01		***Cause and development of tropical showers and thunderstorms: humidity, temperature, tropopause***								
(01)		State the conditions necessary for the formation of tropical	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~rain~~ showers and thunderstorms (mesoscale convective complex, cloud clusters).								
(02)		Describe the characteristics of tropical squall lines.	X	X	X	X	X			
(03)		Explain the formation of convective cloud structures caused by convergence at the boundary of the NE and SE trade winds (Intertropical Convergence Zone (ITCZ)).	X	X	X	X	X			
(04)		State the typical figures for tropical surface air temperatures and humidities, and for heights of the zero-degree isotherm.	X	X	X	X	X			
050 08 02 02		***Seasonal variations of weather and wind, typical synoptic situations***								
~~LO (01)~~		~~Describe the seasonal variations of weather and winds, and describe the typical synoptic situations.~~	~~X~~		~~X~~	~~X~~				
(02)		Indicate on a map the trade winds (tropical easterlies) and describe the associated weather.	X	X	X	X	X			
(03)		Indicate on a map the doldrums and describe the associated weather.	X	X	X	X	X			
(04)		Indicate on a sketch the latitudes of subtropical high (horse latitudes) and describe the associated weather.	X	X	~~X~~	~~X~~				
(05)		Indicate on a map the major monsoon winds. ~~*(Refer to 050 08 02 04 for a description of the weather)*~~	X	X	X	X	X			
050 08 02 03		***Intertropical Convergence Zone (ITCZ), weather in the***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		ITCZ, general seasonal movement								
(01)		Identify or indicate on a map the positions of the ITCZ in January and July.	X	X	~~X~~	~~X~~				
(02)		Explain the seasonal movement of the ITCZ.	X	X	~~X~~	~~X~~				
(03)		Describe the weather and winds at the ITCZ.	X	X	~~X~~	~~X~~				
~~LO (04)~~		~~Explain the variations in weather that are found at the ITCZ.~~	~~X~~		~~X~~	~~X~~				
(05)		Explain the flight hazards associated with the ITCZ.	X	X	~~X~~	~~X~~				
050 08 02 04		***Monsoon, sandstorms, cold-air outbreaks***								
(01)		Define in general the term 'monsoon' and give a general overview of regions of occurrence.	X	X	X	X	X			
(02)		Describe the major monsoon conditions. *(Refer to 050 08 02 02)*	~~X~~	X	~~X~~	~~X~~	X			
(03)	X	Explain how trade winds change character after a long track and become monsoon winds.	X	X	X	X	X			
(04)		Explain the weather and the flight hazards associated with a monsoon.	X	X	X	X	X			
(05)		Explain the formation of the SW/NE monsoon over West Africa and describe the weather, stressing the seasonal differences.	X	X	X	X	X			
(06)		Explain the formation of the SW/NE monsoon over India	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		and describe the weather, stressing the seasonal differences.								
(07)		Explain the formation of the monsoon over the Far East and northern Australia and describe the weather, stressing the seasonal differences.	X	X	X	X	X			
(08)		Describe the formation and properties of sandstorms.	X	X	X	X	X			
(09)		Indicate when and where outbreaks of cold polar air can enter subtropical weather systems.	X	X	X	X	X			
(10)		Name well-known examples of polar-air outbreaks (Blizzard, Pampero).	X	X	X	X	X			
050 08 02 05		***Easterly waves***								
~~LO (01)~~		~~Describe and explain the formation of easterly waves, the associated weather and the duration of the weather activity.~~	~~X~~		~~X~~	~~X~~				
~~LO (02)~~		~~Describe and explain the global distribution of easterly waves.~~	~~X~~		~~X~~	~~X~~				
(03)		Explain the effect of easterly waves on tropical weather systems.	X		X	X				
050 08 03 00		**Typical weather situations in the mid-latitudes**								
050 08 03 01		***Westerly situation (westerlies)***								
(01)		Identify on a weather chart the typical westerly situation with travelling polar front waves.	X	X	~~X~~	~~X~~	~~X~~	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (02)~~		~~Describe the typical weather in the region of the travelling polar front waves including the seasonal variations.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (03)~~		~~State the differences between the northern and the southern hemisphere (roaring forties).~~	~~X~~		~~X~~	~~X~~				
050 08 03 02		***High-pressure area***								
(01)		Describe the high-pressure zones with the associated weather.	X	X	X	X	X	X	X	
(02)		Identify on a weather chart the high-pressure regions.	X	X	X	X	X	X	X	
~~LO (03)~~		~~Describe the weather associated with wedges in the polar air.~~ *~~(Refer to 050 07 02 01)~~*	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~050 08 03 03~~		***~~Flat-pressure pattern~~***								
~~(01)~~		~~Identify on a surface weather chart the typical flat-pressure pattern.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~Describe the weather associated with a flat-pressure pattern.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
050 08 03 04		***~~Cold-air pool (cold-air drop)~~ Cold-air drop ~~(cold-air pool)~~***								
(01)		Define 'cold-air drop'~~'cold-air pool~~'.	X	X	X	X	X	X	X	
(02)		Describe the formation of a cold-air drop.~~pool.~~	X	X	X	X	X	X	X	
~~LO (03)~~		~~Describe the characteristics of a cold-air pool with regard to dimensions, duration of life, geographical position,~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~seasons, movements, weather activities and dissipation.~~								
(04)		Identify cold-air drops~~pool~~ on weather charts.	X	X	X	X	X	X	X	
(05)		Explain the problems and dangers of cold-air drops~~pool~~ for aviation.	X	X	X	X	X	X	X	
050 08 04 00		**Local winds and associated weather**								
050 08 04 01		***Foehn, Mistral, Bora~~, Scirocco, Ghibli and Khamsin~~***								
(01)		Describe the ~~classical~~ mechanism for the development of Foehn winds (including Chinook).	X	X	X	X	X	X		
(02)		Describe the weather associated with Foehn winds.	X	X	X	X	X	X		
(03)		Describe the formation of, the characteristics of, and the weather associated with ~~the~~ Mistral and ~~the~~ Bora. ~~, the Scirocco, the Ghibli and the Khamsin.~~	X	X	X	X	X	X		
050 08 04 02		***Harmattan***								
(01)		Describe the Harmattan wind and the associated visibility problems as an example of local winds affecting visibility.	X	X	X	X	X			
050 09 00 00		**FLIGHT HAZARDS**								
050 09 01 00		**Icing**								
050 09 01 01		***Conditions for ice accretion***								
(01)		Summarise the general conditions under which ice accretion occurs on aircraft (temperatures of outside air; temperature of the airframe; presence of supercooled	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		water in clouds, fog, rain and drizzle; possibility of sublimation).								
(02)		~~Indicate~~Explain the general weather conditions under which ice accretion occurs in a ~~V~~venturi carburettor ~~occurs~~.	X	X	X	X	X	X	X	
(03)		Explain the general weather conditions under which ice accretion occurs on airframe ~~occurs~~.	X	X	X	X	X	X	X	
(04)		Explain the formation of supercooled water in clouds, rain and drizzle. *(Refer to Subject 050 03 02 01)*	X	X	X	X	X	X	X	
(05)		Explain qualitatively the relationship between the air temperature and the amount of supercooled water.	X	X	X	X	X	X	X	
(06)		Explain qualitatively the relationship between the type of cloud and the size and number of the droplets in cumuliform and stratiform clouds.	X	X	X	X	X	X	X	
(07)		Indicate in which circumstances ice can form on an aircraft on the ground: air temperature, humidity, precipitation.	X	X	X	X	X	X	X	
(08)		Explain in which circumstances ice can form on an aircraft in flight: inside clouds, in precipitation, outside clouds and precipitation.	X	X	X	X	X	X	X	
(09)		Explain the influence of fuel temperature, radiative cooling of the aircraft surface and temperature of the aircraft surface (e.g. from previous flight) on ice formation.								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(10)		Describe the different factors that influence~~ing~~ the intensity of icing: air temperature, amount of supercooled water in a cloud or in precipitation, amount of ice crystals in the air, speed of the aircraft, shape (thickness) of the airframe parts (wings, antennas, etc.).	X	X	X	X	X	X	X	
(11)		Explain the effects of topography on icing.	X	X	X	X	X	X	X	
(12)		Explain the higher concentration of water drops in stratiform orographic clouds.	X	X	X	X	X	X	X	
050 09 01 02		***Types of ice accretion***								
(01)	X	Define 'clear ice'.	X	X	X	X	X	X	X	
(02)		Describe the conditions for the formation of clear ice.	X	X	X	X	X	X	X	
(03)		Explain the formation of the structure of clear ice with the release of latent heat during the freezing process.	X	X	X	X	X	X	X	
(04)		Describe the aspect of clear ice: appearance, weight, solidity.	X	X	X	X	X	X	X	
(05)		Define 'rime ice'.	X	X	X	X	X	X	X	
(06)		Describe the conditions for the formation of rime ice.	X	X	X	X	X	X	X	
(07)		Describe the aspects of rime ice: appearance, weight, solidity.	X	X	X	X	X	X	X	
(08)		Define 'mixed ice'.	X	X	X	X	X	X	X	
(09)		Describe the conditions for the formation of mixed ice.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(10)		Describe the aspects of mixed ice: appearance, weight, solidity.	X	X	X	X	X	X	X	
(11)		Describe the possible process of ice formation in snow conditions.	X	X	X	X	X	X	X	
(12)		Define 'hoar frost'.	X	X	X	X	X	X	X	
(13)		Describe the conditions for the formation of hoar frost.	X	X	X	X	X	X	X	
(14)		Describe the aspects of hoar frost: appearance, solidity.	X	X	X	X	X	X	X	
050 09 01 03		***Hazards of ice accretion, avoidance***								
(01)		State the ICAO qualifying terms for the intensity of icing. ***Source:~~ (See~~ ICAO ~~ATM~~ Doc 4444 'Procedures for Air Navigation Services — Air Traffic Management'~~)~~***	X	X	X	X	X	X	X	
(02)		Describe, in general, the hazards of icing.	X	X	X	X	X	X	X	
(03)		Assess the dangers of the different types of ice accretion.	X	X	X	X	X	X	X	
(04)		Describe the position of the dangerous zones of icing in fronts, in stratiform and cumuliform clouds, and in the different precipitation types.	X	X	X	X	X	X	X	
(05)		Indicate the possibilities of avoiding~~ance~~ dangerous zones of icing: — in the flight planning: weather briefing, ~~choice~~selection of appropriate track and altitude; — during flight: recognition of the dangerous zones,	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~choice~~selection of appropriate track and altitude.								
050 09 01 04		**Ice crystal icing**								
(01)		Describe ice crystal icing.	X	X	X	X	X	X	X	
(02)		Describe the atmospheric processes leading to high ice crystal concentration. Define the variable ice water content (IWC).	X	X	X	X	X	X	X	
(03)		Identify weather situations and their relevant areas where high concentrations of ice crystals are likely to occur.	X	X	X	X	X	X	X	
(04)		Name, in general, the flight hazards associated with high concentrations of ice crystals.	X	X	X	X	X	X	X	
(05)		Explain how a pilot may possibly avoid areas with a high concentration of ice crystals.	X	X	X	X	X	X	X	
050 09 02 00		**Turbulence**								
050 09 02 01		***Effects on flight, avoidance***								
(01)		State the ICAO qualifying terms for the intensity of turbulence. ***(Source: ~~(See~~ ICAO ~~ATM~~ Doc 4444 'Procedures for Air Navigation Services — Air Traffic Management'~~)~~***	X	X	X	X	X	X	X	
(02)		Describe the effects of turbulence on an aircraft in flight.	X	X	X	X	X	X	X	
(03)		Indicate the possibilities of avoid~~anceing~~ turbulences: — in the flight planning: weather briefing, ~~choice~~	X	X	X	X	X	X	X	

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		selection of track and altitude; — during flight: ~~choice~~ selection of appropriate track and altitude.								
(04)		Describe atmospheric turbulence and distinguish between turbulence, gustiness and wind shear.	X	X	X	X	X	X	X	
(05)		Describe that forecasts of turbulence are not very reliable and state that pilot reports of turbulence are very valuable as they help others to prepare for or avoid turbulence.	X	X	X	X	X	X	X	
050 09 02 02		***Clear-~~a~~Air ~~t~~Turbulence (CAT): effects on flight, avoidance***								
(01)		Describe the effects of CAT on flight ~~caused by CAT~~. *(Refer to 050 02 06 03)*	X	X	X	X	X			
(02)		Indicate the possibilities of avoid~~ance~~ing CAT in flight: — in the flight planning: weather briefing, ~~choice~~ selection of track and altitude; — during flight: ~~choice~~ selection of appropriate track and altitude.	X	X	X	X	X			
050 09 03 00		**Wind shear**								
050 09 03 01		***Definition of wind shear***								
(01)		Define 'wind shear' (vertical and horizontal).	X	X	X	X	X	X	X	
(02)		Define 'low-level wind shear'.	X	X	X	X	X	X	X	
050 09 03 02		***Weather conditions for wind shear***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Describe the conditions, where and how wind shear can form (e.g. thunderstorms, squall lines, fronts, inversions, land and sea breeze, friction layer, relief).	X	X	X	X	X	X	X	
050 09 03 03		***Effects on flight, avoidance***								
(01)		Describe the effects of wind shear on flight ~~caused by wind shear~~.	X	X	X	X	X	X	X	
(02)		Indicate the possibilities of avoid~~ance~~ing wind shear in flight: — in the flight planning; — during flight.	X	X	X	X	X	X	X	
050 09 04 00		**Thunderstorms**								
050 09 04 01		***Conditions for and process of development, forecast, location, type specification***								
(01)		Name the cloud types which indicate the development of thunderstorms.	X	X	X	X	X	X	X	
(02)		Describe the different types of thunderstorms, their location, the conditions for and the process of development, and list their properties (air mass thunderstorms, frontal thunderstorms, squall lines, supercell storms, orographic thunderstorms).	X	X	X	X	X	X	X	
050 09 04 02		***Structure of thunderstorms, life ~~history~~cycle***								
~~LO (01)~~		~~Describe and sketch the stages of the life history of a~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~thunderstorm: initial, mature and dissipating stage.~~								
(02)		Assess the average duration of thunderstorms and their different stages.	X	X	X	X	X	X	X	
(03)		Describe a supercell storm: initial, supercell, tornado and dissipating stage.	X	X	X	X	X	X	X	
(04)		Summarise the flight hazards associated with a fully developed thunderstorm.	X	X	X	X	X	X	X	
(05)		Indicate on a sketch the most dangerous zones in and around a single-cell and a multi-cell thunderstorm.	X	X	X	X	X	X	X	
050 09 04 03		***Electrical discharges***								
(01)		Describe the basic outline of the electric field in the atmosphere.	X	X	X	X	X	X	X	
(02)		~~Describe the electrical potential differences in and around a thunderstorm.~~ Describe types of lightning, i.e. ground stroke, intra-cloud lightning, cloud-to-cloud lightning, upward lightning.	X	X	X	X	X	X	X	
(03)		Describe and assess the 'St. Elmo's fire' weather phenomenon.	X	X	X	X	X	X	X	
(04)		Describe the development of lightning discharges.	X	X	X	X	X	X	X	
(05)		Describe the effect of lightning strike on aircraft and flight execution.	X	X	X	X	X	X	X	
050 09 04 04		***Development and effects of downbursts***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Define the term 'downburst'.	X	X	X	X	X	X	X	
(02)		Distinguish between macroburst and microburst.	X	X	X	X	X	X	X	
(03)		State the weather situations leading to the formation of downbursts.	X	X	X	X	X	X	X	
(04)		Describe the process of development of a downburst.	X	X	X	X	X	X	X	
(05)		Give the typical duration of a downburst.	X	X	X	X	X	X	X	
(06)		Describe the effects of downbursts.	X	X	X	X	X	X	X	
050 09 04 05		***Thunderstorm avoidance***								
(01)		Explain how the pilot can anticipate each type of thunderstorm~~s~~: through pre-flight weather briefing, observation in flight, use of specific meteorological information, use of information given by ground weather radar and by ~~airborne weather radar~~ ground weather radar and by airborne weather radar (Refer to 050 10 01 04), use of a lightning detector (stormscope). *(Refer to Subject 050 10 01 04)*~~–~~ , use of the stormscope (lightning detector).	X	X	X	X	X	X	X	
(02)		Describe practical examples of flight techniques used to avoid the hazards of thunderstorms.	X	X	X	X	X	X	X	
050 09 05 00		**Tornadoes**								
050 09 05 01		***Properties and occurrence***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)	X	Define ~~the~~ 'tornado'.	X	X	X	X	X	X	X	
(02)		Describe the formation of a tornado.	X	X	X	X	X			
(03)		Describe the typical features of a tornado such as appearance, season, time of day, stage of development, speed of movement and wind speed ~~(including Fujita scale).~~	X	X	X	X	X			
(04)		Compare the occurrence of tornadoes in Europe with the occurrence in other locations, especially in the United States of America.	X	X	X	X	X			
(05)		Compare the dimensions and properties of tornadoes and dust devils.	X	X	X	X	X			
050 09 06 00		**Inversions**								
050 09 06 01		***Influence on aircraft performance***								
~~LO (01)~~		~~Explain the influence of inversions on the aircraft performance.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(02)		Compare the flight hazards during take-off and approach associated with a strong inversion alone and with a strong inversion combined with marked wind shear.	X	X	X	X	X	X	X	
050 09 07 00		**Stratospheric conditions**								
050 09 07 01		***Influence on aircraft performance***								
(01)		Summarise the advantages of stratospheric flights.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		List the influences of the phenomena associated with the lower stratosphere (wind, temperature, air density, turbulence).	X	X	X	X	X			
050 09 08 00		**Hazards in mountainous areas**								
050 09 08 01		***Influence of terrain on clouds and precipitation, frontal passage***								
~~(01)~~		~~Describe the influence of a mountainous terrain on cloud and precipitation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (02)~~		~~Describe the effects of the Foehn.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(03)		Describe the influence of a mountainous area on a frontal passage.	X	X	X	X	X	X	X	
050 09 08 02		***Vertical movements, mountain waves, wind shear, turbulence, ice accretion***								
(01)		Describe the vertical movements, wind shear and turbulence that are typical of mountain areas.	X	X	X	X	X	X	X	
(02)		Indicate ~~o~~in a sketch of a chain of mountains the turbulent zones (mountain waves, rotors).	X	X	X	X	X	X	X	
(03)		Explain the influence of relief on ice accretion.	X	X	X	X	X	X	X	
050 09 08 03		***Development and effect of valley inversions***								
(01)		Describe the formation of valley inversion due to katabatic winds.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		Describe the valley inversion formed by warm winds aloft.	X	X	X	X	X	X	X	
(03)		Describe the effects of a valley inversion for an aircraft in flight.	X	X	X	X	X	X	X	
050 09 09 00		**Visibility-reducing phenomena**								
050 09 09 01		***Reduction of visibility caused by precipitation and obscurations***								
(01)		Describe the reduction of visibility caused by precipitation: drizzle, rain, snow.	X	X	X	X	X	X	X	
(02)		Describe the reduction of visibility caused by obscurations: — fog, mist, haze, smoke, volcanic ash.	X	X	X	X	X	X	X	
(03)		Describe the reduction of visibility caused by obscurations: — sand (SA), dust (DU).	X		X	X				
(04)		Describe the differences between ground ~~visibility~~ and flight visibility, and slant ~~visibility~~ and vertical visibility when an aircraft is above or within a layer of haze or fog.	X	X	X	X	X	X	X	
050 09 09 02		***Reduction of visibility caused by other phenomena***								
(01)		Describe the reduction of visibility caused by low drifting and blowing snow.	X	X	X	X	X	X	X	
(02)		Describe the reduction of visibility caused by low drifting and blowing dust and sand.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)		Describe the reduction of visibility caused by dust storm (DS) and sandstorm (SS).	X	X	X	X	X			
(04)		Describe the reduction of visibility caused by icing (windshield).	X	X	X	X	X	X	X	
(05)		Describe the reduction of visibility caused by the position of the sun relative to the visual direction.	X	X	X	X	X	X	X	
(06)		Describe the reduction of visibility caused by the reflection of the sun's rays from the top of the layers of haze, fog and clouds.	X	X	X	X	X	X	X	
050 10 00 00		**METEOROLOGICAL INFORMATION**								
050 10 01 00		**Observation**								
050 10 01 01		***Surface observations***								
~~LO (01)~~		~~Define 'surface wind'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (02)~~		~~Describe the meteorological measurement of surface wind.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (03)~~		~~List the ICAO units for the wind direction and speed used in METARs (kt, m/s, km/h).~~ ~~*(Refer to 050 02 01 01)*~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(04)		Define 'gusts', as given in METARs.	X	X	X	X	X	X	X	
(05)		Distinguish wind given in METARs and wind given by the control tower for take-off and landing.	X	X	X	X	X	X	X	
(06)		Define 'visibility'.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(07)		Describe the meteorological measurement of visibility.	X	X	X	X	X	X	X	
(08)		Define ‘prevailing visibility’.	X	X	X	X	X	X	X	
(09)		Define ‘ground visibility’.	X	X	X	X	X	X	X	
(10)		List the units used for visibility (m, km, ~~stat. mi.~~ statute mile).	X	X	X	X	X	X	X	
(11)		Define ‘runway visual range’.	X	X	X	X	X	X	X	
(12)		Describe the meteorological measurement of runway visual range.	X	X	X	X	X	X	X	
(13)		Indicate where the transmissometers/forward-scatter meters are placed on the airport.	X	X	X	X	X	X	X	
(14)		List the units used for runway visual range (m, ft).	X	X	X	X	X	X	X	
(15)		List the different possibilities to transmit information to pilots about runway visual range.	X	X	X	X	X	X	X	
(16)		Compare ground visibility, prevailing visibility and runway visual range.	X	X	X	X	X	X	X	
(17)		Indicate the means of observation of present weather.	X	X	X	X	X	X		
(18)		Indicate the means of observing clouds for the purpose of recording: type, amount, height of base (ceilometers) and top.	X	X	X	X	X	X		
(19)		~~List the clouds considered in meteorological reports, and how they are indicated in METARs, TAFs and SIGMETs~~	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		(~~TCU, CB~~). State the clouds which are indicated in METAR, TAF and SIGMET.								
(20)		Define 'oktas'.	X	X	X	X	X	X	X	
(21)		Define 'cloud base'.	X	X	X	X	X	X	X	
(22)		Define 'ceiling'.	X	X	X	X	X	X	X	
(23)		Name the unit and the reference level used for information about cloud base (ft).	X	X	X	X	X	X	X	
(24)		Define 'vertical visibility'.	X	X	X	X	X	X	X	
(25)		Explain briefly how and when vertical visibility is measured.	X	X	X	X	X	X	X	
(26)		Name the units used for vertical visibility (ft, m).	X	X	X	X	X	X	X	
(27)		Indicate the means of observation of air temperature (thermometer).	X	X	X	X	X	X	X	
~~LO (28)~~		~~List the units used for air temperature (Celsius, Fahrenheit, Kelvin).~~ *~~(Refer to 050 01 02 01)~~*	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (29)~~		~~Indicate the means of observation of relative humidity (hygrometer and psychrometer) and dew-point temperature (calculation).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(30)		Name the units of relative humidity (%) and dew-point temperature (Celsius, Fahrenheit).	X	X	X	X	X	X		
~~LO (31)~~		~~Indicate the means of observation of atmospheric pressure~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~(mercury and aneroid barometer).~~								
~~LO (32)~~		~~List the units of atmospheric pressure (hPa, inches of Mercury).~~ ~~*(Refer to 050 01 03 01)*~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
050 10 01 02		***Radiosonde observations***								
(01)		Describe the principle of radiosondes.	X	X	X	X	X	X		
(02)	X	Describe and interpret the sounding by radiosonde given on a simplified T-P diagram.	X	X	X	X	X	X		
050 10 01 03		***Satellite observations***								
(01)	X	Describe the basic outlines of satellite observations.	X	X	X	X	X	X	X	
(02)		Name the main uses of satellite pictures in aviation meteorology.	X	X	X	X	X	X	X	
(03)		Describe the different types of satellite imagery.	X	X	X	X	X	X	X	
(04)		Interpret qualitatively the satellite pictures in order to get useful information for ~~the~~ flights: — location of clouds (distinguish between stratiform and cumuliform clouds).	X	X	X	X	X	X	X	
(05)		Interpret qualitatively the satellite pictures in order to get useful information for ~~the~~ flights: — location of fronts.	X	X	X	X	X	X	X	
(06)		Interpret qualitatively the satellite pictures in order to get	X		~~X~~	~~X~~				

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		useful information for ~~the~~ flights using atmospheric motion vector images to locate jet streams.~~;~~ — ~~location of jet streams.~~								
050 10 01 04		***Weather-radar observations*** ***(Refer to 050 09 04 05)***								
(01)		Describe the basic principle and the type of information given by a ground weather radar.	X	X	X	X	X	X		
(02)		Interpret ground weather radar images.	X	X	X	X	X	X	X	
(03)		Describe the basic principle and the type of information given by airborne weather radar.	X	X	X	X	X	X	X	
(04)		Describe the limits and the errors of airborne weather radar information.	X	X	X	X	X	X	X	
(05)		Interpret typical airborne weather radar images.	X	X	X	X	X	X	X	
050 10 01 05		***Aircraft observations and reporting***								
(01)		Describe routine air-report and special air-report (ARS).	X	X	X	X	X	X	X	
(02)		State the obligation of a pilot to prepare air-reports.	X	X	X	X	X	X	X	
(03)		Name the weather phenomena to be stated in an ARS~~special air report~~.	X	X	X	X	X	X	X	
050 10 02 00		**Weather charts**								
050 10 02 01		***Significant weather charts***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Decode and interpret significant weather charts (low, medium and high level).	X	X	X	X	X	X	X	
(02)		Describe from a significant weather chart the flight conditions at designated locations ~~and/~~or along a defined flight route at a given ~~flight level~~FL.	X	X	X	X	X	X	X	
050 10 02 02		***Surface charts***								
(01)		Recognise the following weather systems on a surface weather chart (analysed and forecast): ridges, cols and troughs; fronts; frontal side, warm sector and rear side of mid-latitude frontal lows; high- and low-pressure areas.	X	X	X	X	X	X	X	
(02)		Determine from surface weather charts the wind direction and speed.	X	X	X	X	X	X	X	
050 10 02 03		***Upper-air charts***								
(01)		Define 'constant-pressure chart'.	X	X	X	~~X~~	~~X~~	~~X~~		
(02)		Define 'isohypse (contour line)'. *(Refer to 050 01 03 02)*	X	X	X	~~X~~	~~X~~	~~X~~		
(03)		Define 'isotherm'.	X	X	X	~~X~~	~~X~~	~~X~~		
(04)		Define 'isotach'.	X	X	X	~~X~~	~~X~~	~~X~~		
(05)		Describe forecast upper-wind and temperature charts.	X	X	X	~~X~~	~~X~~	~~X~~		
(06)		For designated locations or routes determine from forecast upper-wind and temperature charts, if necessary by	X	X	X	~~X~~	~~X~~	~~X~~		

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		interpolation, the spot/average values for outside-air temperature, temperature deviation from ISA, wind direction and wind speed.								
050 10 02 04		***Gridded forecast products***								
(01)		State that numerical weather prediction uses a 3D grid of weather data, consisting of horizontal data (latitude-longitude) and vertical data (height or pressure).	X	X	X	X	X			
(02)		Explain that world area forecast centres prepare global sets of gridded forecasts for flight planning purposes (upper wind, temperature, humidity).	X	X	X	X	X			
(03)		State that the WAFCs also produce gridded datasets for Flight Level and temperature of the tropopause, direction and speed of maximum wind, cumulonimbus clouds, icing and turbulence.	X	X	X	X	X			
(04)		Explain that the data on CB and turbulence can be used in the visualization of flight hazards.	X	X	X	X	X			
(05)		Explain that the gridded forecasts can be merged in information processing systems with data relayed from aircraft or pilot reports, e.g. of turbulence, to provide improved situation awareness.	X	X	X	X	X			
~~LO (07)~~		~~Name the most common flight levels corresponding to the constant pressure charts.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
050 10 03 00		**Information for flight planning**								
050 10 03 01		***Aviation weather messages***								
(01)		Describe, decode and interpret the following aviation weather messages (given in written and/or graphical	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		format): METAR, aerodrome special meteorological report (SPECI), trend forecast (TREND), TAF, information concerning en-route weather phenomena which may affect the safety of aircraft operations (SIGMET), information concerning en-route weather phenomena which may affect the safety of low-level aircraft operations (AIRMET), area forecast for low-level flights (GAMET), ~~special air report~~ARS, volcanic ash advisory information.								
(02)		Describe, decode and interpret the tropical cyclone advisory information in written and graphical form.	X	X	X	X	X			
(03)		Describe the general meaning of MET REPORT and SPECIAL REPORT.	X	X	X	X	X	X	X	
(04)		List, in general, the cases when a SIGMET and an AIRMET are issued.	X	X	X	X	X	X	X	
(05)		Describe, decode (by using a code table) and interpret the following messages: r~~R~~unway s~~S~~tate m~~M~~essage (as written in a METAR)~~, GAFOR~~. *Remark: For r~~R~~unway s~~S~~tate m~~M~~essage ~~and GAFOR,~~ refer to ~~the~~ ICAO Doc 7754 'Air Navigation Plan European Region' ~~Doc 7754~~.*	X	X	X	X	X	X	X	
050 10 03 02		***Meteorological broadcasts for aviation***								
(01)		Describe the meteorological content of broadcasts for aviation:	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— meteorological information for aircraft in flight (VOLMET),~~;~~ — automatic terminal information service (ATIS).								
(02)		Describe the meteorological content of broadcasts for aviation: — HF-VOLMET.	X	X	X	X	X			
050 10 03 03		***Use of meteorological documents***								
(01)		Describe meteorological briefing and advice.	X	X	X	X	X	X	X	
(02)		List the information that a flight crew can receive from meteorological services for pre-flight planning and apply the content of this information on a designated flight route.	X	X	X	X	X	X	X	
(03)		List the meteorological information that a flight crew can receive from flight information services during flight and apply the content of this information for the continuation of the flight.	X	X	X	X	X	X	X	
050 10 03 04		***Meteorological warnings***								
(01)		Describe and interpret aerodrome warnings and wind-shear warnings and alerts.	X	X	X	X	X	X	X	
050 10 04 00		**Meteorological services**								
050 10 04 01		***World area forecast system and meteorological offices***								
(01)	X	~~— Name the main objectives of the world area~~	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~forecast system:~~ — ~~world area forecast centres (upper-air forecasts).~~ Name the world area forecast centres (WAFCs) as the provider for the upper-air forecasts: WAFCs prepare upper-air gridded forecasts of upper winds; upper-air temperature; and humidity; direction, speed and flight level of maximum wind; flight level and temperature of tropopause, areas of cumulonimbus clouds, icing, clear-air and in-cloud turbulence, and geopotential altitude of flight levels.								
(02)	X	~~— Name the main objectives of the world area forecast system:~~ ~~— meteorological offices (aerodrome forecasts, briefing documents).~~ Name the meteorological (MET) offices as the provider for aerodrome forecasts and briefing documents.	X	X	X	X	X	X	X	
(03)		~~— Name the main objectives of the world area forecast system:~~ — ~~meteorological watch offices (SIGMET, AIRMET).~~ Name the meteorological watch offices (MWOs) as the provider for SIGMET and AIRMET information.	X	X	X	X	X	X		
(04)	X	~~— Name the main objectives of the world area forecast system:~~	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		— ~~aeronautical meteorological stations (METAR, MET reports).~~ Name the aeronautical meteorological stations as the provider for METAR and MET reports.								
(05)	X	~~— Name the main objectives of the world area forecast system:~~ — ~~volcanic ash advisory centres (VAACs).~~ Name the volcanic ash advisory centres (VAACs) as the provider for forecasts of volcanic ash clouds.	X	X	X	X	X	X		
(06)		~~— Name the main objectives of the world area forecast system:~~ — ~~tropical cyclone advisory centres (TCACs).~~ Name the tropical cyclone advisory centres (TCACs) as the provider for forecasts of tropical cyclones.	X		X	X				
050 10 04 02		***International organisations***								
(01)		Describe briefly the following organisations and their chief activities in relation to weather for aviation: — International Civil Aviation Organization (ICAO) *(Refer to ~~S~~subject 010 ‘AIR LAW’)*; — World Meteorological Organization (WMO).	X	X	X	X	X	X		

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Appendix to Annex I to ED Decision 2018/001/R

'Acceptable Means of Compliance (AMCs) and Guidance Material (GM) to Part-FCL Amendment 4'

Appendix
'SUBJECT 061 — NAVIGATION — GENERAL NAVIGATION'
to
AMC1 FCL.310; FCL.515(b); FCL.615(b)
'Theoretical knowledge examinations'
of Annex I

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~~SUBJECT 061 — GENERAL NAVIGATION~~

~~Syllabus reference~~	~~BK~~	~~Syllabus details and associated Learning Objectives~~	~~Aeroplane~~		~~Helicopter~~			~~IR~~	~~Comments~~
			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
~~060 00 00 00~~		**~~NAVIGATION~~**							
~~061 00 00 00~~		**~~GENERAL NAVIGATION~~**							
~~061 01 00 00~~		**~~BASICS OF NAVIGATION~~**							
~~061 01 01 00~~		**~~The solar system~~**							
~~061 01 01 01~~		***~~Earth's orbit, seasons and apparent movement of the sun~~***							
~~LO (01)~~		~~State that the solar system consists of the Sun, a number of planets of which the Earth is one, and a large number of asteroids and comets.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (02)~~		~~State that Kepler's first law explains that the planets revolve in elliptical orbits with the Sun at one focus. Each planet has its orbital period.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (03)~~		~~State that Kepler's second law explains the variation in the speed of a planet in its orbit. Each planet revolves so that its radius vector sweeps out equal areas in equal intervals of time.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (04)~~		~~State that the highest speed of the Earth in its orbit is when the Earth is closest to the Sun (perihelion).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (05)~~		~~State that the lowest speed of the Earth in its orbit is when the Earth is furthest away from the Sun (aphelion).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~**Syllabus reference**~~	~~**BK**~~	~~**Syllabus details and associated Learning Objectives**~~	~~**Aeroplane**~~		~~**Helicopter**~~			~~**IR**~~	~~**Comments**~~
			~~**ATPL**~~	~~**CPL**~~	~~**ATPL /IR**~~	~~**ATPL**~~	~~**CPL**~~		
~~(06)~~		~~Explain in which direction the Earth rotates on its axis.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(07)~~		~~Explain that the axis of rotation of the Earth is inclined to its orbital path around the Sun at an angle of about 66,5 degrees.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(08)~~		~~Define the term 'ecliptic' and 'plane of the ecliptic'. Ecliptic is the apparent path of the Sun around the Earth. The plane of the ecliptic is inclined to the plane of the equator at an angle of approximately 23,5 degrees. The inclination of the polar axis to the plane of the ecliptic is the reason for the seasons.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(09)~~		~~Explain that the Earth completes one orbit around the Sun in approximately 365,25 days.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(10)~~		~~Describe the effect of the inclination of the Earth's rotation axis to the plane of its orbit around the Sun, being the seasons and variation of sunrise and sunset with latitude and time of the year.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(11)~~		~~Define the terms 'apparent Sun' and 'mean Sun' and state their relationship.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(12)~~		~~Define the 'celestial equator'. It is the projection of the Earth's equator onto the celestial sphere.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(13)~~		~~Define the term 'declination'. Declination is the angular distance of a celestial body north or south of the celestial equator.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(14)~~		~~State that the mean Sun is conceived to move eastward along~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~Syllabus reference~~	~~BK~~	~~Syllabus details and associated Learning Objectives~~	~~Aeroplane~~		~~Helicopter~~			~~IR~~	~~Comments~~
			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
		~~the celestial equator at a rate that provides a uniform measure of time equal to the average time reckoned from the true Sun.~~							
~~(15)~~		~~Define the 'polar circles', the 'tropic of Cancer' and the 'tropic of Capricorn'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(16)~~		~~Explain summer and winter solstice.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(17)~~		~~Explain the terms 'spring and autumn equinox'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (18)~~		~~Explain at which time of the year the duration of daylight changes at the highest rate.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(19)~~		~~Explain the relationship between the declination of the Sun, latitude and the period of daylight.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (20)~~		~~State that the perihelion occurs early January and aphelion occurs early July.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(21)~~		~~Illustrate the position of the Earth relative to the Sun with respect to the seasons and months of the year.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (22)~~		~~Define 'zenith'. The point on the sky vertically overhead an observer.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 01 02 00~~		**~~The Earth~~**							
~~061 01 02 01~~		***~~Great circle, small circle, rhumb line~~***							
~~(01)~~		~~State that the Earth is not a true sphere. It is flattened slightly at the poles. The value for flattening is 1/298.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~**Syllabus reference**~~	~~**BK**~~	~~**Syllabus details and associated Learning Objectives**~~	~~**Aeroplane**~~		~~**Helicopter**~~			~~**IR**~~	~~**Comments**~~
			~~**ATPL**~~	~~**CPL**~~	~~**ATPL /IR**~~	~~**ATPL**~~	~~**CPL**~~		
~~LO (02)~~		~~Given the Earth flattening and either the semimajor or semiminor axis in NM/km, calculate the distance of the other axis.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~State that the Earth may be described as an ‘ellipsoid’ or ‘oblate spheroid’.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~Explain that the Equator has its plane perpendicular to the Earth’s axis and divides the Earth into the northern and southern hemisphere.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (05)~~		~~Given that the distance of the circumference of the Earth is 40 000 km or approximately 21 600 NM, calculate the approximate Earth diameter or Earth radius.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(06)~~		~~Define a ‘great circle’ in relation to the surface of a sphere.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(07)~~		~~Describe the ‘geometric properties’ of a great circle, including vertex.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(08)~~		~~Define a ‘small circle’ in relation to the surface of a sphere.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(09)~~		~~Define a ‘rhumb line’. A line which cuts all meridians at the same angle.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 01 02 02~~		***~~Convergency, conversion angle~~***							
~~(01)~~		~~Explain the term ‘convergency of meridians’ between two positions.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~Explain how the value of convergency can be determined using~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~Syllabus reference~~	~~BK~~	~~Syllabus details and associated Learning Objectives~~	~~Aeroplane~~		~~Helicopter~~			~~IR~~	~~Comments~~
			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
		~~calculation.~~							
~~(03)~~		~~The formula to calculate convergency between two positions relatively close to each other is: convergency = difference of longitude × sin (mean latitude).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~Calculate the value of convergency between two stated positions.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(05)~~		~~Explain that the difference between great-circle track and rhumb-line track at a specified position is called conversion angle.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(06)~~		~~State that over short distances and out-of-polar regions the average great-circle true track is approximately equal to the rhumb-line true track between two positions.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(07)~~		~~Explain how the value of conversion angle can be calculated as half the value of convergency.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(08)~~		~~Calculate the great-circle track and rhumb-line track angle at specified position involving calculations of convergency and conversion angle.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 01 02 03~~		***~~Latitude, difference of latitude~~***							
~~(01)~~		~~Define 'geographic latitude' as the angle between the plane of the equator and the local plumb line on the ellipsoid.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (02)~~		~~Define 'geocentric latitude' as the angle between the plane of the equator and a line from the position to the centre of the~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~Syllabus reference~~	~~BK~~	~~Syllabus details and associated Learning Objectives~~	~~Aeroplane~~		~~Helicopter~~			~~IR~~	~~Comments~~
			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
		~~Earth.~~							
~~LO (03)~~		~~State that the maximum difference between geographic and geocentric latitude occurs at altitude of 45 degrees.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~Describe a parallel of latitude as a small circle connecting all positions on the Earth with the same latitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(05)~~		~~Calculate the difference of latitude between two given positions lat/long.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(06)~~		~~State that the 1-degree difference of latitude equals 60 nautical miles.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(07)~~		~~Convert the difference of latitude to distance.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (08)~~		~~Calculate the mean latitude between two positions.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 01 02 04~~		***~~Longitude, difference of longitude~~***							
~~(01)~~		~~Describe a meridian as a semigreat circle, which runs north and south from pole to pole.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~Explain that the meridians and their anti-meridian complete a great circle.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~State that the Greenwich meridian is also known as the prime meridian.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~Define 'longitude' as the angle measured at the polar axis between the plane of the prime meridian and the local~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~**Syllabus reference**~~	~~**BK**~~	~~**Syllabus details and associated Learning Objectives**~~	~~**Aeroplane**~~		~~**Helicopter**~~			~~**IR**~~	~~**Comments**~~
			~~**ATPL**~~	~~**CPL**~~	~~**ATPL /IR**~~	~~**ATPL**~~	~~**CPL**~~		
		~~meridian.~~							
~~(05)~~		~~Explain that the Greenwich anti-meridian is the maximum longitude possible, namely 180° east–west.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(06)~~		~~Calculate the difference of longitude between two given positions lat/long.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (07)~~		~~Name examples of great circles on the surface of the Earth.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (08)~~		~~Name examples of small circles on the surface of the Earth.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(09)~~		~~Define a 'rhumb line'. A line intersecting all meridians at the same angle.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(10)~~		~~Explain the geometrical properties of a rhumb line. Parallels and meridians are special cases of rhumb lines.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~***061 01 02 05***~~		~~***Use of latitude and longitude coordinates to locate any specific position***~~							
~~(01)~~		~~Explain that along the equator a difference of longitude of 1° equals a distance of 60 NM.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~Explain that because the meridians converge towards the poles, the distance between meridians will decrease with increase in latitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (03)~~		~~State that the Earth's distance along a parallel of latitude is also known as departure.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~**Syllabus reference**~~	~~**BK**~~	~~**Syllabus details and associated Learning Objectives**~~	~~**Aeroplane**~~		~~**Helicopter**~~			~~**IR**~~	~~**Comments**~~
			~~**ATPL**~~	~~**CPL**~~	~~**ATPL /IR**~~	~~**ATPL**~~	~~**CPL**~~		
~~(04)~~		~~Calculate the Earth's distance between two meridians along a parallel of latitude (departure) using the following formula:~~ ~~distance = difference of longitude × 60 × cosine latitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(05)~~		~~Given a position lat/long, distances travelled north–south in NM/km and distance travelled east–west in NM/km along a parallel of latitude. Calculate the new position.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(06)~~		~~Given two positions on same meridian (or one on the anti-meridian), calculate the distance.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~**061 01 03 00**~~		~~**Time and time conversions**~~							
~~***061 01 03 01***~~		~~***Apparent time***~~							
~~LO (01)~~		~~Explain the principles of zone time.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~Explain that, because the Earth rotates on its axis from west to east, the celestial bodies appear to revolve around the Earth from east to west.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (03)~~		~~Define and explain the term 'transit'. Explain that transit means that a celestial body crosses the observer's meridian.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~Explain that the time period of a 'day' is the elapsed time between two successive transits of a heavenly body.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(05)~~		~~Explain that the term 'sidereal day' is the time measured with reference to a fixed point on the celestial sphere.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(06)~~		~~State that if the day is measured by the apparent passage of~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~Syllabus reference~~	~~BK~~	~~Syllabus details and associated Learning Objectives~~	~~Aeroplane~~		~~Helicopter~~			~~IR~~	~~Comments~~
			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
		~~the Sun, the length of a day will vary.~~							
~~(07)~~		~~Explain the reason for the variation in the length of an apparent day, being a combination of the variation in the Earth's orbital speed around the Sun and the inclination of the Earth's rotation axis to the plane of the ecliptic.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(08)~~		~~Illustrate that, since both the direction of rotation of the Earth around its axis and its orbital rotation around the Sun are the same, the Earth must rotate through more than 360° to produce successive transits.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(09)~~		~~State that the period between two successive transits of the Sun is called an apparent solar day, and that the time based on this is called apparent time.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(10)~~		~~State that in order to have a constant measurement of time, which will still have the solar day as a basis, the average length of an apparent solar day is taken. This average day is called mean solar day. It is divided into 24 hours of mean time.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(11)~~		~~State that the mean Sun is a fictitious Sun orbiting along the plane of the equator at a constant angular velocity that provides a uniform measure of time.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(12)~~		~~State that the time between two successive transits of the mean Sun over a meridian is constant.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (13)~~		~~Explain that the difference between apparent time and mean~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~**Syllabus reference**~~	~~**BK**~~	~~**Syllabus details and associated Learning Objectives**~~	~~**Aeroplane**~~		~~**Helicopter**~~			~~**IR**~~	~~**Comments**~~
			~~**ATPL**~~	~~**CPL**~~	~~**ATPL /IR**~~	~~**ATPL**~~	~~**CPL**~~		
		~~time is defined as the 'equation of time'.~~							
~~LO (14)~~		~~State that the time of orbital revolution of the Earth in 1 year around the Sun is approximately 365 ¼ calendar days.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (15)~~		~~State that the calendar year is 365 days and every 4th year a leap year with 366 days and 3 leap years are suppressed every 4 centuries.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(16)~~		~~State that time can also be measured in arc since, in one day of mean solar time, the mean Sun is imagined to travel in a complete circle round the Earth, a motion of 360° in 24 hours.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(17)~~		~~Illustrate the relationship between time and arc along the equator.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(18)~~		~~Deduce conversion values for arc to time and visa versa.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~***061 01 03 02***~~		~~***Universal Time Coordinated (UTC)***~~							
~~(01)~~		~~State that the Greenwich meridian is selected as standard meridian, and that LMT at the Greenwich meridian is equal to Greenwich mean time (GMT).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~State that UTC is based on atomic time and GMT on the Earth's rotation, but in practice they are considered as the same.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~State that the conversion factor between LMT and UTC is arc (change of longitude) converted to time.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~Convert arc to time.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~**Syllabus reference**~~	~~**BK**~~	~~**Syllabus details and associated Learning Objectives**~~	~~**Aeroplane**~~		~~**Helicopter**~~			~~**IR**~~	~~**Comments**~~
			~~**ATPL**~~	~~**CPL**~~	~~**ATPL /IR**~~	~~**ATPL**~~	~~**CPL**~~		
~~(05)~~		~~Convert time to arc.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(06)~~		~~Convert between UTC and LMT.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~***061 01 03 03***~~		~~***Local Mean Time (LMT)***~~							
~~(01)~~		~~State that the beginning of the local mean day at any location is when the mean Sun is in transit with the anti-meridian. This is known as midnight or 0000 hours LMT.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~State that when the mean Sun is in transit with the location's meridian, it is noon or 1200 hours LMT.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~State that the LMT at locations at different longitudes varies by an amount corresponding to the change in longitude.~~							
~~***061 01 03 04***~~		~~***Standard times (STs)***~~							
~~(01)~~		~~State that standard time is the time used by a particular country (or part of a country) determined by the government of that particular country.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~State that some countries use summer time (daylight saving time).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~State that conversion from UTC to standard time and visa versa is usually done using extracts from the air almanac published in appropriate documents.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~Given appropriate documents, convert from UTC to ST of a specific country and from ST of a specific country to UTC.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

FOR INFORMATION ONLY

~~**Syllabus reference**~~	~~**BK**~~	~~**Syllabus details and associated Learning Objectives**~~	~~**Aeroplane**~~		~~**Helicopter**~~			~~**IR**~~	~~**Comments**~~
			~~**ATPL**~~	~~**CPL**~~	~~**ATPL /IR**~~	~~**ATPL**~~	~~**CPL**~~		
~~***061 01 03 05***~~		~~***Dateline***~~							
~~(01)~~		~~Explain the effect on the LMT when approaching the 180° meridian line from either side.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~State that the dateline does not follow exactly the 180° east–west meridian.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~Explain that when crossing the anti-meridian of Greenwich, one day is lost or gained depending on the direction of travel.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~State that the dateline is the actual place where the change is made and, although mainly at the 180° meridian, there are some slight divergences in order to avoid countries being divided by the dateline.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(05)~~		~~State that when calculating times, the dateline is automatically taken into account by doing all conversions via UTC.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(06)~~		~~Calculate conversions of LMT and GMT/UTC and ST for cases involving the international dateline.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~***061 01 03 06***~~		~~***Determination of sunrise (SR), sunset (SS) and civil twilight***~~							
~~(01)~~		~~State that SR or SS is when the Sun's upper edge is at the observer's horizon. State how atmospheric refraction affects this apparent sighting.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~Explain that SR and SS occur at different times on the same meridian depending on the latitude for a given day.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

FOR INFORMATION ONLY

~~Syllabus reference~~	~~BK~~	~~Syllabus details and associated Learning Objectives~~	~~Aeroplane~~		~~Helicopter~~			~~IR~~	~~Comments~~
			~~ATPL~~	~~CPL~~	~~ATPL/IR~~	~~ATPL~~	~~CPL~~		
~~(03)~~		~~Explain that SR will occur earlier and SS will occur later with increase in altitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~State that the times for SR and SS given in the air almanac are calculated for the Greenwich meridian.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(05)~~		~~Explain that at the spring and autumn equinox, SR and SS occur approximately at the same time at all latitudes.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(06)~~		~~State that, except in high latitudes, the times of SR and SS at any place change only a little each day. So, for all places of the same latitude, SR or SS will occur at approximately the same LMT.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(07)~~		~~State that the reason for the variation of the duration of daylight and night throughout the year is the inclination of the Earth's rotation axis to the ecliptic.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(08)~~		~~State that SR and SS times are tabulated against specified dates and latitudes.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(09)~~		~~State that at equator SR is always close to 0600 LMT and SS close to 1800 LMT (within 15 minutes).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(10)~~		~~Calculate examples of SR and SS at mean sea level in LMT, ST or UTC, given SR and SS tables, latitudes and longitude of the place in question and the date.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(11)~~		~~Given SR or SS time in UTC or ST for a given position, calculate SR or SS for another position on the same latitude in UTC or ST.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

FOR INFORMATION ONLY

~~Syllabus reference~~	~~BK~~	~~Syllabus details and associated Learning Objectives~~	~~Aeroplane~~		~~Helicopter~~			~~IR~~	~~Comments~~
			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
~~(12)~~		~~Explain the meaning of the term ‘twilight’.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(13)~~		~~Define the ‘duration of evening civil twilight’. The time from sunset to the time when the centre of the Sun is 6° below the horizon.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(14)~~		~~Define the ‘duration of morning civil twilight’. The time from the point when the centre of the Sun is 6° below the horizon to the time of sunrise.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(15)~~		~~State that the beginning of morning civil twilight and the end of evening civil twilight has been tabulated in UTC, valid for the prime meridian, with latitude and date as the entering argument. It may be taken to be LMT for any other meridian.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(16)~~		~~Calculate examples of twilight in UTC and ST given a twilight table, latitude and longitude of the place in question and the date.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(17)~~		~~Determine the duration of morning and evening civil twilight.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(18)~~		~~Explain the effect of declination and latitude on the duration of twilight.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 01 04 00~~		**~~Directions~~**							
~~061 01 04 01~~		***~~True north~~***							
~~(01)~~		~~State that all meridians run in north–south direction, and that the true-north direction is along any meridian towards the~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

FOR INFORMATION ONLY

~~Syllabus reference~~	~~BK~~	~~Syllabus details and associated Learning Objectives~~	~~Aeroplane~~		~~Helicopter~~			~~IR~~	~~Comments~~
			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
		~~geographic north pole.~~							
~~(02)~~		~~State that true directions are measured clockwise as an angle in degrees from true north.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~***061 01 04 02***~~		~~***Terrestrial magnetism: magnetic north, inclination and variation***~~							
~~LO (01)~~		~~State that a freely suspended compass needle will turn to the direction of the local magnetic field. The direction of the horizontal component of this field is the direction of magnetic north (MN).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~State that the magnetic poles do not coincide with the geographic poles.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~State that the magnetic variation varies as a function of time due to the movement of the northern magnetic pole.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (04)~~		~~Define 'magnetic dip or inclination'. The angle between the horizontal and the total component of the magnetic field.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (05)~~		~~State that the angle of inclination at the magnetic poles is 90°.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (06)~~		~~Explain that the accuracy of the compass depends on the strength of the horizontal component of the Earth's magnetic field.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (07)~~		~~State that, in the polar areas, the horizontal component of the Earth's magnetic field is too weak to permit the use of a magnetic compass.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
~~061 01 04 03~~		***~~Compass deviation, compass north~~***							
~~LO (01)~~		~~State that, in a direct-reading compass, the magnetic element will align along a magnetic field. This direction is called compass north (CN) and is the direction 000° on the compass rose. The field is the resultant of the Earth's magnetic field and the magnetic field of the aircraft.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (02)~~		~~State that the effect of the aircraft magnetism on the compass changes with different headings, as well as with different latitudes.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~State that the angle between magnetic north and compass northis called deviation (DEV) and is given in degrees east (+ or E) or west (– or W) of the magnetic north.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (04)~~		~~State that deviation is kept to a minimum by compass swinging.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 01 04 04~~		***~~Isogonals, relationship between true and magnetic north~~***							
~~(01)~~		~~State that the angle between the true north and magnetic northis called variation (VAR) being measured in degrees east (+ or E) or west (– or W) of the true north.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~Define an 'isogonal line'. A line joining positions of equal variation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~Convert between compass, magnetic and true directions.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 01 04 05~~		***~~Gridlines, isogrives~~***							

FOR INFORMATION ONLY

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			~~**ATPL**~~	~~**CPL**~~	~~**ATPL /IR**~~	~~**ATPL**~~	~~**CPL**~~		
~~LO (01)~~		~~Explain the purpose of a grid north (GN) based on a suitable meridian on a polar stereographic chart (reference or datum meridian).~~	~~X~~		~~X~~	~~X~~			
~~LO (02)~~		~~Explain that the gridlines or the grid meridians are drawn on the chart parallel to the reference meridian.~~	~~X~~		~~X~~	~~X~~			
~~LO (03)~~		~~State that the angle between the grid north (GN) and true north (TN) is called grid convergence being measured in degrees east (+ or E) if GN is west of TN or west (– or W) if GN is east of TN.~~	~~X~~		~~X~~	~~X~~			
~~LO (04)~~		~~State that the angle between the grid north (GN) and magnetic north (MN) is called grivation (griv) being measured in degrees east (+ or E) or west (– or W) of the grid north.~~	~~X~~		~~X~~	~~X~~			
~~LO (05)~~		~~State that a line joining points, which have the same grivation, is called an isogriv.~~	~~X~~		~~X~~	~~X~~			
~~LO (06)~~		~~Convert between compass, magnetic, true and grid directions.~~	~~X~~		~~X~~	~~X~~			
~~**061 01 05 00**~~		~~**Distance**~~							
~~***061 01 05 01***~~		~~***Units of distance and height used in navigation: nautical miles, statute miles, kilometres, metres, feet***~~							
~~(01)~~		~~Define the 'nautical mile'. A distance being equal to 1 852 km.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (02)~~		~~In map/charts, distance between two positions is measured along a meridian at mean latitude, where 1 minute of latitude~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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			~~ATPL~~	**~~CPL~~**	**~~ATPL /IR~~**	**~~ATPL~~**	**~~CPL~~**		
		~~presents 1 NM.~~							
~~LO (03)~~		~~State that when dealing with heights and altitudes the unit used is metres or feet subject to the choice of individual States.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 01 05 02~~		***~~Conversion from one unit to another~~***							
~~(01)~~		~~Convert between the following units: nautical miles (NM), statute miles (SM), kilometres (km), metres (m) and feet (ft).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 01 05 03~~		***~~Relationship between nautical miles and minutes of latitude and minutes of longitude~~***							
~~(01)~~		~~State that horizontal distances are calculated in metres, kilometres and nautical miles.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~Given two positions or latitude/longitude difference, calculate the distance.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~Given two positions on the same latitude and distance between the two positions in km or NM, calculate the difference of longitude between the two positions.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~Flying a rhumb-line true track of 090, 180, 270 and 360 degrees given an initial geographical position, flight time and ground speed, calculate the new geographic position.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 02 00 00~~		**~~MAGNETISM AND COMPASSES~~**							
~~061 02 01 00~~		**~~Knowledge of the principles of the direct-reading (standby) compass~~**							

FOR INFORMATION ONLY

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			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
~~061 02 01 01~~		***~~The use of this compass~~***							
~~LO (01)~~		~~Direct-reading compass (DRC).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (02)~~		~~Interpret the indications on a DRC, given an indication on the compass, deviation or deviation table and variation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 02 01 02~~		***~~Serviceability tests~~***							
~~LO (01)~~		~~State the pre-flight serviceability check of the DRC, such as:~~ ~~— general condition;~~ ~~— check indication is within the limits.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (02)~~		~~State that the serviceability test consists of comparing the DRC indication to another reference (e.g. other compass system or runway direction).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (03)~~		~~State that the compass should be checked when carrying magnetic freight or freight with a large ferrous metal content.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 02 01 03~~		***~~Situations requiring a compass swing~~***							
~~LO (01)~~		~~State the occurrences when a compass swing may be required:~~ ~~— if transferred to another base involving a large change in latitude;~~ ~~— major changes in aircraft equipment;~~ ~~— aircraft hit by lightning;~~ ~~— aircraft parked in the same direction for a long period of~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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			~~ATPL~~	~~CPL~~	~~ATPL/IR~~	~~ATPL~~	~~CPL~~		
		~~time;~~ — ~~when a new compass is fitted;~~ — ~~at any time when the compass or recorded deviation is suspect;~~ — ~~when specified in the aircraft maintenance schedule.~~							
~~**061 03 00 00**~~		~~**CHARTS**~~							
~~**061 03 01 00**~~		~~**General properties of miscellaneous types of projections**~~							
~~(01)~~		~~Define the term 'conformal'. At any given point on the chart, distortions (as a result of the projection) in east–west direction must be the same as in north–south direction. The meridians and parallels must cut each other at right angles.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~State that on a conformal chart the angles measured on the chart are the same as on the Earth.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~State that different chart projections are used, depending on the application and area of use involved.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~State that all charts, although they have been developed mathematically, are designated as projections.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(05)~~		~~State that the following projection surfaces are used when projecting charts:~~ — ~~plane,~~ — ~~cylindrical,~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
		~~— conical.~~							
~~(06)~~		~~Define the ‘scale’ of a chart. The ratio of the chart length compared to the Earth’s distance that it represents.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(07)~~		~~Use the scale of a chart to calculate particular distances.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(08)~~		~~Calculate scale given chart length and Earth distance.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(09)~~		~~Define the term ‘chart convergency’. The angle between two given meridians on the chart.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(10)~~		~~Define ‘parallel of origin’. The parallel where the projection surface touches the surface of the reduced Earth.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 03 01 01~~		***~~Direct Mercator~~***							
~~(01)~~		~~State that the direct Mercator is a cylindrical projection. The parallel of origin is the equator.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~State that the convergency on the chart is 0°.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~State that the scale increases with increasing distance from the equator.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (04)~~		~~State that on a direct Mercator: scale at any latitude = scale at the equator × secant latitude (1/cosine latitude).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (05)~~		~~Given the scale at one latitude, calculate the scale at different latitudes.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (06)~~		~~Given a chart length at one atitude, show that it represents a~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
		~~different Earth distance at other latitudes.~~							
~~061 03 01 02~~		***~~Lambert conformal conic~~***							
~~(01)~~		~~State that the Lambert conformal chart is based on a conical projection. Only Lambert conformal charts mathematically produced with two standard parallels will be considered.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~Define the term 'standard parallel'. The latitudes where the cone cuts the reduced Earth.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~State that at the parallel of origin, Earth convergency is equal to chart convergency.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~State that the parallel of origin is close to the mean latitude between the standard parallels.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (05)~~		~~Explain the scale variation throughout the charts as follows:~~ ~~— the scale indicated on the chart will be correct at the standard parallels;~~ ~~— the scale will increase away from the parallel of origin;~~ ~~— the scale within the standard parallels differs by less than 1 % from the scale stated on the chart.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(06)~~		~~Define the term 'constant of cone/convergency factor'. The ratio between the top angle of the unfolded cone and 360°, or sine of the parallel of origin.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(07)~~		~~Chart convergency = difference of longitude × constant of cone.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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			~~ATPL~~	~~CPL~~	~~ATPL/IR~~	~~ATPL~~	~~CPL~~		
~~LO (08)~~		~~Given appropriate data, calculate initial, final or rhumb-line tracks between two positions (lat/long).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (09)~~		~~Given two positions (lat/long) and information to determine convergency between the two positions, calculate the parallel of origin.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (10)~~		~~Given a Lambert chart, determine the parallel of origin, or constant of cone.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(11)~~		~~Given constant of cone or parallel of origin, great-circle track at one position and great-circle track at another position, calculate the difference of longitude between the two positions.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~*061 03 01 03*~~		~~*Polar stereographic*~~							
~~(01)~~		~~State that the polar stereographic projection is based on a plane projection, and state that the parallel of the origin is the pole.~~	~~X~~		~~X~~	~~X~~			
~~(02)~~		~~State that chart convergency = difference of longitude.~~	~~X~~		~~X~~	~~X~~			
~~(03)~~		~~State that the scale is increasing with increasing distance from the pole.~~	~~X~~		~~X~~	~~X~~			
~~LO (04)~~		~~Given two positions (lat/long), rhumb-line true track or initial/final great-circle true track, calculate the missing track angles.~~	~~X~~		~~X~~	~~X~~			

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			~~**ATPL**~~	~~**CPL**~~	~~**ATPL/IR**~~	~~**ATPL**~~	~~**CPL**~~		
~~LO (05)~~		~~Calculate the chart scale at a specific latitude when difference of longitude and chart distance along the parallel of longitude are given.~~	~~X~~		~~X~~	~~X~~			
~~**061 03 02 00**~~		~~**The representation of meridians, parallels, great circles and rhumb lines**~~							
~~***061 03 02 01***~~		~~***Direct Mercator***~~							
~~(01)~~		~~State that meridians are straight parallel lines, which cut parallels of latitudes at right angles.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~State that parallels of latitude are straight lines parallel to the equator.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~State that a straight line on the chart is a rhumb line.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~State that the great circle is a line convex to the nearest pole.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (05)~~		~~For great-circle track angle calculations over short distances, the conversion angle may be calculated by the formula:~~ ~~— conversion angle = ½ × difference of longitude × sin mean latitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (06)~~		~~Given rhumb-line true track between two positions (lat/long), calculate initial or final great-circle true track.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~***061 03 02 02***~~		~~***Lambert conformal conic***~~							
~~(01)~~		~~State that meridians are straight lines, which cut parallels of latitudes at right angles.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
~~(02)~~		~~State that parallels of latitude are arcs of concentric circles.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~State that great circles are curved lines concave towards the parallels of origin.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~State that for short distances the great circle is approximately a straight line.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 03 02 03~~		***~~Polar stereographic~~***							
~~(01)~~		~~State that meridians are straight lines radiating from the pole, which cut parallels of latitudes at right angles.~~	~~X~~		~~X~~	~~X~~			
~~(02)~~		~~State that parallels of latitude are concentric circles, and in this projection the distance apart increases away from the pole.~~	~~X~~		~~X~~	~~X~~			
~~(03)~~		~~State that great circles are approximately straight lines close to the pole. The exact great circle being concave to the pole.~~	~~X~~		~~X~~	~~X~~			
~~061 03 03 00~~		**~~The use of current aeronautical charts~~**							
~~061 03 03 01~~		***~~Plotting positions~~***							
~~(01)~~		~~Enter the position on a chart using range and bearing from a VORDME station, and derive geographical coordinates.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~Enter the positions on a chart using geographical coordinates and derive tracks and distances.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~Plot DME ranges on an aeronautical chart and derive geographical coordinates.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

FOR INFORMATION ONLY

~~Syllabus reference~~	~~BK~~	~~Syllabus details and associated Learning Objectives~~	~~Aeroplane~~		~~Helicopter~~			~~IR~~	~~Comments~~
			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
~~(04)~~		~~Describe the methods used to provide information on chart scale. Use the chart scales stated and beware of the limitations of the stated scale for each projection.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 03 03 02~~		***~~Methods of indicating scale and relief~~***							
~~(01)~~		~~Describe the methods of representing relief and demonstrate the ability to interpret data.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 03 03 03~~		***~~Conventional signs~~***							
~~(01)~~		~~Interpret conventional signs and symbols on ICAO and other most frequently used charts.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 03 03 04~~		***~~Measuring tracks and distances~~***							
~~(01)~~		~~Given two positions, measure the track and the distance between them.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 03 03 05~~		***~~Plotting bearings~~***							
~~LO (01)~~		~~Resolve bearings of an NDB station for plotting on an aeronautical chart.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~Resolve radials from VOR stations for plotting on an aeronautical chart.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 04 00 00~~		**~~DEAD RECKONING (DR) NAVIGATION~~**							
~~061 04 01 00~~		**~~Basis of dead reckoning~~**							
~~(01)~~		~~Explain the triangle of velocities, e.g. true heading/TAS, W/V,~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~Syllabus reference~~	~~BK~~	~~Syllabus details and associated Learning Objectives~~	~~Aeroplane~~		~~Helicopter~~			~~IR~~	~~Comments~~
			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
		~~and true track/GS.~~							
~~061 04 01 01~~		***~~Track~~***							
~~(01)~~		~~Explain the concept of vectors including adding together or splitting in two directions.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 04 01 02~~		***~~Heading (compass, magnetic, true, grid)~~***							
~~(01)~~		~~Calculate (compass, magnetic, true, grid) heading from given appropriate data.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 04 01 03~~		***~~Wind velocity~~***							
~~(01)~~		~~Calculate wind velocity from given appropriate data.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 04 01 04~~		***~~Airspeed (IAS, CAS, TAS, Mach number)~~***							
~~(01)~~		~~Calculate TAS from IAS/CAS and Mach number from given appropriate data.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 04 01 05~~		***~~Ground speed~~***							
~~(01)~~		~~Calculate ground speed from given appropriate data.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~Calculate ETA, flying time from distance, and GS.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~Calculate revised directional data for heading, track, course and W/V, e.g. true, magnetic, compass and grid from given appropriate data.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 04 01 07~~		***~~Drift, wind correction angle~~***							

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~~Syllabus reference~~	~~BK~~	~~Syllabus details and associated Learning Objectives~~	~~Aeroplane~~		~~Helicopter~~			~~IR~~	~~Comments~~
			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
~~(01)~~		~~Calculate drift and wind correction angle from given appropriate data.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 04 02 00~~		**~~Use of the navigational computer~~**							
~~061 04 02 01~~		***~~Speed~~***							
~~(01)~~		~~Given appropriate data, determine speed.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 04 02 02~~		***~~Time~~***							
~~(01)~~		~~Given appropriate data, determine time.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 04 02 03~~		***~~Distance~~***							
~~(01)~~		~~Given appropriate data, determine distance.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 04 02 04~~		***~~Fuel consumption~~***							
~~LO (01)~~		~~Calculation of fuel used/fuel flow/flying time.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 04 02 05~~		***~~Conversions~~***							
~~LO (01)~~		~~Conversion between kilograms/ pounds/litres/U.S. gallons/imperial gallons.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~Conversion of distances. Kilometres/nautical miles/statute miles.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~Conversion of distances. Feet/metres.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (04)~~		~~Conversion of volumes and weight of fuel using density in mass per unit volume.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~**Syllabus reference**~~	~~**BK**~~	~~**Syllabus details and associated Learning Objectives**~~	~~**Aeroplane**~~		~~**Helicopter**~~			~~**IR**~~	~~**Comments**~~
			~~**ATPL**~~	~~**CPL**~~	~~**ATPL /IR**~~	~~**ATPL**~~	~~**CPL**~~		
~~***061 04 02 06***~~		~~***Airspeed***~~							
~~(01)~~		~~Calculation of airspeed problems including IAS/EAS/CAS/TAS/ and Mach number from given appropriate data.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~***061 04 02 07***~~		~~***Wind velocity***~~							
~~(01)~~		~~Given appropriate data, determine wind velocity.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~***061 04 02 08***~~		~~***True altitude***~~							
~~LO (01)~~		~~Given appropriate data, determine true altitude/indicated altitude/ density altitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~**061 04 03 00**~~		~~**The triangle of velocities**~~							
~~(01)~~		~~Solve problems to determine:~~ ~~— heading;~~ ~~— ground speed;~~ ~~— wind direction and speed;~~ ~~— track/course;~~ ~~— drift angle/wind correction angle;~~ ~~— head/tail/crosswind components.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~**061 04 04 00**~~		~~**Determination of DR position**~~							
~~**061 04 04 01**~~		~~**Confirmation of flight progress (DR)**~~							
~~LO (01)~~		~~Describe the role and purpose of DR navigation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~**Syllabus reference**~~	~~**BK**~~	~~**Syllabus details and associated Learning Objectives**~~	~~**Aeroplane**~~		~~**Helicopter**~~			~~**IR**~~	~~**Comments**~~
			~~**ATPL**~~	~~**CPL**~~	~~**ATPL /IR**~~	~~**ATPL**~~	~~**CPL**~~		
~~LO (02)~~		~~Demonstrate mental DR techniques.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (03)~~		~~Define 'speed factor'. Speed divided by 60, used for mental flight-path calculations.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO(04)~~		~~Calculate head/tailwind component.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(05)~~		~~Calculate wind correction angle (WCA) using the formula:~~ ~~WCA = XWC (crosswind component)/SF (speed factor)~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(06)~~		~~Distance, speed and time calculations.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(07)~~		~~Demonstrate DR position graphically and by means of a DR computer.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(08)~~		~~Given any four of the parts of the triangle of velocities, calculate the other two.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(09)~~		~~Apply the validity of wind triangle symbols correctly. Heading vector one arrow, track/course vector two arrows, and W/V vector three arrows.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~**061 04 04 02**~~		~~**Lost procedures**~~							
~~(01)~~		~~Describe course of action when lost.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~**061 04 05 00**~~		~~**Measurement of DR elements**~~							
~~**061 04 05 01**~~		~~**Calculation of altitude, adjustments, corrections, errors**~~							
		~~***Remark: For questions involving height calculation, 30 ft/hpa is to be used unless another figure is specified in the question.***~~							

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~~**Syllabus reference**~~	~~**BK**~~	~~**Syllabus details and associated Learning Objectives**~~	~~**Aeroplane**~~		~~**Helicopter**~~			~~**IR**~~	~~**Comments**~~
			~~**ATPL**~~	~~**CPL**~~	~~**ATPL/IR**~~	~~**ATPL**~~	~~**CPL**~~		
~~LO (01)~~		~~Calculate True Altitude (T ALT) from given indicated altitude, airfield elevation, Static-Air Temperature (SAT)/Outside-Air Temperature (OAT) and QNH/QFE.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (02)~~		~~Calculate indicated altitude from given T ALT, airfield elevation, SAT/OAT and QNH/QFE.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (03)~~		~~Calculate density altitude from given pressure altitude and SAT/OAT.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (04)~~		~~Calculate density altitude from given airfield elevation, SAT/OAT and QNH/QFE.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~**061 04 05 02**~~		~~**Determination of temperature**~~							
~~LO (01)~~		~~Define 'OAT/SAT'. The temperature of the surrounding air.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (02)~~		~~Define 'Ram-Air Temperature (RAT)/ Total-Air Temperature (TAT)/ Indicated Outside-Air Temperature (IOAT)'. The temperature measured by the temperature probe affected by friction and compressibility.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (03)~~		~~Define 'ram rise'. The increase of temperature at the temperature probe due to friction and compressibility.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (04)~~		~~RAT (TAT, IOAT) = OAT (SAT) + ram rise.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (05)~~		~~Explain the difference in using OAT/SAT compared to RAT/TAT/IOAT in airspeed calculations.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~**061 04 05 03**~~		~~**Determination of appropriate speed**~~							

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~~Syllabus reference~~	~~BK~~	~~Syllabus details and associated Learning Objectives~~	~~Aeroplane~~		~~Helicopter~~			~~IR~~	~~Comments~~
			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
~~(01)~~		~~Explain the relationship between:~~ ~~— IAS,~~ ~~— CAS,~~ ~~— EAS,~~ ~~— and TAS.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~Calculate TAS from given IAS/CAS, OAT/SAT and pressure inputs.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~Calculate CAS from given TAS, OAT/SAT and pressure inputs.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 04 05 04~~		**~~Determination of Mach number~~**							
~~(01)~~		~~Calculate Mach number from given TAS and OAT/SAT.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 05 00 00~~		**~~IN-FLIGHT NAVIGATION~~**							
~~061 05 01 00~~		**~~Use of visual observations and application to in-flight navigation~~**							
~~(01)~~		~~Describe what is meant by the term 'map reading'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~Define the term 'visual checkpoint'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~Discuss the general features of a visual checkpoint and give examples.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~State that the evaluation of the differences between DR positions and actual position can refine flight performance and navigation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~Syllabus reference~~	~~BK~~	~~Syllabus details and associated Learning Objectives~~	~~Aeroplane~~		~~Helicopter~~			~~IR~~	~~Comments~~
			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
~~(05)~~		~~Establish fixes on navigational charts by plotting visually derived intersecting lines of position.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(06)~~		~~Describe the use of a single observed position line to check flight progress.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(07)~~		~~Describe how to prepare and align a map/chart for use in visual navigation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(08)~~		~~Describe visual-navigation techniques including:~~ ~~— use of DR position to locate identifiable landmarks;~~ ~~— identification of charted features/landmarks;~~ ~~— factors affecting the selection of landmarks;~~ ~~— an understanding of seasonal and meteorological effects on the appearance and visibility of landmarks;~~ ~~— selection of suitable landmarks;~~ ~~— estimation of distance from landmarks from successive bearings;~~ ~~— estimation of the distance from a landmark using an approximation of the sighting angle and the flight altitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(09)~~		~~Describe the action to be taken if there is no visual checkpoint available at a scheduled turning point.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(10)~~		~~Understanding the difficulties and limitations that may be encountered in map reading in some geographical areas due to~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~Syllabus reference~~	~~BK~~	~~Syllabus details and associated Learning Objectives~~	~~Aeroplane~~		~~Helicopter~~			~~IR~~	~~Comments~~
			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
		~~the nature of terrain, lack of distinctive landmarks or lack of detailed and accurate charted data.~~							
~~(11)~~		~~State the function of contour lines on a topographical chart.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(12)~~		~~Indicate the role of 'layer tinting' (colour gradient) in relation to the depiction of topography on a chart.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(13)~~		~~Using the contours shown on a chart, describe the appearance of a significant feature.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(24)~~		~~Understand that in areas of snow and ice from horizon to horizon and where the sky is covered with a uniform layer of clouds so that no shadows are cast, the horizon disappears, causing earth and sky to blend.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 05 02 00~~		**~~Navigation in climb and descent~~**							
~~061 05 02 01~~		**~~Average airspeed~~**							
~~LO (01)~~		~~Average TAS used for climb problems is calculated at the altitude 2/3 of the cruising altitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (02)~~		~~Average TAS used for descent problems is calculated at the altitude 1/2 of the descent altitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 05 02 02~~		**~~Average wind velocity (WV)~~**							
~~LO (01)~~		~~WV used for climb problems is the WV at the altitude 2/3 of the cruising altitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (02)~~		~~WV used for descent problems is the WV at the altitude 1/2 of~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~Syllabus reference~~	~~BK~~	~~Syllabus details and associated Learning Objectives~~	~~Aeroplane~~		~~Helicopter~~			~~IR~~	~~Comments~~
			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
		~~the descent altitude.~~							
~~LO (03)~~		~~Calculate the average climb/descent GS from given TAS at various altitudes, WV at various altitudes and true track.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (04)~~		~~Calculate the flying time and distance during climb/descent from given average rate of climb/descent and using average GS.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (05)~~		~~Calculate the rate of descent on a given glide-path angle using the following formulae:~~ ~~valid for 3°-glide path:~~ ~~rate of descent = (GS (ground speed) × 10) / 2~~ ~~rate of descent = SF (speed factor) × glide-path angle × 100~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (06)~~		~~Given distance, speed and present altitude, calculate the rate of climb/descent in order to reach a certain position at a given altitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (07)~~		~~Given speed, rate of climb/descent and altitude, calculate the distance required in order to reach a position at a given altitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (08)~~		~~Given speed, distance to go and altitude to climb/descent, calculate the rate of climb/descent.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(09)~~		~~State the effect on TAS and Mach number when climbing/descending with a constant CAS.~~							

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~~**Syllabus reference**~~	~~**BK**~~	~~**Syllabus details and associated Learning Objectives**~~	~~**Aeroplane**~~		~~**Helicopter**~~			~~**IR**~~	~~**Comments**~~
			~~**ATPL**~~	~~**CPL**~~	~~**ATPL /IR**~~	~~**ATPL**~~	~~**CPL**~~		
~~**061 05 02 03**~~		~~**Ground speed/distance covered during climb or descent**~~							
~~LO (10)~~		~~State that most Aircraft Operating Handbooks supply graphical material to calculate climb and descent problems.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (11)~~		~~Given distance, speed and present altitude, calculate the rate of climb/descent in order to reach a certain position at a given altitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (12)~~		~~Given speed, rate of climb/descent and altitude, calculate the distance required in order to reach a certain position at a given altitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~**061 05 02 04**~~		~~**Gradients versus rate of climb/descent**~~							
~~LO (01)~~		~~Calculate climb/descent gradient (ft/NM, % and degrees), GS or vertical speed according to the following formulae:~~ ~~Vertical speed (feet/min) = (ground speed (kt) × gradient (feet/NM)) / 60~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (02)~~		~~Gradient in % = altitude difference (feet) × 100 / ground difference (feet).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (03)~~		~~Gradient in degrees = Arctg (Altitude difference (feet) / ground distance (feet)).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (04)~~		~~Rate of climb/descent (feet/min) = gradient (%) × GS (kt).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (05)~~		~~State that it is necessary to determine the position of the aircraft accurately before commencing descent in order to~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~Syllabus reference~~	~~BK~~	~~Syllabus details and associated Learning Objectives~~	~~Aeroplane~~		~~Helicopter~~			~~IR~~	~~Comments~~
			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
		~~ensure safe ground clearance.~~							
~~061 05 03 00~~		**~~Navigation in cruising flight, use of fixes to revise navigation data~~**							
~~061 05 03 01~~		**~~Ground-speed revision~~**							
~~(01)~~		~~Calculate revised ground speed to reach a waypoint at a specific time.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~Calculate the average ground speed based on two observed fixes.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (03)~~		~~Calculate the distance to the position passing abeam an NDB station by timing from the position with a relative bearing of 045/315 to the position abeam (relative bearing 090/270).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 05 03 02~~		**~~Off-track corrections~~**							
~~(01)~~		~~Calculate the track-error angle at a given course from A to B and an off- course fix, using the one-in-sixty rule.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~		~~Calculate the heading change at an off-course fix to directly reach the next waypoint using the one-in-sixty rule.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~		~~Calculate the average drift angle based upon an off-course fix observation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~061 05 03 03~~		**~~Calculation of wind speed and direction~~**							
~~(01)~~		~~Calculate the average wind speed and direction based on two observed fixes.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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~~Syllabus reference~~	~~BK~~	~~Syllabus details and associated Learning Objectives~~	~~Aeroplane~~		~~Helicopter~~			~~IR~~	~~Comments~~
			~~ATPL~~	~~CPL~~	~~ATPL /IR~~	~~ATPL~~	~~CPL~~		
~~**061 05 03 04**~~		~~**Estimated Time of Arrival (ETA) revisions**~~							
~~(01)~~		~~Calculate ETA revisions based upon observed fixes and revised ground speed.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~**061 05 04 00**~~		~~**Flight log**~~							
~~LO (01)~~		~~Given relevant flight-plan data, calculate the missing data.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (02)~~		~~Enter the revised navigational en route data, for the legs concerned, into the flight log (e.g. updated wind and ground speed, and correspondingly losses or gains in time and fuel consumption).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (03)~~		~~Enter, in the progress of flight, at checkpoint or turning point, the 'actual time over' and the 'estimated time over' for the next checkpoint into the flight log.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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SUBJECT 061 — NAVIGATION — GENERAL NAVIGATION

Mental dead reckoning (MDR)

Where the term 'mental dead reckoning' (MDR) is used within a Learning Objective (LO), the applicable technique which will be used for the European Central Question Bank (ECQB) questions is based on the methods shown below.

Examination questions will state that an MDR technique is required to produce the solution. If other techniques (e.g. trigonometry) are used to determine the answer, then the determined answer may be incorrect.

MDR crosswind component (XWC)

The XWC can be calculated using a 'clock code rule', where each 15° of wind angle is represented by 1/4 of an hour — meaning 1/4 the wind strength.

The XWC can be estimated using the values from the table below:

Wind angle	**15°**	**30°**	**45°**	**60°**
% of wind speed	**25**	**50**	**75**	**100**

(Wind angle (WA) is the angle between the wind vector and the track/runway direction to the <u>nearest</u> 10°)

Example:

RWY 04 and surface wind from tower is 085°/20 kt. What is the XWC?

WA = 45°

XWC = (0.75) × 20

= <u>15 kt</u>

MDR headwind component (HWC)/tailwind component (TWC)

The H/TWC can be estimated using the values from the following table:

90° – wind angle	**10°**	**20°**	**30°**	**40°**	**50°**	**60°**
% of wind speed	**0.2**	**0.3**	**0.5**	**0.6**	**0.8**	**0.9**

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To assist recall, an aid is shown below:

90° – wind angle	**10°**	**20°**	**30°**	**40°**	**50°**	**60°**
Aid	**1**	**1**	**2**	**2**	**3**	**3**
% of wind speed	**0.2**	**0.3**	**0.5**	**0.6**	**0.8**	**0.9**

Example:

RWY 04 and surface wind from tower is 080°/20 kt. What is the HWC?

WA = 40°

90° – WA = 50°

HWC = (0.8) × 20

= 16 kt

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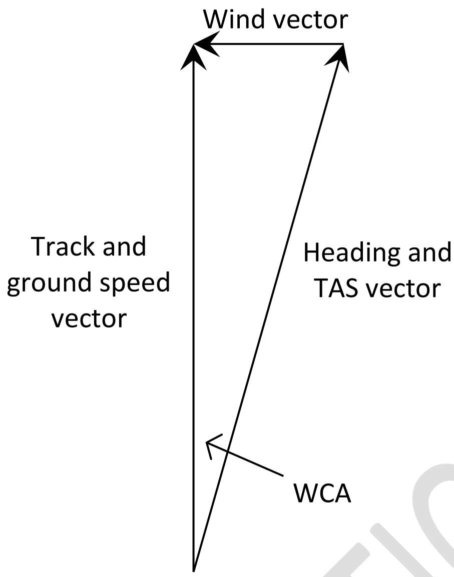
MDR triangle of velocities (TOV)

Heading is determined by calculating the XWC as previously described, then applying the 1:60 rule to the TOV as follows:



This MDR technique works for the relatively small WCAs which are typical for medium to high TAS values (the ground speed (GS) therefore can be assumed to be equal to the TAS for application of the 1:60 rule).

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Example 1:

Planned track = 070° (T)

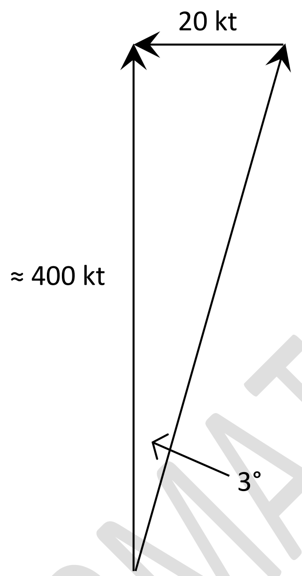
TAS = 400 kt

WV = 100° (T)/40 kt

WA = 30°

XWC = (0.5) × 40

= 20 kt



Heading required = 073° (T)

GS is determined by using the headwind/tailwind example previously explained.

WA = 30°

90° – 30° = 60°

HWC = (0.9) × 40

= 36 kt

GS = 400 – 36 = 364 kt

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Example 2:

Planned track = 327° (T)

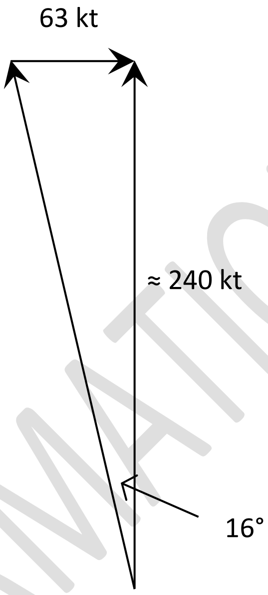
TAS = 240 kt

WV = 210° (T)/70 kt

WA = 60°

XWC = (0.9) × 7

= 63 kt



WCA = 16°

Heading required = <u>311° (T)</u>

GS is determined by using the headwind/tailwind example previously explained.

WA = 60°

90° – 60° = 30°

TWC = (0.5) × 70

= 35 kt

GS = 240 + 35 = <u>275 kt</u>

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VFR navigation (061 02 00 00)

The techniques referred to within the LOs are based on the methods as described below.

Mental dead reckoning (MDR) off-track corrections

Based on the 1:60 rule

1 NM of cross-track error (XTE) for every 60 NM along track from waypoint = 1° of track error angle (TKE).

1 NM of XTE for every 60 NM along track to waypoint = 1° of closing angle (CA).

Change of heading required to regain track in same distance as covered from waypoint to position off track = 2 × TKE.

Change of heading required to reach next waypoint from position off track = TKE + CA.

Example 1:

Planned heading is 162° (T), and after 40 NM along track the aircraft position is fixed 2 NM right of planned track. What heading is required to regain track in approximately the same time as has taken to the fix position?

TKE = 3°

Heading required = 156° (T)

Example 2:

Planned heading is 317° (T), and after 22 NM along track the aircraft position is fixed 3.5 NM left of planned track. What heading is required to fly direct to the next waypoint which is another 45 NM down track?

TKE = 10°, CA = 5°

Heading required = 332° (T)

Mental dead reckoning (MDR) estimated time of arrival (ETA) calculations

Round the GS to the nearest NM/min, and then make the same percentage adjustment for the distance.

Example:

Distance to go = 42 NM

GS = 132 kt

GS rounded to 120 kt = 2 NM/min

Percentage change = 10 %

Distance = 42 – 10 % = 38 NM

Time = 38 / 2 = 19 min

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Unsure-of-position procedure

As soon as the position of the aircraft is in doubt:

1. note the time;
2. communicate if in contact with an air traffic control (ATC) unit to request assistance;
3. consider using any radio-navigation aids that may be available to give position information (do not become distracted from flying the aircraft safely);
4. if short of fuel or near controlled airspace, and not in contact with ATC, set 121.5 MHz and make a PAN call;
5. if that is not necessary, check the directional indicator (DI) and compass are still synchronised and continue to fly straight and level and on route plan heading;
6. estimate the distance travelled since the last known position;
7. compare the ground with your estimated position on the map (look at the terrain for hills and valleys or line features such as a motorway, railway, river or coastline);
8. once the position has been re-established, keep checking the heading (and look out for other aircraft) and continue the flight by updating the estimated position regularly while looking for unique features such as a lake, wood, built-up area, mast, or a combination of roads, rivers and railways.

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Procedure when lost

If the unsure-of-position procedure does not resolve the problem:

1. inform someone — call first on the working frequency and state the word 'LOST';
2. if there is no contact on that frequency or there is no frequency selected, change to 121.5 MHz and make a PAN call; select 7700 with ALT on the transponder if fitted.

In all cases: maintain visual meteorological conditions (VMC), note the fuel state, and try to identify an area suitable for a precautionary landing.

Consider the 'HELP ME' mnemonic:

H. High ground/obstructions — are there any nearby?

E. Entering controlled airspace — is that a possibility?

L. Limited experience, low time or student pilot — let someone know.

P. PAN call in good time — don't leave it too late.

M. MET conditions — is the weather deteriorating?

E. Endurance — is fuel getting low?

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
060 00 00 00		**NAVIGATION**								
061 00 00 00		**GENERAL NAVIGATION**								
061 01 00 00		**BASICS OF NAVIGATION**								
061 01 01 00		**The Earth**								
061 01 01 01		***Form***								
(01)	X	State that the geoid is an irregular shape based on the surface of the oceans influenced only by gravity and centrifugal force.	X	X	X	X	X			
(02)	X	State that a number of different ellipsoids are used to describe the shape of the Earth for mapping but that WGS-84 is the reference ellipsoid required for geographical coordinates.	X	X	X	X	X			
(03)		State that the circumference of the Earth is approximately 40 000 km or approximately 21 600 NM.	X	X	X	X	X			
061 01 01 02		***Earth rotation***								
(01)	X	Describe the rotation of the Earth around its own spin axis and the plane of the ecliptic (including the relationship of the spin axis to the plane of the ecliptic).	X	X	X	X	X			
(02)		Explain the effect that the inclination of the Earth's spin axis has on insolation and duration of daylight.	X	X	X	X	X			
061 01 01 03		***Earth rotation***								
061 01 02 00		**Position**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
_061 01 02 01_		**_Position reference system_**								
(01)	X	State that geodetic latitude and longitude is used to define a position on the WGS-84 ellipsoid.	X	X	X	X	X			
(02)		Define geographic (geodetic) latitude and parallels of latitude.	X	X	X	X	X			
(03)		Calculate the difference in latitude between any two given positions.	X	X	X	X	X			
(04)		Define geographic (geodetic) longitude and meridians.	X	X	X	X	X			
(05)		Calculate the difference in longitude between any two given positions.	X	X	X	X	X			
061 01 03 00		**Direction**								
_061 01 03 01_		**_Datums_**								
(01)	X	Define ‘true north’ (TN).	X	X	X	X	X			
(02)		Measure a true direction on any given aeronautical chart.	X	X	X	X	X			
(03)	X	Define ‘magnetic north’ (MN).	X	X	X	X	X			
(04)		Define and apply variation.	X	X	X	X	X			
(05)		Explain changes of variation with time and position.	X	X	X	X	X			
(06)	X	Define ‘compass north’ (CN).	X	X	X	X	X			
(07)		Apply deviation.	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
061 01 03 02		***Track and heading***								
(01)		Calculate XWC by: — trigonometry; and — MDR.								
(02)		Explain and apply the concepts of drift and WCA.	X	X	X	X	X			
(03)		Calculate the actual track with appropriate data of heading and drift.	X	X	X	X	X			
(04)		Calculate TKE with appropriate data of WCA and drift.	X	X	X	X	X			
(05)		Calculate the heading change at an off-course fix to directly reach the next waypoint using the 1:60 rule.	X	X	X	X	X			
(06)		Calculate the average drift angle based upon an off-course fix observation.	X	X	X	X	X			
061 01 04 00		**Distance**								
061 01 04 01		***WGS-84 ellipsoid***								
(01)	X	State that 1 NM is equal to 1 852 km, which is the average distance of 1' of latitude change on the WGS-84 ellipsoid.	X	X	X	X	X			
(02)		State that 1' of longitude change at the equator on the WGS-84 ellipsoid is approximately equal to 1 NM.	X	X	X	X	X			
061 01 04 02		***Units***								
(01)		Convert between units of distance (nautical mile	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		(NM), kilometre (km), statute mile (SM), feet (ft), inches (in)).								
061 01 04 03		***Graticule distances***								
(01)		Calculate the distance between positions on the same meridian, on opposite (antipodal) meridians, on the same parallel of latitude, and calculate new latitude/longitude when given distances north-south and east-west.	X	X	X	X	X			
061 01 04 04		***Air mile***								
(01)		Evaluate the effect of wind and altitude on air distance.	X	X	X	X	X			
(02)		Convert between ground distance (NM) and air distance (NAM) using the formula: NAM = NM × TAS/GS.	X	X	X	X	X			
061 01 05 00		**Speed**								
061 01 05 01		***True airspeed (TAS)***								
(01)		Calculate TAS from CAS, and CAS from TAS by: — mechanical computer; and — rule of thumb (2 % per 1 000 ft).	X	X	X	X	X			
061 01 05 02		***Mach number (M)***								
(01)		Calculate TAS from M, and M from TAS.	X	X						
061 01 05 03		***CAS/TAS/M relationship***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)		Deduce the CAS, TAS and M relationship in climb/descent/cruise (flying at constant CAS or M).	X	X						
(02)		Deduce CAS and TAS in climb/descent/cruise (flying at constant CAS).			X	X	X			
061 01 05 04		***Ground speed (GS)***								
(01)		Calculate headwind component (HWC) and tailwind component (TWC) by: — trigonometry; and — MDR.	X	X	X	X	X			
(02)		Apply HWC and TWC to determine GS from TAS and vice versa.	X	X	X	X				
(03)	X	Explain the relationship between GS and TAS with increasing WCA.	X	X	X	X	X			
(04)		Calculate GS with: — mechanical computer (TOV solution); and — MDR (given track, TAS and WV).	X	X	X	X	X			
(05)		Perform GS, distance and time calculations.	X	X	X	X	X			
(06)		Calculate revised GS to reach a waypoint at a specific time.	X	X	X	X	X			
(07)		Calculate the average GS based on two observed fixes.	X	X	X	X	X			
061 01 05 05		***Flight log***								
(01)		Enter revised navigational en-route data, for the legs concerned, into the flight plan (e.g. updated wind and	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		GS and correspondingly losses or gains in time and fuel consumption).								
061 01 05 06		***Gradient versus rate of climb/descent***								
(01)		Estimate average climb/descent gradient (%) or glide path degrees according to the following rule of thumb: — Gradient in degrees = (vertical distance (ft) / 100) / ground distance (NM)) — Gradient in % = (vertical distance (ft) / 60) / ground distance (NM)) — Gradient in degrees = arctan (altitude difference (ft) / ground distance (ft)). *N.B. These rules of thumb approximate 1 NM to 6 000 ft and are based on the 1:60 rule.*	X	X	X	X	X			
(02)		Calculate rate of descent (ROD) on a given glide-path angle or gradient using the following rule of thumb formulae: — ROD (ft/min) = GP° × GS (NM/min) × 100 — ROD (ft/min) = GP% × GS (kt)	X	X	X	X	X			
(03)		Calculate climb/descent gradient (ft/NM, % and degrees), GS or vertical speed according to the following formula: — Vertical speed (ft/min) = (GS (kt) × gradient (ft/NM)) / 60.	X	X	X	X	X			
(04)	X	State that it is necessary to determine the position of the aircraft accurately before commencing descent in	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		order to ensure safe ground clearance.								
061 01 06 00		**Triangle of velocities (TOV)**								
061 01 06 01		***Construction***								
(01)		Draw and correctly label the TOV.	X	X	X	X	X			
061 01 06 02		***Solutions***								
(01)		Resolve the TOV for: — heading and GS (with mechanical computer and MDR); — WV (with mechanical computer); and — track and GS (with mechanical computer and MDR.	X	X	X	X	X			
061 01 07 00		**Dead reckoning (DR)**								
061 01 07 01		**Dead reckoning (DR) technique**								
(01)		Determine a DR position.	X	X	X	X	X			
(02)		Evaluate the difference between a DR and a fix position.	X	X	X	X	X			
(03)		Define ‘speed factor’ (SF). Speed divided by 60, used for mental flight-path calculations.	X	X	X	X	X			
(04)		Calculate wind correction angle (WCA) using the formula: — WCA = XWC (crosswind component)/SF	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
061 01 08 00		**Navigation in climb and descent**								
061 01 08 01		**Average airspeed**								
(01)		Average TAS used for climb problems is calculated at the altitude 2/3 of the cruising altitude.	X	X	X	X	X			
(02)		Average TAS used for descent problems is calculated at the altitude 1/2 of the descent altitude.	X	X	X	X	X			
061 01 08 02		**Average wind velocity (WV)**								
(01)		WV used for climb problems is the WV at the altitude 2/3 of the cruising altitude.	X	X	X	X	X			
(02)		WV used for descent problems is the WV at the altitude 1/2 of the descent altitude.	X	X	X	X	X			
(03)		Calculate the average climb/descent GS from given TAS at various altitudes, and WV at various altitudes and true track.	X	X	X	X	X			
061 01 08 03		**Ground speed (GS)/distance covered during climb or descent**								
(01)	X	State that most aircraft operating handbooks supply graphical material to calculate climb and descent problems.	X	X	X	X	X			
(02)		Calculate the flying time and distance during climb/descent from given average rate of climb/descent and using average GS using the following formulae valid for a 3°-glide path: — rate of descent = (GS × 10) / 2 — rate of descent = speed factor (SF) × glide-path	X	X	X	X	X			

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		angle × 100								
(03)		Given distance, speed and present altitude, calculate the rate of climb/descent in order to reach a certain position at a given altitude.	X	X	X	X	X			
(04)		Given speed, rate of climb/descent and altitude, calculate the distance required in order to reach a certain position at a given altitude.	X	X	X	X	X			
(05)		Given speed, distance to go and altitude to climb/descent, calculate the rate of climb/descent.	X	X	X	X	X			
061 02 00 00		**VISUAL FLIGHT RULE (VFR) NAVIGATION**								
061 02 01 00		**Ground features**								
061 02 01 01		***Ground features***								
(01)		Recognise which elements would make a ground feature suitable for use for VFR navigation.	X	X	X	X	X			
061 02 01 02		***Visual identification***								
(01)		Describe the problems of VFR navigation at lower levels and the causes of reduced visibility.	X	X	X	X	X			
(02)		Describe the problems of VFR navigation at night.	X	X	X	X	X			
061 02 02 00		**VFR navigation techniques**								
061 02 02 01		***Use of visual observations and application to in-flight navigation***								
(01)	X	Describe what is meant by the term ‘map reading’.	X	X	X	X	X			

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL/ IR**	**ATPL**	**CPL**			
(02)	X	Define the term ‘visual checkpoint’.	X	X	X	X	X			
(03)		Discuss the general features of a visual checkpoint and give examples.	X	X	X	X	X			
(04)		State that the evaluation of the differences between DR positions and actual position can refine flight performance and navigation.	X	X	X	X	X			
(05)	X	Establish fixes on navigational charts by plotting visually derived intersecting lines of position.	X	X	X	X	X			
(06)	X	Describe the use of a single observed position line to check flight progress.	X	X	X	X	X			
(07)	X	Describe how to prepare and align a map/chart for use in visual navigation.	X	X	X	X	X			
(08)		Describe visual-navigation techniques including: — use of DR position to locate identifiable landmarks; — identification of charted features/landmarks; — factors affecting the selection of landmarks; — an understanding of seasonal and meteorological effects on the appearance and visibility of landmarks; — selection of suitable landmarks; — estimation of distance from landmarks from successive bearings; — estimation of the distance from a landmark using an approximation of the sighting angle	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		and the flight altitude.								
(09)		Describe the action to be taken if there is no visual checkpoint available at a scheduled turning point.	X	X	X	X	X			
(10)		Understand the difficulties and limitations that may be encountered in map reading in some geographical areas due to the nature of terrain, lack of distinctive landmarks, or lack of detailed and accurate charted data.	X	X	X	X	X			
(11)	X	State the function of contour lines on a topographical chart.	X	X	X	X	X			
(12)	X	Indicate the role of 'layer tinting' (colour gradient) in relation to the depiction of topography on a chart.	X	X	X	X	X			
(13)		Using the contours shown on a chart, describe the appearance of a significant feature.	X	X	X	X	X			
(14)		Apply the techniques of DR, map reading, orientation, timing and revision of ETAs and headings.	X	X	X	X	X			
061 02 02 02		***Unplanned events***								
(01)		Explain what needs to be considered in case of diversion, when unsure of position and when lost.	X	X	X	X	X			
061 03 00 00		**GREAT CIRCLES AND RHUMB LINES**								
061 03 01 00		**Great circles**								
061 03 01 01		***Properties***								

FOR INFORMATION ONLY

Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL/ IR**	**ATPL**	**CPL**			
(01)		Describe the geometric properties of a great circle (including the vertex) and a small circle.	X	X						
(02)		Describe the geometric properties of a great circle and a small circle, up to 30° difference of longitude.			X	X	X			
(03)	X	Explain why a great-circle route is the shortest distance between any two positions on the Earth.	X	X	X	X	X			
(04)		Name examples of great circles on the surface of the Earth.	X	X	X	X	X			
061 03 01 02		***Convergence***								
(01)	X	Explain why the track direction of a great-circle route (other than following a meridian or the equator) changes.	X	X	X	X	X			
(02)		State the formula used to approximate the value of Earth convergence as change of longitude × sine mean latitude.	X	X	X	X	X			
(03)		Calculate the approximate value of Earth convergence between any two positions, up to 30° difference of longitude.	X	X	X	X	X			
061 03 02 00		**Rhumb lines**								
061 03 02 01		***Properties***								
(01)	X	Describe the geometric properties of a rhumb line.	X	X	X	X	X			
(02)	X	State that a rhumb-line route is not the shortest distance between any two positions on the Earth	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		(excluding meridians and equator).								
061 03 03 00		**Relationship**								
061 03 03 01		***Distances***								
(01)		Explain that the variation in distance of the great-circle route and rhumb-line route between any two positions increases with increasing latitude or change in longitude.	X	X	X	X	X			
061 03 03 02		***Conversion angle***								
(01)		Calculate and apply the conversion angle.	X	X						
061 04 00 00		**CHARTS**								
061 04 01 00		**Chart requirements**								
061 04 01 01		***ICAO Annex 4 'Aeronautical Charts'***								
(01)		State the requirement for conformality and for a straight line to approximate a great circle.	X	X	X	X	X			
061 04 01 02		***Convergence***								
(01)		Explain and calculate the constant of the cone (sine of parallel of origin).	X	X	X	X	X			
(02)		Explain the relationship between Earth and chart convergence with respect to the ICAO requirement for a straight line to approximate a great circle.	X	X	X	X	X			
061 04 01 03		***Scale***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)		Recognise methods of representing scale on aeronautical charts.	X	X	X	X	X			
(02)		Perform scale calculations based on typical en-route chart scales.	X	X	X	X	X			
061 04 02 00		**Projections**								
061 04 02 01		***Methods of projection***								
(01)	X	Identify azimuthal, cylindrical and conical projections.	X	X	X	X	X			
061 04 02 02		***Polar stereographic***								
(01)		State the properties of a polar stereographic projection.	X	X	X	X	X			
(02)		Calculate straight line track changes on a polar stereographic chart.	X	X	X	X	X			
061 04 02 03		***Direct Mercator***								
(01)		State the properties of a direct Mercator projection.	X	X	X	X	X			
(02)		Given the scale at one latitude, calculate the scale at different latitudes.	X	X	X	X	X			
(03)		Given a chart length at one latitude, show that it represents a different Earth distance at other latitudes.	X	X	X	X	X			
061 04 02 04		***Lambert***								
(01)		State the properties of a Lambert projection.	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(02)		Calculate straight line track changes on a Lambert chart.	X	X	X	X	X			
(03)		Explain the scale variation throughout the charts as follows: — the scale indicated on the chart will be correct at the standard parallels; — the scale will increase away from the parallel of origin; — the scale within the standard parallels differs by less than 1 % from the scale stated on the chart.	X	X	X	X	X			
(04)		Given appropriate data, calculate initial, final or rhumb-line tracks between two positions (lat./long.).	X	X	X	X	X			
(05)		Given two positions (lat./long.) and information to determine convergency between the two positions, calculate the parallel of origin.	X	X	X	X	X			
(06)		Given a Lambert chart, determine the parallel of origin, or constant of cone.	X	X	X	X	X			
(07)		Given constant of cone or parallel of origin, great-circle track at one position and great-circle track at another position, calculate the difference of longitude between the two positions.	X	X	X	X	X			
061 04 03 00		**Practical use**								
061 04 03 01		***Symbology***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)		Recognise ICAO Annex 4 symbology.	X	X	X	X	X			
061 04 03 02		***Plotting***								
(01)		Measure tracks and distances on VFR and IFR en-route charts.	X	X	X	X	X			
(02)		Fix the aircraft position on an en-route chart with information from VOR and DME equipment.	X	X	X	X	X			
(03)		Resolve bearings of an NDB station for plotting on an aeronautical chart.	X	X	X	X	X			
061 05 00 00		**Time**								
061 05 01 00		**Local Mean Time (LMT)**								
061 05 01 01		***Mean solar day***								
(01)	X	Explain the concepts of a mean solar day and LMT.	X	X	X	X	X			
061 05 01 02		***Local Mean Time (LMT) and Universal Time Coordinated (UTC)***								
(01)		Perform LMT and UTC calculations.	X	X	X	X	X			
061 05 02 00		**Standard time**								
061 05 02 01		***Standard time and daylight saving time***								
(01)		Explain and apply the concept of standard time and daylight saving time, and perform standard time and daylight saving time calculations.	X	X	X	X	X			
061 05 02 02		***International Date Line***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)		State the changes when crossing the International Date Line.	X	X	X	X	X			
061 05 03 00		**Sunrise and sunset**								
_**061 05 03 01**_		_**Sunrise and sunset times**_								
(01)		Define sunrise, sunset, and civil twilight, and extract times from a suitable source (e.g. an almanac).	X	X	X	X	X			
(02)		Explain the changes to sunrise, sunset, and civil twilight times with date, latitude and altitude.	X	X	X	X	X			
(03)		Explain at which time of the year the duration of daylight changes at the highest rate.	X	X	X	X	X			

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Appendix to Annex I to ED Decision 2018/001/R

'Acceptable Means of Compliance (AMCs) and Guidance Material (GM) to Part-FCL Amendment 4'

Appendix
'SUBJECT 062 — NAVIGATION — RADIO NAVIGATION'
to
AMC1 FCL.310; FCL.515(b); FCL.615(b)
'Theoretical knowledge examinations'
of Annex I

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SUBJECT 062 — NAVIGATION — RADIO NAVIGATION

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
060 00 00 00		**NAVIGATION**								
062 00 00 00		**RADIO NAVIGATION**								
062 01 00 00		**BASIC RADIO PROPAGATION THEORY**								
062 01 01 00		**Basic principles**								
062 01 01 01		***Electromagnetic waves***								
(01)	X	State that radio waves travel at the speed of light, being approximately 300 000 km/s ~~or 162 000 NM/s~~.	X	X	X	X	X	X		
(02)	X	Define a 'cycle': ~~A~~ a complete series of values of a periodical process.	X	X	X	X	X	X		
~~(03)~~	~~X~~	~~Define 'Hertz' (Hz)'. 1 Hertz is 1 cycle per second.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
062 01 01 02		***Frequency, wavelength, amplitude, phase angle***								
(01)	X	Define 'frequency'~~.~~: ~~T~~the number of cycles occurring in 1 second ~~in a radio wave~~ expressed in Hertz (Hz).	X	X	X	X	X	X		
(02)	X	Define 'wavelength': the physical distance travelled by a radio wave during one cycle of transmission.	X	X	X	X	X	X		
(03)	X	Define 'amplitude': the maximum deflection in an oscillation or wave.	X	X	X	X	X	X		
(04)	X	State that the relationship between wavelength and	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		frequency is: — wavelength (λ) = speed of light (c) / frequency (f)~~;~~. ~~— or λ (meters) = 300 000 / kHz.~~								
(05)	X	Define 'phase angle': the fraction of one wavelength expressed in degrees from 000° to 360°.	X	X	X	X	X	X		
(06)	X	Define 'phase angle difference/shift': the angular difference between the corresponding points of two cycles of equal wavelength, which is measurable in degrees (°).	X	X	X	X	X	X		
062 01 01 03		***Frequency bands, sidebands, single sideband***								
(01)		List the bands of the frequency spectrum for electromagnetic waves: — ~~V~~very Llow ~~F~~frequency (VLF): 3–30 kHz; — l~~L~~ow f~~F~~requency (LF): 30–300 kHz; — m~~M~~edium f~~F~~requency (MF): 300–3 000 kHz; — h~~H~~igh f~~F~~requency (HF): 3–30 MHz; — v~~V~~ery h~~H~~igh f~~F~~requency (VHF): 30–300 MHz; — u~~U~~ltra h~~H~~igh f~~F~~requency (UHF): 300–3 000 MHz; — s~~S~~uper h~~H~~igh f~~F~~requency (SHF): 3–30 GHz; — e~~E~~xtremely h~~H~~igh f~~F~~requency (EHF): 30–300 GHz.	X	X	X	X	X	X		
(02)		State that when a carrier wave is modulated, the resultant radiation consists of the carrier frequency plus	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		additional upper and lower sidebands.								
(03)		State that HF meteorological information for aircraft in flight (VOLMET) and HF two-way communication use a single sideband.	X	X	X	X	X	X		
(04)		~~State that a radio signal may be classified by three symbols in accordance with the ITU Radio Regulation, Volume 1: e.g. A1A.~~ ~~— The first symbol indicates the type of modulation of the main carrier;~~ ~~— The second symbol indicates the nature of the signal modulating the main carrier;~~ ~~— The third symbol indicates the nature of the information to be transmitted.~~ State that the following abbreviations (classifications according to International Telecommunication Union (ITU) regulations) are used for aviation applications: — N0N: carrier without modulation as used by non-directional radio beacons (NDBs); — A1A: carrier with keyed Morse code modulation as used by NDBs; — A2A: carrier with amplitude modulated Morse code as used by NDBs; — A3E: carrier with amplitude modulated speech used for communication (VHF-COM).	X	X	X	X	X	X		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
062 01 01 04		***~~Pulse characteristics~~ Intentionally left blank***								
(01)		Define the following terms ~~as~~ that are associated with a pulse string: — pulse length, — pulse power, — continuous power.	X	X	X	X	X	X		
062 01 01 05		***Carrier, modulation***								
(01)	X	Define 'carrier wave': the radio wave acting as the carrier or transporter.	X	X	X	X	X	X		
~~(02)~~	~~X~~	~~Define 'keying': interrupting the carrier wave to break it into dots and dashes.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(03)	X	Define 'modulation': the technical term for the process of impressing and transporting information by radio waves.	X	X	X	X	X	X		
062 01 01 06		***Kinds of modulation (amplitude, frequency, pulse, phase)***								
(01)	X	Define 'amplitude modulation': the information that is impressed onto the carrier wave by altering the amplitude of the carrier.	X	X	X	X	X	X		
(02)	X	Define 'frequency modulation': the information that is impressed onto the carrier wave by altering the frequency of the carrier.	X	X	X	X	X	X		
(03)	X	Describe 'pulse modulation': a modulation form used in	X	X	X	X	X	X		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		radar by transmitting short pulses followed by larger interruptions.								
(04)	X	Describe 'phase modulation': a modulation form used in GPS where the phase of the carrier wave is reversed.	X	X	X	X	X	X		
062 01 02 00		**Antennas**								
062 01 02 01		***Characteristics***								
(01)	X	Define 'antenna': ~~a wave-type transducer for the process of converting a line AC into a free electromagnetic wave.~~ An antenna or aerial, is an electrical device which converts electric power into radio waves, and vice versa.	X	X	X	X	X	X		
(02)	X	State that the simplest type of antenna is a dipole which is a wire of length equal to one half of the wavelength.	X	X	X	X	X	X		
~~LO (03)~~		~~State that in a wire which is fed with an AC (alternating current), some of the power will radiate into space.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (04)~~		~~State that in a wire parallel to the wire fed with an AC but remote from it, an AC will be induced.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(05)	X	State that an electromagnetic wave always consists of an oscillating electric (E) and an oscillating magnetic (H) field which propagates at the speed of light.	X	X	X	X	X	X		
(06)	X	State that the ~~(E)~~ and ~~(H)~~ fields are perpendicular to each other. The oscillations are perpendicular to the propagation direction and are in-phase.	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~LO (07)~~		~~State that the electric field is parallel to the wire and the magnetic field is perpendicular to it.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
062 01 02 02		***Polarisation***								
(01)	X	State that the polarisation of an electromagnetic wave describes the orientation of the plane of oscillation of the electrical component of the wave with regard to its direction of propagation.	X	X	X	X	X	X		
~~LO (02)~~		~~State that in linear polarisation the plane of oscillation is fixed in space, whereas in circular (eliptical) polarisation the plane is rotating.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~	~~X~~	~~Explain the difference between horizontal and vertical polarisation in the dependence of the alignment of the dipole.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
062 01 02 03		***Types of antennas***								
(01)		~~List and describe~~Name the common different ~~kinds~~ types of directional antennas: — loop antenna used in old automatic direction-finding (ADF) receivers; — parabolic antenna used in weather radars; — slotted planar array used in more modern weather radars; ~~— helical antenna used in GPS transmitters.~~	X	X	X	X	X	X		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(02)		Explain ‘antenna shadowing’.	X	X	X	X	X			
(03)		Explain the importance of antenna placement on aircraft.	X	X	X	X	X			
062 01 03 00		**Wave propagation**								
062 01 03 01		***Structure of the ionosphere*** *and its effect on radio waves*								
(01)	X	State that the ionosphere is the ionised component of the Earth’s upper atmosphere from approximately 60 ~~km~~ to 400 km above the surface, which is vertically structured in three regions or layers.	X	X	X	X	X	X		
(02)	X	State that the layers ~~in~~of the ionosphere are named D, E and F layers, and their depth varies with time.	X	X	X	X	X	X		
(03)	X	State that electromagnetic waves refracted from the E and F layers of the ionosphere are called sky waves.	X	X	X	X	X	X		
(04)	X	Explain how the different layers of the ionosphere influence wave propagation.	X	X	X	X	X	X		
062 01 03 02		***Ground waves***								
(01)	X	Define ‘ground or surface waves’: the electromagnetic waves travelling along the surface of the Earth.	X	X	X	X	X	X		
062 01 03 03		***Space waves***								
(01)	X	Define ‘space waves’: the electromagnetic waves travelling through the air directly from the transmitter to	X	X	X	X	X	X		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		the receiver.								
062 01 03 04		***Propagation with the frequency bands***								
(01)		State that radio waves in VHF, UHF, SHF and EHF propagate as space waves.	X	X	X	X	X	X		
(02)		State that radio waves in ~~VLF,~~ LF, MF and HF propagate as surface/ground waves and sky waves.	X	X	X	X	X	X		
062 01 03 05		***Doppler principle***								
(01)	X	State that the Doppler effect is the phenomenon ~~that~~ where the frequency of a~~n~~ electromagnetic a wave will increase or decrease if there is relative motion between the transmitter and the receiver.	X	X	X	X	X	X		
~~LO (02)~~		~~State that the frequency will increase if the transmitter and receiver are converging, and will decrease if they are diverging.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
062 01 03 06		***Factors affecting propagation***								
(01)	X	Define 'skip distance': the distance between the transmitter and the point on the surface of the Earth where the first sky wave return arrives.	X	X	X	X	X	X		
(02)		State that skip zone/dead space is the distance between the limit of the surface wave and the sky wave.	X	X	X	X	X	X		
(03)		Describe 'fading': when a receiver picks up two signals with the same frequency, and ~~the sky signal and the surface signal,~~ the signals will interfere with each other	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		causing ~~the signals to be cancelled out.~~ changes in the resultant signal strength and polarisation.								
(04)		State that radio waves in the VHF band and above are limited in range as they are not reflected by the ionosphere and do not have a surface wave.	X	X	X	X	X	X		
(05)	X	Describe the physical phenomena 'reflection', 'refraction', 'diffraction', 'absorption' and 'interference'.	X	X	X	X	X	X		
(06)		State that multipath is when the signal arrives at the receiver via more than one path (the signal being reflected from surfaces near the receiver).	X	X	X	X	X	X		
062 02 00 00		**RADIO AIDS**								
062 02 01 00		**Ground direction finding (D~~/~~F)**								
062 02 01 01		***Principles***								
(01)	X	Describe the use of a g~~G~~round ~~Direction Finder~~DF.	X	X	X	X	X	X		
~~LO (02)~~		~~Explain why the service provided is subdivided as:~~ ~~- VHF direction finding (VDF)~~ ~~- UHF direction finding (UDF).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(03)		Explain the limitation of range because of the path of the VHF signal.	X	X	X	X	X	X		
~~LO (04)~~		~~Describe the operation of the VDF in the following general terms:~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~— radio waves emitted by the radio-telephony (R/T) equipment of the aircraft;~~ ~~— special directional antenna;~~ ~~— determination of the direction of the incoming signal;~~ — ~~ATC display.~~								
062 02 01 02		***Presentation and interpretation***								
(01)		Define the term 'QDM': the magnetic bearing to the station.	X	X	X	X	X	X	X	
(02)		Define the term 'QDR': the magnetic bearing from the station.	X	X	X	X	X	X	X	
~~LO (03)~~		~~Define the term 'QUJ'. The true bearing to the station.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (04)~~		~~Define the term 'QTE'. The true bearing from the station.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(05)		Explain that by using more than one ground station, the position of an aircraft can be determined and transmitted to the pilot.	X	X	X	X	X	X		
062 02 01 03		***Coverage and range***								
(01)		Use the formula: *1.23 × √transmitter height in feet + 1.23 × √receiver height in feet*, to calculate the range in NM.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
062 02 01 04		***Errors and accuracy***								
(01)	X	Explain why synchronous transmissions will cause errors.	X	X	X	X	X	X		
(02)	X	Describe the effect of ‘multipath signals’.	X	X	X	X	X	X		
(03)		Explain that VDF information is divided into the following classes according to ICAO Annex 10: — ~~c~~Class A: accurate to a range within ± 2°; — ~~c~~Class B: accurate to a range within ± 5°; — ~~c~~Class C: accurate to a range within ± 10°; — ~~c~~Class D: accurate to less than class C.	X	X	X	X	X	X		
062 02 02 00		**Non-d~~D~~irectional radio b~~B~~eacon (NDB)/a~~A~~utomatic d~~D~~irection f~~F~~ind~~er~~ing (ADF)**								
062 02 02 01		***Principles***								
(01)	X	Define the acronym ‘NDB’: n~~N~~on-d~~D~~irectional radio b~~B~~eacon.	X	X	X	X	X	X	X	
(02)	X	Define the acronym ‘ADF’: a~~A~~utomatic d~~D~~irection f~~F~~ind~~er~~ing equipement.	X	X	X	X	X	X	X	
(03)	X	State that the NDB is the ground part of the system.	X	X	X	X	X	X	X	
(04)	X	State that the ADF is the airborne part of the system.	X	X	X	X	X	X	X	
(05)		State that the NDB operates in the LF and MF frequency bands.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(06)		State that the ~~The~~ frequency band assigned to aeronautical NDBs according to ICAO Annex 10 is 190–1 750 kHz.	X	X	X	X	X	X	X	
(07)		Define a 'locator beacon': an LF/MF NDB used as an aid to final approach usually with a range~~,~~ of 10–25 NM.	X	X	X	X	X	X	X	
~~LO (08)~~		~~Explain the difference between NDBs and locator beacons.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~LO (09)~~		~~Explain which beacons transmit signals suitable for use by an ADF.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(10)	X	State that certain commercial radio stations transmit within the frequency band of the NDB.	X	X	X	X	X	X	X	
(11)	X	~~Explain why it is necessary to use a directionally sensitive receiver antenna system in order to obtain the direction of the incoming radio wave.~~ State that according to ICAO Annex 10, an NDB station has an automatic ground monitoring system.	X	X	X	X	X	X	X	
(12)		Describe the use of NDBs for navigation.	X	X	X	X	X	X	X	
(13)		Describe the procedure to identify an NDB station.	X	X	X	X	X	X	X	
(14)	X	Interpret the term 'cone of ~~silence~~ confusion' in respect of an NDB.	X	X	X	X	X	X	X	
(15)	X	State that an NDB station emits a ~~NON~~N0N/A1A or a ~~NON~~N0N/A2A signal.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(16)	X	State the function of the b~~B~~eat f~~F~~requency o~~O~~scillator (BFO).	X	X	X	X	X	X	X	
(17)	X	State that in order to identify a ~~NON~~N0N/A1A NDB, the BFO circuit of the receiver has to be activated.	X	X	X	X	X	X	X	
~~LO (18)~~		~~State that the NDB emitting NON/A1A gives rise to erratic indications of the bearing while the station is identifying.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(19)	X	~~Explain~~ State that on modern aircraft the BFO is activated automatically.	X	X	X	X	X	X	X	
062 02 02 02		***Presentation and interpretation***								
(01)	X	Name the types of indicators commonly in use ~~in common use~~: — electronic ~~navigation~~ display; — r~~R~~adio m~~M~~agnetic i~~I~~ndicator (RMI); — fixed-card ADF (radio compass); — moving-card ADF.	X	X	X	X	X	X	X	
(02)		~~Describe~~ Interpret the indications given on RMI, fixed-card and moving-card ADF displays.	X	X	X	X	X	X	X	
(03)		Given a display, interpret the relevant ADF information.	X	X	X	X	X	X	X	
(04)		Calculate the true bearing from the compass heading and relative bearing.	X	X	X	X	X	X	X	
(05)		Convert the compass bearing into magnetic bearing and	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		true bearing.								
(06)		Describe how to fly the following in-flight ADF procedures according to ICAO Doc 8168~~,~~ Volume 1: — homing and tracking, and explain the influence of wind; — interceptions; — procedural turns; — holding patterns.	X	X	X	X	X	X	X	
062 02 02 03		***Coverage and range***								
(01)	X	State that the power of the transmitter limits the range of an NDB.	X	X	X	X	X	X	X	
(02)		Explain the relationship between power and range.	X	X	X	X	X	X	X	
~~LO (03)~~		~~State that the range of an NDB over sea is better than over land due to better ground wave propagation over seawater than over land.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(04)	X	Describe the propagation path of NDB radio waves with respect to the ionosphere and the Earth's surface.	X	X	X	X	X	X	X	
(05)		Explain that the interference between sky waves and ground waves leads to 'fading'.	X	X	X	X	X	X	X	
(06)		Define that the accuracy the pilot has to fly the required bearing in order to be considered established during approach, according to ICAO Doc 8168, has to be within	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		± 5°.								
(07)		State that there is no warning indication of NDB failure.	X	X	X	X	X	X	X	
062 02 02 04		***~~Errors and accuracy~~ Intentionally left blank***								
~~LO (01)~~		~~Define 'quadrantal error'. The distortion of the incoming signal from the NDB station by reradiation from the airframe. This is corrected for during installation of the antenna.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(02)~~	~~X~~	~~Explain 'coastal refraction': as a radio wave travelling over land crosses the coast, the wave speeds up over water and the wave front bends.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(03)~~	~~X~~	~~Define 'night/twilight effect': the influence of sky waves and ground waves arriving at the ADF receiver with a difference of phase and polarisation which introduce bearing errors.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(04)~~		~~State that interference from other NDB stations on the same frequency may occur at night due to sky-wave contamination.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
062 02 02 05		***Factors affecting range and accuracy***								
~~LO (01)~~		~~State that there is no coastal refraction error when:~~ ~~— the propagation direction of the wave is 90° to the coastline;~~ ~~— the NDB station is sited on the coastline.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~LO (02)~~		~~State that coastal refraction error increases with increased incidence.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~LO (03)~~		~~State that night effect predominates around dusk and dawn.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(04)		~~Define multipath propabation~~ Describe diffraction of radio waves in mountainous terrain (mountain effect).	X	X	X	X	X	X	X	
(05)		State that static ~~emission~~ radiation energy from a cumulonimbus cloud may interfere with the radio wave and influence the ADF bearing indication.	X	X	X	X	X	X	X	
(06)		Explain that the bank angle of the aircraft causes a dip error.	X	X	X	X	X	X	X	
062 02 03 00		**VHF omnidirectional radio range (VOR): conventional VOR (CVOR) and Doppler VOR (DVOR)**								
062 02 03 01		***Principles***								
(01)	X	Explain the ~~operation~~ working principle of VOR using the following general terms: — reference phase; — variable phase; — phase difference.	X	X	X	X	X	X		
(02)		State that the frequency band allocated to VOR according to ICAO Annex 10 is VHF, and the frequencies used are 108.0–117.975 MHz.	X	X	X	X	X	X	X	

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(03)		State that frequencies within the allocated VOR range 108.0–111.975 MHz, which have an odd number in the first decimal place, are used by instrument landing system (ILS).	X	X	X	X	X	X	X	
(04)		State that the following types of VOR are in operation: — ~~C~~conventional VOR (CVOR): a first-generation VOR station emitting signals by means of a rotating antenna; — Doppler VOR (DVOR): a second-generation VOR station emitting signals by means of a combination of fixed antennas utilising the Doppler principle; — en route VOR for use by IFR traffic; — ~~T~~terminal VOR (TVOR): a station with a shorter range used as part of the approach and departure structure at major ~~airports~~aerodromes; — ~~T~~test VOR (VOT): a VOR station emitting a signal to test VOR indicators in an aircraft.	X	X	X	X	X	X	X	
(05)		State ~~Describe how~~ that automatic terminal information service (ATIS) information is transmitted on VOR frequencies.	X	X	X	X	X	X	X	
(06)	X	List the three main components of VOR airborne equipment: — the antenna;	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— the receiver; — the indicator.								
(07)		Describe the identification of a VOR in terms of Mors-code letters ~~letter, continous tone or dots (VOT), tone pitch, repetition rate~~ and additional plain text.	X	X	X	X	X	X	X	
(08)	X	State that according to ICAO Annex 10, a VOR station has an automatic ground monitoring system.	X	X	X	X	X	X		
~~LO (09)~~		~~State that the VOR monitoring system monitors change in measured radial and reduction in signal strength.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(10)		State that failure of the VOR station to stay within the required limits can cause the removal of identification and navigation components from the carrier or radiation to cease.	X	X	X	X	X	X	X	
062 02 03 02		**Presentation and interpretation**								
(01)		Read off the radial on an ~~Radio Magnetic Indicator (~~RMI~~)~~.	X	X	X	X	X	X		
(02)		Read off the angular displacement in relation to a preselected radial on a~~n~~ horizontal situation indicator (HSI) or omnibearing indicator (OBI)	X	X	X	X	X	X		
(03)		Explain the use of the TO/FROM indicator in order to determine aircraft position relative to the VOR considering also the heading of the aircraft.	X	X	X	X	X	X		
(04)		Interpret VOR information as displayed on HSI, CDI and	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		RMI.								
(05)		Describe the following in-flight VOR procedures ~~as in~~ according to ICAO Doc 8168, Volume 1: — tracking, and explain the influence of wind when tracking; — interceptions; — procedural turns; — holding patterns.	X	X	X	X	X	X		
(06)		State that when converting a radial into a true bearing, the variation at the VOR station has to be taken into account.	X	X	X	X	X	X		
062 02 03 03		***~~Coverage and range~~ Intentionally left blank***								
~~LO (01)~~		~~Describe the range with respect to the transmitting power and radio signal.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~Calculate the range using the formula:~~ ~~1.23 × √transmitter height in feet + 1.23 × √receiver height in feet.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
062 02 03 04		***Errors and accuracy***								
(01)		Define that the accuracy the pilot has to fly the required bearing in order to be considered established on a VOR track when flying approach procedures according to ICAO Doc 8168, has to be within the half-full scale deflection of	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		the required track.								
(02)		State that due to reflections from terrain, radials can be bent and lead to wrong or fluctuating indications, which is called 'scalloping'.	X	X	X	X	X	X	X	
~~LO (03)~~		~~State that DVOR is less sensitive to site error than CVOR.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
062 02 04 00		**Distance-measuring equipment (DME)**								
062 02 04 01		***Principles***								
(01)		State that DME operates in the UHF band ~~between 960 – 1215 MHz according to ICAO Annex 10~~.	X	X	X	X	X	X	X	
(02)	X	State that the system comprises two basic components: — the aircraft component~~,~~: the interrogator; — the ground component~~,~~: the transponder.	X	X	X	X	X	X	X	
(03)		Describe the principle of distance measurement using DME in terms of a timed transmission from the interrogator and reply from the transponder on different frequencies.~~:~~ ~~— pulse pairs~~ ~~— fixed frequency division of 63 MHz;~~ ~~— propagation delay;~~ ~~— 50 microsecond delay time;~~ ~~— irregular transmission sequence;~~	X	X	X	X	X	X		

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~— search mode;~~ ~~— tracking mode;~~ — ~~memory mode.~~								
(04)		~~State~~ Explain that the distance measured by DME is slant range.	X	X	X	X	X	X	X	
(05)		Illustrate that a position line using DME is a circle with the station at its centre.	X	X	X	X	X	X	X	
(06)		~~Describe how~~ State that the pairing of VHF and UHF frequencies (VOR/DME) enables the selection of two items of navigation information from one frequency setting.	X	X	X	X	X	X	X	
(07)	X	Describe, in the case of co-location with VOR and ILS, the frequency pairing and identification procedure.	X	X	X	X	X	X	X	
~~LO (08)~~		~~Explain that depending on the configuration, the combination of a DME distance with a VOR radial can determine the position of the aircraft.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(09)		~~Explain~~ State that military UHF tactical air navigation aid (TACAN) stations may be used for DME information.	X	X	X	X	X	X	X	
062 02 04 02		**Presentation and interpretation**								
(01)	X	~~Explain~~ State that when identifying a DME station co-located with a VOR station, the identification signal with the higher-tone frequency is the DME which identifiess	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		itself approximately every 40 seconds.								
(02)		Calculate ground distance from given slant range and altitude.	X	X	X	X	X	X	X	
(03)		Describe the use of DME to fly a DME arc in accordance with ICAO Doc 8168, Volume 1.	X	X	X	X	X	X	X	
(04)	X	State that a DME system may have a ground speed (GS) and time to station read-out combined with the DME read-out.	X	X	X	X	X	X	X	
062 02 04 03		***Coverage and range***								
(01)		Explain why a ground station can generally respond to a maximum of 100 aircraft.	X	X	X	X	X	X	X	
(02)		Explain which aircraft will be denied a DME range first when more than 100 interrogations are being made.	X	X	X	X	X	X	X	
062 02 04 04		***~~Errors and accuracy~~ Intentionally left blank***								
(01)		State that the error of the DME 'N' according to ICAO Annex 10 should not exceed ± 0.25 NM + 1.25 % of the distance measured. For installations installed after 1 January 1989, the total system error should not exceed 0.2 NM DME 'P'.	X	X	X	X	X	X		
062 02 04 05		***Factors affecting range and accuracy***								
~~LO (01)~~		~~State that the ground speed read-out combined with DME is only correct when tracking directly to or from the~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~DME station.~~								
(02)		~~State~~ Explain why ~~that, close to the station,~~ the ~~ground speed~~ GS read-out ~~commbined with~~ from a DME ~~is~~ can be less than the actual ~~ground speed~~ GS, and is zero when flying a DME arc.	X	X	X	X	X	X	X	
062 02 05 00		**Instrument landing system (ILS)**								
062 02 05 01		***Principles***								
(01)		Name the three main components of an ILS: — the localiser (~~LLZ~~LOC); — the glide path (GP); — range information (markers or DME).	X		X			X	X	
(02)	X	State the site locations of the ILS components: — the ~~localiser~~LOC antenna should be located on the extension of the runway centre line at the stop-end; — the ~~glide-path~~GP antenna should be located ~~300 m~~ beyond the runway threshold, laterally displaced ~~approximately 120 m~~ to the side of the runway centre line.	X		X			X	X	
(03)		Explain that marker beacons produce radiation patterns to indicate predetermined distances from the threshold along the ILS ~~glide path~~GP.	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(04)		~~Explain~~ State that marker beacons are sometimes replaced by a DME paired with the ~~LLZ~~LOC frequency.	X		X			X	X	
(05)		State that in the ILS LOC frequency assigned band 108.0–111.975 MHz, only frequencies which have an odd number in the first decimal are ILS LOC frequencies.	X		X			X	X	
~~LO (06)~~		~~State that the LLZ operates in the 108.0–111.975 MHz VHF band, according to ICAO Annex 10.~~	~~X~~		~~X~~			~~X~~	~~X~~	
(07)		State that the GP operates in the UHF band.	X		X			X	X	
(08)	X	Describe the use of the 90-Hz and the 150-Hz signals in the ~~LLZ~~LOC and GP transmitters/receivers, stating how the signals at the receivers vary with angular deviation.	X		X			X	~~X~~	
~~LO (09)~~		~~Draw the radiation pattern with respect to the 90-Hz and 150-Hz signals.~~	~~X~~		~~X~~			~~X~~		
(10)		~~Explain how~~ State that the UHF ~~glide-path~~GP frequency is selected automatically by being paired with the ~~LLZ~~LOC frequency.	X		X			X		
~~LO (11)~~		~~Explain the term 'Difference of Depth of Modulation (DDM)'.~~	~~X~~		~~X~~			~~X~~		
~~LO (12)~~		~~State that the difference in the modulation depth increases with displacement from the centre line.~~	~~X~~		~~X~~			~~X~~		
(13)		~~State~~ Explain that both the ~~LLZ~~LOC and the GP antenna radiates side lobes (false beams) which can give rise to	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		false centre-line and false ~~glide-path~~GP indication.								
(14)	X	Explain that the back beam from the ~~LLZ~~LOC antenna may be used as a published 'non-precision approach'.	X		X			X	X	
(15)		State that ~~according ICAO Annex 10~~ the ~~nominal~~ recommended ~~glide path~~GP is 3°.	X		X			X	X	
(16)		Name the frequency, modulation and identification assigned to all marker beacons ~~according to ICAO Annex 10:~~. All marker beacons operate on 75-MHz carrier frequency. The modulation frequencies of the audio are: — outer marker: ~~400 Hz~~ low; — middle marker: ~~1 300 Hz~~ medium; — inner marker: ~~3 000 Hz~~ high. The audio frequency modulation (for identification) is the continuous modulation of the audio frequency and is keyed as follows: — outer marker: 2 dashes per second continuously; — middle marker: a continuous series of alternate dots and dashes; — inner marker: 6 dots per second continuously. The outer-marker cockpit indicator is coloured blue, the middle marker amber, and the inner marker white.	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(17)		State that ~~according to ICAO Doc 8168~~ the final-approach area contains a fix or facility that permits verification of the ILS ~~glide path~~ GP–altimeter relationship. The outer marker or DME is usually used for this purpose.	X		X			X	X	
062 02 05 02		***Presentation and interpretation***								
(01)		Describe the ILS identification regarding frequency and Morse code ~~and/~~or plain text.	X		X			X	X	
~~LO (02)~~		~~Calculate the rate of descent for a 3° glide-path angle given the ground speed of the aircraft and using the formula:~~ ~~Rate of Descent (ROD) in ft/min = (ground speed in kt × 10) / 2.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO (03)~~		~~Calculate the rate of descent using the following formula when flying any glide-path angle:~~ ~~ROD ft/min = *Speed Factor (SF)* × glide-path angle × 100.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO (04)~~		~~Interpret the markers by sound, modulation, and frequency.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO (05)~~		~~State that the outer-marker cockpit indicator is coloured blue, the middle marker amber, and the inner marker white.~~	~~X~~		~~X~~			~~X~~	~~X~~	
(06)		State that ~~according ICAO Annex 10~~ an ILS installation has an automatic ground monitoring system.	X		X			X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(07)		State that the ~~LLZ~~LOC and GP monitoring system monitors any shift in the ~~LLZ~~LOC and GP mean course line or reduction in signal strength.	X		X			X		
(08)		~~State that a failure of either the LLZ~~LOC ~~or the GP to stay within the predetermined limits will cause:~~ ~~— removal of identification and navigation components from the carrier;~~ ~~— radiation to cease;~~ — ~~a warning to be displayed at the designated control point.~~ State that warning flags will appear for both the LOC and the GP if the received signal strength is below a threshold value.	X		X			X	X	
~~LO (09)~~		~~State that an ILS receiver has an automatic monitoring function.~~	~~X~~		~~X~~			~~X~~	~~X~~	
(10)		Describe the circumstances in which warning flags will appear for both the ~~LLZ~~LOC and the GP: — absence of the carrier frequency; — absence of the ~~90 and 150 Hz nav~~ modulation simultaneously; — the percentage modulation of ~~either~~ the ~~90 or 150 Hz~~ navigation signal reduced to 0.	X		X			X		
(11)		Interpret the indications on a ~~Course Deviation Indicator~~	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~(~~CDI~~)~~ and an ~~Horizontal Situation Indicator (~~HSI~~)~~: — full-scale deflection of the CDI needle corresponds to approximately 2.5° displacement from the ILS centre line; — full-scale deflection on the GP corresponds to approximately 0.7° from the ILS GP centre line.								
(12)		Interpret the aircraft's position in relation to the extended runway centre line on a back-beam approach.	X		X			X	~~X~~	
(13)		Explain the setting of the course pointer of an HSI and the course selector of an omnibearing indicator (OBI) for front-beam and back-beam approaches.	X		X			X	~~X~~	
062 02 05 03		***Coverage and range***								
(01)		Sketch the standard coverage area of the ~~LLZ~~LOC and GP with angular sector limits in degrees and distance limits from the transmitter: — ~~LLZ~~LOC coverage area is 10° on either side of the centre line to a distance of 25 NM from the runway, and 35° on either side of the centre line to a distance of 17 NM from the runway; — GP coverage area is 8° on either side of the centre line to a distance of minimum 10 NM from the runway. ~~- Define a 'locator beacon' as an LF/MF NDB used as an aid to final approach usually with a range, according to~~	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~ICAO Annex 10, of 10–25 NM.~~								
062 02 05 04		***Errors and accuracy***								
(01)		Explain that ILS approaches are divided into facility performance categories defined in ICAO Annex 10.	X		X			X	X	
(02)		Define the following ILS operation categories: — Category I; — Category II; — Category IIIA; — Category IIIB; — Category IIIC.	X		X			X		
(03)		Explain that all Category III ILS operations guidance information is provided from the coverage limits of the facility to, and along, the surface of the runway.	X		X			X		
(04)		Explain why the accuracy requirements are progressively higher for CAT I, CAT II and CAT III ILS.	X		X			X		
~~LO (05)~~		~~State the vertical-accuracy requirements above the threshold for CAT I, II and III for the signals of the ILS ground installation.~~	~~X~~		~~X~~			~~X~~		
(06)		Explain the following in accordance with ICAO Doc 8168: — the accuracy the pilot has to fly the ILS ~~localiser~~LOC to be considered established on an ILS track is within the half-full scale deflection of the required	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		track; — the aircraft has to be established within the half-scale deflection of the ~~LLZ~~LOC before starting descent on the GP; — the pilot has to fly the ILS GP to a maximum of half-scale fly-up deflection of the GP in order to stay in protected airspace.								
(07)		State that if a pilot deviates by more than ~~half-scale~~ half-course deflection on the ~~LLZ~~LOC or by more than half-dot ~~course~~ ~~fly-up~~ deflection on the GP, an immediate go-around should be executed because obstacle clearance may no longer be guaranteed.	X		X			X	X	
(08)		Describe ILS beam bends as ~~. D~~deviations from the nominal ~~position of the LLZ~~LOC and GP respectively which can be assessed~~. They are ascertained~~ by flight test.	X		X			X		
(09)		Explain that multipath interference is caused by ~~: R~~reflections from ~~large~~ objects within the ILS coverage area.	X		X			X		
062 02 05 05		***Factors affecting range and accuracy***								
(01)		Define the ‘ILS-critical area’: an area of defined dimensions ~~about~~ around the ~~LLZ~~LOC and GP antennas where vehicles, including aircraft, are excluded during all ILS operations.	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(02)		Define the 'ILS-sensitive area': an area extending beyond the ILS-critical area where the parking ~~and/~~or movement of vehicles, including aircraft, is controlled to prevent the possibility of unacceptable interference to the ILS signal during ILS operations.	X		X			X	X	
~~LO (03)~~		~~Describe the effect of FM broadcast stations that transmit on frequencies just below 108 MHz.~~	X		X			X		
062 02 06 00		**Microwave ~~L~~landing ~~S~~system (MLS)**								
062 02 06 01		***Principles***								
(01)		Explain the principle of operation: — horizontal course guidance during the approach; — vertical guidance during the approach; — horizontal guidance for departure and missed approach; — DME (DME/P) distance; — transmission of special information regarding the system and the approach conditions.	X		X			X		
(02)		State that MLS operates in the S band on 200 channels.	X		X			X		
(03)		Explain the reason why MLS can be installed at aerodromes where ~~airports on which~~, as a result of the effects of surrounding buildings ~~and/~~or terrain, ILS siting is difficult.	X		X			X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
062 02 06 02		***Presentation and interpretation***								
(01)		Interpret the display of airborne equipment designed to continuously show the position of the aircraft in relation to a preselected course and glide path along with distance information, during approach and departure.	X		X			X		
(02)		Explain that segmented approaches can be carried out with a presentation with two cross bars directed by a computer which has been programmed with the approach to be flown.	X		X			X		
(03)		Illustrate that segmented and curved approaches can only be executed with DME~~-~~/P installed.	X		X			X		
(04)		Explain why aircraft are equipped with a ~~M~~multimode ~~R~~receiver (MMR) in order to be able to receive ILS, MLS and GPS.	X		X			X		
(05)		Explain why MLS without DME~~-~~/P gives an ILS lookalike straight-line approach.	X		X			X		
062 02 06 03		***Coverage and range***								
(01)		Describe the coverage area for the approach direction as being within a sector of ± 40° of the centre line out to a range of 20 NM from the threshold (according to ICAO Annex 10).	X		X			X		
~~***062 02 06 04***~~		~~***Error and accuracy***~~								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
~~LO (01)~~		~~State the 95 % lateral and vertical accuracy within 20 NM (37 km) of the MLS approach reference datum and 60 ft above the MLS datum point (according to ICAO Annex 10).~~	~~X~~		~~X~~			~~X~~		
062 03 00 00		**RADAR**								
062 03 01 00		**Pulse techniques ~~and associated terms~~**								
062 03 01 01		***Pulse techniques and associated terms***								
(01)		Name the different applications of radar with respect to air traffic control (ATC), ~~MET~~ weather observations, and airborne weather radar (AWR).	X	X	X	X	X	X	X	
(02)	X	Describe the pulse technique and echo principle on which primary radar systems are based.	X	X	X	X	X	X		
(03)	X	~~Explain the relationship between the maximum theoretical range and the Pulse Repetition Frequency (PRF)~~ State that the range of a radar depends on pulse repetition frequency (PRF), pulse length, pulse power, height of aircraft, height of antenna and frequency used.	X	X	X	X	X	X		
~~LO (04)~~		~~Calculate the maximum theoretical unambiguous range if the PRF is given using the formula:~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (05)~~		~~Calculate the PRF if the maximum theoretical unambiguous range of the radar is given using the formula:~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~LO (06)~~		~~Explain that pulse length defines the minimum theoretical range of a radar.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (07)~~		~~Explain the need to harmonise the rotation speed of the antenna, the pulse length and the pulse repetition frequency for range.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(08)~~	~~X~~	~~Describe, in general terms, the effects of the following factors with respect to the quality of the target depiction on the radar display:~~ ~~— super-refraction and sub-refraction;~~ ~~— attenuation with distance;~~ ~~— condition and size of the reflecting surface.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
062 03 02 00		**Ground radar**								
062 03 02 01		***Principles***								
(01)		Explain that primary radar provides bearing and distance of targets.	X		X	X		X	X	
(02)	X	Explain that primary ground radar is used to detect aircraft that are not equipped with a secondary radar transponder.	X		X	X		X	X	
~~LO (03)~~		~~Explain why Moving Target Indicator (MTI) is used.~~	~~X~~		~~X~~	~~X~~		~~X~~	~~X~~	
062 03 02 02		***Presentation and interpretation***								
(01)		~~State that modern ATC systems use computer-generated display.~~	~~X~~		~~X~~	~~X~~		~~X~~	~~X~~	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		State that modern ATC systems use inputs from various sensors to generate the display								
~~LO (02)~~		~~Explain that the radar display enables the ATS controller to provide information, surveillance or guidance service.~~	~~X~~		~~X~~	~~X~~		~~X~~	~~X~~	
062 03 03 00		**Airborne weather radar**								
062 03 03 01		***Principles***								
(01)		List the two main tasks of the weather radar in respect of weather and navigation.	X		X	X		X	X	
(02)		~~State the wavelength (approx. 3 cm) and frequency of most AWRs (approx. 9 GHz).~~ State that modern weather radars employ frequencies that give wavelengths of about 3 cm that reflect best on wet hailstones	X		X	X		X		
(03)	X	~~Explain how~~ State that the antenna is ~~attitude-~~stabilised in ~~relation to~~ the horizontal plane with signals from ~~using~~ the aircraft's attitude reference system.	X		X	X		X	X	
~~LO (04)~~		~~Explain that older AWRs have two different radiation patterns which can be produced by a single antenna, one for mapping (cosecant-squared) and the other for weather (pencil/cone-shaped).~~	~~X~~		~~X~~	~~X~~		~~X~~		
(05)	X	Describe the cone-shaped pencil beam of about 3° to 5° beam width used for weather detection ~~depiction~~.	X		X	X		X	X	
~~LO (06)~~		~~Explain that in modern AWRs a single radiation pattern is used for both mapping and weather with the scanning~~	~~X~~		~~X~~	~~X~~		~~X~~	~~X~~	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~angle being changed between them.~~								
062 03 03 02		***Presentation and interpretation***								
(01)		Explain the functions of the following different ~~modes~~ controls on the radar control panel: — off/on switch; — function switch~~,~~ with WX, WX+T and MAP modes; — gain-control setting (auto/manual); — tilt/autotilt switch.	X		X	X		X	X	
(02)		Name, for areas of differing reflection intensity, the colour gradations (green, yellow, red and magenta) indicating the increasing intensity of precipitation.	X		X	X		X	X	
(03)	X	~~Illustrate~~ State the use of azimuth-marker lines and range lines in respect of the relative bearing and the distance to a thunderstorm ~~or to a landmark~~ on the screen.	X		X	X		X	X	
062 03 03 03		***Coverage and range***								
(01)		Explain how the radar is used for weather detection and for mapping (range, tilt and gain, if available).	X		X	X		X	X	
062 03 03 04		***Errors, accuracy, limitations***								
(01)		Explain why AWR should be used with extreme caution when on the ground.	X		X	X		X	X	
062 03 03 05		***Factors affecting range and accuracy***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)		Explain the danger of the area behind heavy rain (shadow area) where no radar waves will penetrate.	X		X	X		X	X	
(02)		Describe appropriate tilt settings in relation to altitude and thunderstorms.	X		X	X		X	X	
~~LO (03)~~		~~Explain why the tilt setting should be lower when the aircraft climbs to a higher altitude.~~	X		X	X		X	X	
(04)		Explain why a thunderstorm may not be detected when the tilt is set too high.	X		X	X		X	X	
062 03 03 06		***Application for navigation***								
(01)		Describe the navigation function of the radar in the mapping mode.	X		X	X		X	X	
(02)		Describe the use of the weather radar to avoid a thunderstorm (Cb).	X		X	X		X	X	
(03)		Explain how turbulence (not CAT) can be detected by a modern weather radar.	X		X	X		X	X	
(04)		Explain how wind shear can be detected by a modern weather radar.	X		X	X		X	X	
062 03 04 00		**Secondary surveillance radar and transponder**								
062 03 04 01		***Principles***								
(01)		~~Explain~~ State that the ~~Air Traffic Control (~~ATC~~)~~ system is based on the replies provided by the airborne transponders in response to interrogations from the ATC	X	X	X	X	X	X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		secondary radar.								
(02)	X	~~Explain~~ State that the ground ATC secondary radar uses techniques which provide the ATC with information that cannot be acquired by the primary radar.	X	X	X	X	X	X	X	
(03)	X	~~Explain~~ State that an airborne transponder provides coded-reply signals in response to interrogation signals from the ground secondary radar and from aircraft equipped with traffic alert and collision avoidance system (TCAS).	X	X	X	X	X	X	X	
(04)		~~Explain~~ State the advantages of secondary surveillance radar (SSR) over a primary radar regarding range and collected information due to transponder principal information and active participation of the aircraft.	X	X	X	X	X	X	X	
062 03 04 02		***Modes and codes***								
(01)	X	~~Explain~~ State that the interrogator transmits its interrogations in the form of a series of pulse pairs.	X	X	X	X	X	X	X	
(02)		Name ~~and explain~~ the interrogation modes: — Mode A and C; and successor Mode S; ~~— Intermode:~~ ~~• Mode A/C/S all call,~~ ~~• Mode A/C only all call;~~ — Mode S~~:~~.	X	X	X	X	X	X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		• ~~Mode S only all call,~~ • ~~broadcast (no reply elicited),~~ • ~~selective.~~								
(03)		State that the interrogation frequency ~~is 1 030 MHz~~ and the reply frequency are different. ~~is 1 090 MHz~~.	X	X	X	X	X			
(04)		Explain that the decoding of the time interval between the ~~interrogation~~ pulse pairs determines the operating mode of the transponder: — Mode A: transmission of aircraft transponder code; — Mode C: transmission of aircraft pressure altitude; — Mode S: selection of aircraft address ~~selection~~ and transmission of flight data for the ground surveillance.	X	X	X	X	X			
~~LO (05)~~		~~State that the ground interrogation signal is transmitted in the form of pairs of pulses P1 and P3 for Mode A and C, and that a control pulse P2 is transmitted following the first interrogation pulse P1.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (06)~~		~~Explain that the interval between P1 and P3 determines the mode of interrogation, Mode A or C.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (07)~~		~~State that the radiated amplitude of P2 from the side lobes and from the main lobe is different.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(08)		State that Mode A designation is a sequence of four digits which can be manually selected from 4 096 available	X	X	X	X	X	X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		codes.								
(09)		State that in Mode C reply, the pressure altitude is reported in 100-ft increments.	X	X	X	X	X	X		
(10)		~~Explain~~ State that in addition to the information ~~pulses~~ provided, on request from ATC, a s~~S~~pecial p~~P~~osition i~~I~~dentification (SPI) pulse can be transmitted but only as a result of a manual selection by the pilot (IDENT button).	X	X	X	X	X	X		
(11)	X	State the need for compatibility of Mode S with Mode A and C.	X	X	X	X	X	X		
(12)		Explain that Mode S transponders receive interrogations from TCAS ~~other Mode S transponders~~ and SSR ground stations.	X	X	X	X	X	X		
(13)	X	State that Mode S interrogation contains either the aircraft address, selective call or all-call address ~~surveillance protocols implicitly use the principle of selective addressing.~~	X	X	X	X	X	X		
(14)	X	~~Explain~~ State that every aircraft ~~will have been~~ is allocated an ICAO a~~A~~ircraft a~~A~~ddress which is hard-coded into the ~~airframe~~ Mode S transponder (Mode S address).	X	X	X	X	X	X	X	
~~LO (15)~~		~~Explain that the ICAO Aircraft Address consists of 24 bits (therefore more than 16 000 000 possible codes) allocated by the registering authority of the State in which the aircraft is registered.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(16)		~~Explain that this (24-bit) address is included in all Mode-S transmissions, so that every interrogation can be directed to a specific aircraft, preventing multiple replies.~~ Explain that a 24-bit address is used in all Mode S transmissions, so that every interrogation can be directed to a specific aircraft.	X	X	X	X	X	X		
~~LO (17)~~		~~State that the ground interrogation signal is transmitted in the form of P1, P3 and P4 pulses for Mode S.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(18)~~	~~X~~	~~Interpret the following Mode S terms:~~ ~~— selective addressing;~~ ~~— mode 'all call';~~ ~~— selective call.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~(19)~~	~~X~~	~~State that Mode S interrogation contains either:~~ ~~— aircraft address;~~ ~~— all-call address;~~ ~~— broadcast address.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~LO (20)~~		~~Mode A/C/S all-call consists of 3 pulses: P1, P3 and the long P4. A control pulse P2 is transmitted following P1 to suppress responses from aircraft in the side lobes of the interrogation antenna.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (21)~~		~~Mode A/C only all-call consists of 3 pulses: P1, P3 and the short P4.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~LO (22)~~		~~State that there are 25 possible Mode-S reply forms.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (23)~~		~~State that the reply message consists of a preamble and a data block.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (24)~~		~~State that the Aircraft Address shall be transmitted in any reply except in Mode-S only all-call reply.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(25)		~~Explain~~ State that Mode S can provide enhanced vertical tracking, using a 25-feet altitude increment.	X	X	X	X	X	X		
(26)		~~Explain how~~ State that SSR can be used for automatic dependent surveillance — broadcast (ADS-B).	X	X	X	X	X	X		
062 03 04 03		***Presentation and interpretation***								
(01)		State that an aircraft can be identified by a unique code.	X	X	X	X	X	X	X	
(02)		~~Illustrate how~~ State which ~~the following~~ information ~~is~~ can be presented on the ATC display system ~~radar screen:~~: — pressure altitude; — flight level; — flight number or aircraft registration number; — ~~ground speed~~GS.	X	X	X	X	X	X	X	
(03)		~~Name and interpret the codes 7700, 7600 and 7500.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(04)	X	~~Interpret the~~ Explain the use and function of the selector modes: OFF, Standby, ON (~~m~~Mode A), ALT (~~m~~Mode A, C	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		and S~~C~~), ~~and~~ TEST and of the reply lamp.								
~~LO (05)~~		~~Explain the function of the emission of a Special Position Identification (SPI) pulse after pushing the IDENT button in the aircraft.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
		~~***ELEMENTARY SURVEILLANCE***~~								
~~(06)~~		~~Explain that the elementary surveillance provides the ATC controller with the aircraft's position, altitude and identification.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~(07)~~		~~State that the elementary surveillance needs Mode S transponders with sSurveillance iIdentifier (SI) code capacity and the automatic reporting of aircraft identification, known as ICAO Level 2s.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~(08)~~		~~State that the SI code must correspond to the aircraft identification specified in item 7 of the ICAO flight plan or to the registration marking.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~(09)~~		~~State that only the ICAO identification format is compatible with the ATS ground system.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (10)~~		~~State that Mode-S-equipped aircraft with a maximum mass in excess of 5 700 kg or a maximum cruising true airspeed capability in excess of 250 kt must operate with transponder antenna diversity.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (11)~~		~~Describe the different types of communication protocols (A, B, C and D).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~LO (12)~~		~~Explain that elementary surveillance is based on Ground-Initiated Comm-B protocols.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
		ENHANCED SURVEILLANCE								
(13)		~~State that enhanced surveillance consists of the extraction of additional aircraft parameters known as dDownlink aAircraft pParameters (DAP) consisting of:~~ ~~— magnetic heading;~~ ~~— indicated airspeed;~~ ~~— Mach number;~~ ~~— vertical rate;~~ ~~— roll angle;~~ ~~— track angle rate;~~ ~~— true track angle;~~ ~~— ground speed;~~ ~~— selected altitude.~~ State that every aircraft is allocated an ICAO aircraft address which is hard-coded into the airframe Mode S transponder (Mode S address).	X	X	X	X	X	X		
~~(14)~~		~~Explain that the ATC controller's information is improved by providing actual aircraft-derived data such as magnetic heading, indicated airspeed, vertical rate and selected altitude.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
~~(15)~~		~~Explain that the automatic extraction of an aircraft's parameters, and their presentation to the controller, will reduce their R/T workload and will free them to concentrate on ensuring the safe and efficient passage of air traffic.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (16)~~		~~Explain that the reduction in radio-telephony between the air traffic controllers and the pilots will reduce pilot workload and remove a potential source of error.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~062 03 04 04~~		***~~Errors and accuracy~~***								
~~LO (01)~~		~~Explain the following disadvantages of SSR (Mode A/C):~~ — ~~code garbling of aircraft less than 1.7 NM apart measured in the vertical plane perpendicular to and from the antenna; .~~ — ~~'fruiting' which results from the reception of replies caused by interrogations from other radar stations.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
062 04 00 00		**INTENTIONALLY LEFT BLANK**								
062 05 00 00		**~~AREA NAVIGATION SYSTEMS, RNAV/FMS~~**								
~~062 05 01 00~~		**~~General philosophy and definitions~~**								
~~062 05 01 01~~		***~~Basic RNAV (B-RNAV), Precision RNAV (P-RNAV), RNP-PNAV~~***								
~~LO~~		~~Define 'Area Navigation' (RNAV) (ICAO Annex 11). A~~	~~X~~		~~X~~			~~X~~	~~X~~	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~method of navigation permitting aircraft operations on any desired track within the coverage of station-referenced navigation signals, or within the limits of a self-contained navigation system.~~								
~~LO~~		~~State that Basic RNAV (B-RNAV) systems require RNP 5.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO~~		~~State that Precision RNAV (PRNAV) systems require RNP 1.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~***062 05 01 02***~~		~~***Principles of 2D RNAV, 3D RNAV and 4D RNAV***~~								
~~LO~~		~~State that a 2D-RNAV system is able to navigate in the horizontal plane only.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO~~		~~State that a 3D-RNAV system is able to navigate in the horizontal plane and in addition has a guidance capability in the vertical plane.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO~~		~~State that a 4D-RNAV system is able to navigate in the horizontal plane, has a guidance capability in the vertical plane and in addition has a timing function.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~***062 05 01 03***~~		~~***Required Navigation Performance (RNP) in accordance with ICAO Doc 9613***~~								
~~LO~~		~~State that RNP is a concept that applies to navigation performance within an airspace.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO~~		~~The RNP type is based on the navigation performance accuracy to be achieved within anairspace.~~	~~X~~		~~X~~			~~X~~	~~X~~	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~LO~~		~~State that RNP X requires a navigation performance accuracy of ± X NM both lateral and longitudinal 95 % of the flying time (RNP 1 requires a navigation performance of ± 1 NM both lateral and longitudinal 95 % of the flying time).~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO~~		~~State that RNAV equipment is one requirement in order to receive approval to operate in an RNP environment.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO~~		~~State that RNAV equipment operates by automatically determining the aircraft's position.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~State that the following are output data from a 4D RNAV system:~~ ~~— distance to any waypoint;~~ ~~— estimated time overhead;~~ ~~— ground speed and TAS;~~ ~~— true wind;~~ ~~— track error.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO~~		~~Flight Management System (FMS) and general terms.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO~~		~~Navigation and flight management.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO~~		~~Explain that the development of computers which combine reliable liquid crystal displays offer the means of accessing more data and displaying them to~~	~~X~~		~~X~~			~~X~~	~~X~~	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~the flight crew.~~								
~~LO~~		~~Explain that a flight management system has the ability to monitor and direct both navigation and performance of the flight.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~**062 05 02 00**~~		~~**Simple 2D RNAV**~~ ~~*Info: First generation of radio-navigation systems allowing the flight crew to select a phantom waypoint on the RNAV panel and select a desired track to fly inbound to the waypoint.*~~								
~~***062 05 02 01***~~		~~***Flight-deck equipment***~~								
~~LO~~		~~The control unit allows the flight crew to:~~ ~~— tune the VOR/DME station used to define the phantom waypoint;~~ ~~— define the phantom waypoint as a radial and distance (DME) from the selected VOR/DME station;~~ ~~— select the desired magnetic track to follow inbound to the phantom waypoint;~~ ~~— select between an en route mode, an approach mode of operation and the basic VOR/DME mode of operation.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO~~		~~Track guidance is shown on the HSI/CDI.~~	~~X~~		~~X~~			~~X~~	~~X~~	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~**062 05 02 02**~~		~~Navigation computer, VOR/DME navigation~~								
~~LO~~		~~The navigation computer of the simple 2D-RNAV system computes the navigational problems by simple sine and cosine mathematics, solving the triangular problems.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~**062 05 02 03**~~		~~Navigation computer input/output~~								
~~LO~~		~~State that the following input data to the navigation computer is:~~ ~~— the actual VOR radial and DME distance from the selected VOR station;~~ ~~— the radial and distance to phantom waypoint;~~ ~~— the desired magnetic track inbound to the phantom waypoint.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO~~		~~State the following output data from the navigation computer:~~ ~~— desired magnetic track to the phantom waypoint shown on the CDI at the course pointer;~~ ~~— distance from the present position to the phantom waypoint;~~ ~~— deviations from the desired track as follows:~~ ~~• in en route mode, full-scale deflection on the CDI is 5 NM;~~ ~~• in approach mode, full-scale deflection on the CDI is 1 ¼ NM;~~	~~X~~		~~X~~			~~X~~	~~X~~	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~• in VOR/DME mode, full-scale deflection on the CDI is 10°.~~								
~~LO~~		~~State that the system is limited to operate within the range of the selected VOR/DME station.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~**062 05 03 00**~~		~~**4D RNAV**~~ ~~*Info: The next generation of area navigation equipment allowed the flight crew to navigate on any desired track within the coverage of VOR/DME stations.*~~								
~~***062 05 03 01***~~		~~***Flight-deck equipment***~~								
~~LO~~		~~State that in order to give the flight crew control over the required lateral guidance functions, RNAV equipment should at least be able to perform the following functions:~~ ~~— display present position in latitude/ longitude or as distance/bearing to the selected waypoint;~~ ~~— select or enter the required flight plan through the Control and Display Unit (CDU);~~ ~~— review and modify navigation data for any part of a flight plan at any stage of flight and store sufficient data to carry out the active flight plan;~~ ~~— review, assemble, modify or verify a flight plan in flight, without affecting the guidance output;~~ ~~— execute a modified flight plan only after positive~~	~~X~~		~~X~~			~~X~~	~~X~~	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~action by the flight crew;~~ — ~~where provided, assemble and verify an alternative flight plan without affecting the active flight plan;~~ — ~~assemble a flight plan, either by identifier or by selection of individual waypoints from the database, or by creation of waypoints from the database, or by creation of waypoints defined by latitude/longitude, bearing/distance parameters or other parameters;~~ — ~~assemble flight plans by joining routes or route segments;~~ — ~~allow verification or adjustment of displayed position;~~ — ~~provide automatic sequencing through waypoints with turn anticipation; manual sequencing should also be provided to allow flight over, and return to, waypoints;~~ — ~~display cross-track error on the CDU;~~ — ~~provide time to waypoints on the CDU;~~ — ~~execute a direct clearance to any waypoint;~~ — ~~fly parallel tracks at the selected offset distance; offset mode should be clearly indicated;~~ — ~~purge previous radio updates;~~ — ~~carry out RNAV holding procedures (when~~								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~defined);~~ ~~— make available to the flight crew estimates of positional uncertainty, either as a quality factor or by reference to sensor differences from the computed position;~~ ~~— conform to WGS-84 geodetic reference system;~~ ~~— indicate navigation-equipment failure.~~								
~~***062 05 03 02***~~		~~***Navigation computer, VOR/DME navigation***~~								
~~LO~~		~~State that the navigation computer uses signals from the VOR/DME stations to determine position.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~Explain that the system automatically tunes the VOR/DME stations by selecting stations which provide the best angular fix determination.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~Explain that the computer uses DME/DME to determine position if possible, and only if two DMEs are not available the system will use VOR/DME to determine the position of the aircraft.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~Explain that the computer is navigating on the great circle between waypoints inserted into the system.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~State that the system has a navigational database which may contain the following elements:~~ ~~— reference data for airports (4-letter ICAO identifier);~~	~~X~~		~~X~~			~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~— VOR/DME station data (3-letter ICAO identifier);~~ ~~— waypoint data (5-letter ICAO identifier);~~ ~~— STAR data;~~ ~~— SID data;~~ ~~— airport runway data including thresholds and outer makers;~~ ~~— NDB stations (alphabetic ICAO identifier);~~ ~~— company flight-plan routes.~~								
~~LO~~		~~State that the navigational database is valid for a limited time, usually 28 days.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~State that the navigational database is read only, but additional space exists so that crew-created navigational data may be saved in the computer memory. Such additional data will also be deleted at the 28-day navigational update of the database.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~State that the computer receives a TAS input from the air-data computer and a heading input in order to calculate actual wind velocity.~~	~~X~~		~~X~~			~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~LO~~		~~State that the computer calculates track error in relation to desired track. This data can easily be interfaced with the automatic flight control, and when done so, it enables the aircraft to automatically follow the flight plan loaded into the RNAV computer.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~State that the computer is able to perform great-circle navigation when receiving VOR/DME stations. If out of range, the system reverts to DR (Dead Reckoning) mode, where it updates the position by means of last computed wind and TAS and heading information. Operation in DR mode is time-limited.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~State that the system has 'direct to' capability to any waypoint.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~State that the system is capable of parallel offset tracking.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~State that any waypoint can be inserted into the computer in one of the following ways:~~ ~~— alphanumeric ICAO identifier;~~ ~~— latitude and longitude;~~ ~~— radial and distance from a VOR station.~~	~~X~~		~~X~~			~~X~~		
~~062 05 03 03~~		***~~Navigation computer input/output~~***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
~~LO~~		~~State that the following are input data into a 4D-RNAV system:~~ ~~— DME distances from DME stations;~~ ~~— radial from a VOR station;~~ ~~— TAS and altitude from the air-data computer;~~ ~~heading from the aircraft's heading system.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~State that the following are output data from a 4D-RNAV system:~~ ~~— distance to any waypoint;~~ ~~— estimated time overhead;~~ ~~— ground speed and TAS;~~ ~~— true wind;~~ ~~track error.~~	~~X~~		~~X~~			~~X~~		
~~062 05 04 00~~		**~~Flight Management System (FMS) and general terms~~**								
~~062 05 04 01~~		***~~Navigation and flight management~~***								
~~LO~~		~~Explain that the development of computers which combine reliable liquid crystal displays offer the means of accessing more data and displaying them to the flight crew.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~Explain that a flight management system has the ability to monitor and direct both navigation and performance of the flight.~~	~~X~~		~~X~~			~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~LO~~		~~Explain the two functions common to all FMS systems:~~ ~~— automatic navigation Lateral Navigation (LNAV);~~ ~~— flight path management Vertical Navigation (VNAV).~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~Name the main components of the FMS system as being:~~ ~~— Flight Management Computer (FMC);~~ ~~— Control and Display Unit (CDU);~~ ~~— Symbol generator~~ ~~— Electronic Flight Instrument System (EFIS) consisting of the NAV display, including mode selector and attitude display;~~ ~~— Auto-throttle (A/T) and Flight Control Computer (FCC).~~	~~X~~		~~X~~			~~X~~		
~~***062 05 04 02***~~		~~***Flight management computer***~~								
~~LO~~		~~State that the centre of the flight management system is the FMC with its stored navigation and performance data.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~***062 05 04 03***~~		~~***Navigation database***~~								
~~LO~~		~~State that the navigation database of the FMC may contain the following data:~~ ~~— reference data for airports (4-letter ICAO identifier);~~ ~~— VOR/DME station data (3-letter ICAO identifier);~~	~~X~~		~~X~~			~~X~~	~~X~~	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~— waypoint data (5-letter ICAO identifier);~~ ~~— STAR data;~~ ~~— SID data;~~ ~~— holding patterns;~~ ~~— airport runway data;~~ ~~— NDB stations (alphabetic ICAO identifier);~~ ~~— company flight-plan routes.~~								
~~LO~~		~~State that the navigation database is updated every 28 days.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO~~		~~State that the navigational database is write-protected, but additional space exists so that crew-created navigational data may be saved in the computer's memory. Such additional data will also be deleted at the 28-day navigational update of the database.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~***062 05 04 04***~~		~~***Performance database***~~								
~~LO~~		~~State that the performance database stores all the data relating to the specific aircraft/engine configuration, and is updated by ground staff when necessary.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~State that the performance database of the FMC contain the following data:~~ ~~— V1, VR and V2 speeds;~~ ~~— aircraft drag;~~	~~X~~		~~X~~			~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~— engine-thrust characteristics;~~ ~~— maximum and optimum operating altitudes;~~ ~~— speeds for maximum and optimum climb;~~ ~~— speeds for long-range cruise, maximum endurance and holding;~~ ~~— maximum Zero-Fuel Mass (ZFM), maximum Take-Off Mass (TOM) and maximum Landing Mass (LM);~~ ~~— fuel-flow parameters;~~ ~~— aircraft flight envelope.~~								
~~***062 05 04 05***~~		~~***Typical input/output data from the FMC***~~								
~~LO~~		~~State the following are typical input data to the FMC:~~ ~~— time;~~ ~~— fuel flow;~~ ~~— total fuel;~~ ~~— TAS, altitude, vertical speed, Mach number and outside-air temperature from the Air-Data Computer (ADC);~~ ~~— DME and radial information from the VHF/NAV receivers;~~ ~~— air/ground position;~~ ~~— flap/slat position;~~ ~~— IRS and GPS positions;~~	~~X~~		~~X~~			~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~Control and Display Unit (CDU) entries.~~								
~~LO~~		~~State that the following are typical output data from the FMC:~~ ~~— command signals to the flight directors and autopilot;~~ ~~— command signals to the auto-throttle;~~ ~~— information to the EFIS displays through the symbol generator;~~ ~~— data to the CDU and various annunciators.~~	~~X~~		~~X~~			~~X~~		
~~062 05 04 06~~		***~~Determination of the FMS position of the aircraft~~***								
~~LO~~		~~State that modern FMS may use a range of sensors for calculating the position of the aircraft including VOR, DME, GPS, IRS and ILS.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO~~		~~State that the information from the sensors used may be blended into a single position by using a mathematic algorithm.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~State that the Kalman filter is an algorithm for filtering incomplete and noisy measurements of dynamical processes so that errors of measurements from different sensors are minimised, thus leading to the calculated position being more accurate than that produced by any single sensor.~~	~~X~~		~~X~~			~~X~~		
~~062 05 05 00~~		**~~Typical flight-deck equipment fitted on FMS aircraft~~**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~***062 05 05 01***~~		~~***Control and Display Unit (CDU)***~~								
~~LO~~		~~State that the communication link between the flight crew and the FMC is the CDU.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~Explain the main components of the CDU as follows:~~ ~~— CDU display including the following terms:~~ ~~• page title,~~ ~~• data field,~~ ~~• scratch pad;~~ ~~— line-select keys;~~ ~~— numeric keys;~~ ~~— alpha keys;~~ ~~— function and mode keys used to select specific data pages on the CDU display, to execute orders or to navigate to pages through the data presented;~~ ~~warning lights, message light and offset light.~~	~~X~~		~~X~~			~~X~~		
~~***062 05 05 02***~~		~~***EFIS instruments (attitude display, navigation display)***~~								
~~LO~~		~~State that FMS-equipped aircraft typically has two displays on the instrument panel in front of each pilot.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~State that the following data are typically displayed on the attitude display:~~ ~~— attitude information;~~ ~~— flight director command bars;~~	~~X~~		~~X~~			~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~— radio height and barometric altitude;~~ ~~— course deviation indication;~~ ~~— glide-path information (when an ILS is tuned);speed information.~~								
~~***062 05 05 03***~~		~~***Typical modes of the navigation display***~~								
~~LO~~		~~State the following typical modes of the navigation display:~~ ~~— full VOR/ILS mode showing the whole compass rose;~~ ~~— expanded (arc) VOR/ILS mode showing the forward 90° sector;~~ ~~— map mode;~~ ~~— plan mode.~~	~~X~~		~~X~~			~~X~~		
~~***062 05 05 04***~~		~~***Typical information on the navigation display***~~								
~~LO~~		~~List and interpret the following information typically shown on a navigation display in 'Full VOR/ILS' mode:~~ ~~— the map display will be in full VOR mode when a VOR frequency is selected, and full ILS mode when an ILS frequency is selected on the VHF NAV frequency selector;~~ ~~— DME distance to selected DME station;~~ ~~— a full 360° compass rose.~~	~~X~~		~~X~~			~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~At the top of the compass rose, present heading is indicated and shown as digital numbers in a heading box. Next to the heading box it is indicated whether the heading is true or magnetic. True heading is available on aircraft with IRS.~~ ~~A triangle (different symbols are used on different aircraft) on the compass rose indicates present track. Track indication is only available when the FMC navigation computer is able to compute the aircraft's position. A square symbol on the outside of the compass rose indicates the selected heading for the autopilot, and if 'heading select' mode is activated on the autopilot, this is the heading the aircraft will turn to.~~ ~~Within the compass rose, a CDI is shown. On the CDI, the course pointer points to the selected VOR/ILS course SET on the OBS. On the CDI, the course deviation bar will indicate angular deflection from the selected VOR/ILS track. Full-scale deflection side to side in VOR mode is 20°, and 5° in ILS mode. In VOR mode, a TO/FROM indication is shown on the display.~~ ~~The selected ILS/VOR frequency is shown.~~ ~~ILS or VOR mode is shown according to the selected frequency.~~ ~~If an ILS frequency is selected, a glide-path deviation scale is shown.~~								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~A wind arrow indicating wind direction according to the compass rose, and velocity in numbers next to the arrow.~~								
~~LO~~		~~A wind arrow indicate wind direction according to the compass rose, and velocity in numbers next to the arrow.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~Given an EFIS navigation display in full VOR/ILS mode, read off the following information:~~ ~~— heading (magnetic/true);~~ ~~— track (magnetic/true);~~ ~~— drift;~~ ~~— wind correction angle;~~ ~~— selected course;~~ ~~— actual radial;~~ ~~— left or right of selected track;~~ ~~— above or below the glide path;~~ ~~— distance to the DME station;~~ ~~— selected heading for the autopilot heading select bug;~~ ~~— determine whether the display is in VOR or ILS rose mode.~~	~~X~~		~~X~~			~~X~~		
~~LO~~		~~Given an EFIS navigation display in expanded VOR/ILS mode, read off the following information:~~ ~~— heading (magnetic/true);~~	~~X~~		~~X~~			~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		— ~~track (magnetic/true);~~ — ~~drift;~~ — ~~wind correction angle;~~ — ~~tailwind/headwind;~~ — ~~wind velocity;~~ — ~~selected course;~~ — ~~actual radial;~~ — ~~left or right of selected track;~~ — ~~above or below the glide path;~~ — ~~distance to the DME station;~~ — ~~selected heading for the autopilot heading select bug;~~ — ~~state whether the display is in VOR or ILS rose mode.~~								
~~LO~~		~~Given an EFIS navigation display in map mode, read off the following information:~~ — ~~heading (magnetic/true);~~ — ~~track (magnetic/true);~~ — ~~drift;~~ — ~~wind correction angle;~~ — ~~tailwind/headwind;~~ — ~~wind velocity;~~	~~X~~		~~X~~			~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~— left or right of the FMS track;~~ ~~— distance to active waypoint;~~ ~~— ETO next waypoint;~~ ~~— selected heading for the autopilot heading select bug;~~ ~~— determine whether a depicted symbol is a VOR/DME station or an airport;~~ ~~— determine whether a specific waypoint is part of the FMS route.~~								
~~LO~~		~~Given an EFIS navigation display in plan mode, read off the following information:~~ ~~— heading (magnetic/true)~~ ~~— track (magnetic/true)~~ ~~— drift;~~ ~~— wind correction angle;~~ ~~— distance to active waypoint;~~ ~~— ETO active waypoint;~~ ~~— state the selected heading for the autopilot heading select bug;~~ ~~— measure and state true track of specific FMS route track.~~	~~X~~		~~X~~			~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
062 06 00 00		**GLOBAL NAVIGATION SATELLITE SYSTEMS (GNSSs)**								
062 06 01 00		**~~GPS, GLONASS, GALILEO~~ Global navigation satellite systems (GNSSs)**								
062 06 01 01		***~~Principles~~ General***								
(01)		State that there are ~~two~~ four main ~~Global Navigation Satellite Systems (~~GNSS~~s)~~. ~~currently in existence with a third one which is planned to be fully operational by 2011.~~ These are: — USA NAVigation System with Timing And Ranging Global Positioning System (NAVSTAR GPS); — Russian GLObal NAvigation Satellite System (GLONASS); — European ~~GALILEO~~ Galileo (under construction);~~.~~ — Chinese BeiDou (under construction).	X	X	X	X	X	X	X	
(02)	X	State that all ~~three~~ four systems (will) consist of a constellation of satellites which can be used by a suitably equipped receiver to determine position.	X	X	X	X	X	X	X	
062 06 01 02		***Operation***								
		~~NAVSTAR GPS~~ Global navigation satellite system (GNSS)								
(01)		State that there are currently two modes of operation: ~~S~~standard ~~P~~positioning ~~S~~service (SPS) for civilian users, and ~~P~~precise ~~P~~positioning ~~S~~service (PPS) for authorised	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		users.								
LO (02)		SPS was originally designed to provide civilian users with a less accurate positioning capability than PPS.	X	X	X	X	X	X	X	
(03)	X	Name the three segments as follows: — space segment; — control segment; — user segment.	X	X	X	X	X	X	X	
		Space segment (example: NAVSTAR GPS)								
~~(04)~~	~~X~~	~~State that the space segment consists of a notional constellation of 24 operational satellites.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~LO (05)~~	~~X~~	~~State that the space segment consists of a notional constellation of 24 operational satellites.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (06)~~	~~X~~	~~State that the satellites are orbiting the Earth in orbits inclined 55° to the plane of the equator.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (07)~~	~~X~~	~~State that the satellites are in a nearly circular orbit of the Earth at an altitude of 20 200 km (10 900 NM).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (08)~~	~~X~~	~~State that the satellites are distributed in 6 orbital planes with at least 4 satellites in each.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (09)~~		~~State that a satellite completes an orbit in approximately 12 hours.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(10)		State that each satellite broadcasts ranging signals on	X	X	X	X	X	X		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		two UHF frequencies: L1 ~~1 575.42 MHz~~ and L2 ~~1 227.6 MHz~~.								
(11)		State that SPS is a positioning and timing service provided on frequency L1.	X	X	X	X	X	X		
(12)		State that PPS uses both frequencies L1 and L2.	X	X	X	X	X	X		
~~LO (13)~~		~~In 2005, the first replacement satellite was launched with a new military M code on the L1 frequency, and a second signal for civilian use L2C on the L2 frequency.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(14)	X	~~State that the ranging signal contains a cCoarse aAcquisition (C/A) code and a navigational data message.~~ State that the satellites transmit a coded signal used for ranging, identification (satellite individual PRN code), timing and navigation	X	X	X	X	X	X		
(15)	X	State that the navigation message contains: ~~— almanac data;~~ ~~— ephemeris;~~ — satellite clock correction parameters; — Universal Time Coordinated (UTC) parameters; — an ionospheric model; — satellite health data.	X	X	X	X	X	X		
~~LO (16)~~		~~State that it takes 12.5 minutes for a GPS receiver to receive all the data frames in the navigation message.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~(17)~~		~~State that the almanac contains the orbital data about all the satellites in the GPS constellation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~LO (18)~~		~~State that the ephemeris contains data used to correct the orbital data of the satellites due to small disturbances.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~LO (19)~~		~~State that the clock correction parameters are data for the correction of the satellite time.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~LO (20)~~		~~State that UTC parameters are factors determining the difference between GPS time and UTC.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(21)	X	State that an ionospheric model is ~~currently~~ used to calculate the time delay of the signal travelling through the ionosphere.	X	X	X	X	X	X	X	
~~LO (22)~~		~~State that the GPS health message is used to exclude unhealthy satellites from the position solution. Satellite health is determined by the validity of the navigation data.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
~~(23)~~	~~X~~	~~State that GPS uses the WGS-84 model.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(24)	X	State that two codes are transmitted on the L1 frequency, namely a coarse acquisition (C/A) code and a p~~P~~recision (P) code. The P code is not used for standard positioning service (SPS).	X	X	X	X	X	X		
~~LO (25)~~		~~State that the C/A code is a Pseudo Random Noise (PRN) code sequence, repeating every millisecond.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~Each C/A code is unique and provides the mechanism to identify each satellite.~~								
~~LO (26)~~		~~State that satellites broadcast the PRN codes with reference to the satellite vehicle time which are subsequently changed by the receiver to UTC.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(27)	X	State that satellites are equipped with atomic clocks, which allow the system to keep very accurate time reference.	X	X	X	X	X	X	X	
		Control segment								
(28)	X	State that the control segment comprises: — a master control station; — a ground antenna; — monitoring stations. —	X	X	X	X	X	X	X	
(28 a)	X	State that the control segment provides: — monitoring of the constellation status; — correction of orbital parameters; — navigation data uploading.	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	X	
(29)		~~State that the master control station is responsible for all aspects of the constellation command and control.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
(30)		~~State that the main tasks of the control segment are:~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~— managing SPS performance;~~ ~~— navigation data upload;~~ ~~monitoring satellites.~~								
		User segment								
(31)	X	State that ~~GPS~~ GNSS supplies three-dimensional position fixes and speed data, plus a precise time reference.	X	X	X	X	X	X	X	
~~LO (32)~~		~~State that the GPS receiver used in aviation is a multichannel type.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(33)	X	State that a ~~GPS~~ GNSS receiver is able to determine the distance to a satellite by determining the difference between the time of transmission by the satellite and the time of reception.	X	X	X	X	X	X	X	
(34)	X	State that the initial distance calculated to the satellites is called pseudo-range because the difference between the ~~GPS~~ GNSS receiver and the satellite time references initially creates an erroneous range.	X	X	X	X	X	X		
(35)	X	State that each range defines a sphere with its centre at the satellite.	X	X	X	X	X	X	X	
~~LO (36)~~		~~State that three satellites are needed to determine a two-dimensional position.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(37)	X	State that ~~four spheres are needed to calculate a three-dimensional position, hence four satellites~~	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~are required.~~ there are four unknown parameters, x, y, z and Δt (receiver clock error), which require the measurement of ranges to four different satellites in order to get the position.								
(38)	X	State that the ~~GPS~~ GNSS receiver is able to synchronise to the correct time ~~base~~ reference when receiving four satellites.	X	X	X	X	X	X	X	
(39)	X	State that the receiver is able to calculate aircraft ground speed using the space vehicle (SV) Doppler frequency shift ~~and/~~or the change in receiver position over time.	X	X	X	X	X	X		
		NAVigation System with Timing And Ranging Global Positioning System (NAVSTAR GPS) integrity								
(40)		Define 'r~~R~~eceiver a~~A~~utonomous i~~I~~ntegrity m~~M~~onitoring (RAIM)'~~:~~ as a technique that ensures the integrity of the provided data by redundant measurements. ~~whereby a receiver processor determines the integrity of the navigation signals.~~	X	X	X	X	X	X	X	
(41)		State that RAIM is achieved by consistency checks among ~~pseudo-~~range measurements.	X	X	X	X	X	X	X	
(42)		State that basic RAIM requires five satellites. A sixth one is for isolating a faulty satellite from the navigation solution.	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~LO (43)~~		~~State that when a GPS receiver uses barometric altitude as an augmentation to RAIM, the number of satellites needed for the receiver to perform the RAIM function may be reduced by one.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
		~~GLONASS~~								
~~LO (44)~~		~~List the three components of GLONASS:~~ ~~— space segment, which contains the constellation of satellites;~~ ~~— control segment, which contains the ground-based facilities;~~ ~~user segment, which contains the user equipment.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (45)~~		~~State the composition of the constellation in the 'space segment':~~ ~~— 24 satellites in 3 orbital planes with 8 equally displaced by 45° of latitude;~~ ~~— a near-circular orbit at 19 100 km at an inclination of 64.8° to the equator;~~ ~~each orbit is completed in 11 hours and 15 minutes.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~(46)~~		~~State that the control segment provides:~~ ~~— monitoring of the constellation status;~~ ~~— correction to orbital parameters;~~ ~~— navigation data uploading.~~	X	X	X	X	X	X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
~~LO (47)~~		~~State that the user equipment consists of receivers and processors for the navigation signals for the calculation of the coordinates, velocity and time.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (48)~~		~~State that the time reference is UTC.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (49)~~		~~State that the datum used is PZ-90 Earth-centred Earth-fixed.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (50)~~		~~State that each satellite transmits navigation signals on two frequencies of L-band, L1 1.6 GHz and L2 1.2 GHz. .~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (51)~~		~~State that L1 is a standard-accuracy signal designed for civilian users worldwide and L2 is a high-accuracy signal modulated by a special code for authorised users only. .~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (52)~~		~~State that the navigation message has a duration of 2 seconds and contains 'immediate' data which relates to the actual satellite transmitting the given navigation signal and 'non-immediate' data which rel. ates to all other satellites within the constellation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (53)~~		~~State that 'immediate data' consists of:~~ ~~— enumeration of the satellite time marks;~~ ~~— difference between onboard time scale of the satellite and GLONASS time;~~ ~~— relative differences between carrier frequency of~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~the satellite and its nominal value;~~ ~~— ephemeris parameters.~~								
~~LO (54)~~		~~State that 'non-immediate' data consists of:~~ ~~— data on the status of all satellites within the space segment;~~ ~~— coarse corrections to onboard time scales of each satellite relative to GLONASS time;~~ ~~— orbital parameters of all satellites within the space segment;~~ ~~— correction to GLONASS time relative to UTC (must remain within 1 microsecond).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (55)~~		~~State that integrity monitoring includes checking the quality of the characteristics of the navigation signal and the data within the navigation message.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (56)~~		~~State that integrity monitoring is implemented in two ways:~~ ~~— Continuous automatic operability monitoring of principal systems in each satellite. If a malfunction occurs, an 'unhealthy' flag appears within the 'immediate data' of the navigation message.~~ ~~— Special tracking stations within the ground-based control segment are used to monitor the space-segment performance. If a malfunction occurs, an 'unhealthy' flag appears within the~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~'immediate data' of the navigation message.~~								
(57)		State that agreements have been concluded between the appropriate agencies for the compatibility and interoperability by any approved user of NAVSTAR and GLONASS systems.	X	X	X	X	X	X		
(58)	X	State that the different GNSSs use different data with respect to reference systems, orbital data, and navigation services.	X	X	X	X	X	X		
		~~**GALILEO**~~								
~~LO (59)~~		~~State that the core of the Galileo constellation will consist of 30 satellites with 9 plus a spare replacement in each of the 3 planes in near-circular orbit at an altitude of 23 222 km inclined at 56° to the plane of the equator.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (60)~~		~~State that the signals will be transmitted in 3 frequency bands: 1 164–1 215 MHz, 1 260–1 300 MHz and 1 559–1 591 MHz (1 559–1 591 MHz will be shared with GPS on a non-interference basis).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (61)~~		~~State that each orbit will take 14 hours.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (62)~~		~~State that each satellite has three sections: timing, signal generation and transmit.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (63)~~		~~State that in the 'timing section' two clocks have been developed, a Rubidium Frequency Standard clock and~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~a more precise Passive Hydrogen Maser clock.~~								
~~LO (64)~~		~~State that the signal generation contains the navigation signals.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (65)~~		~~State that the navigation signals consist of a ranging-code identifier and the navigation message.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (66)~~		~~State that the navigation message basically contains information concerning the satellite orbit (ephemeris) and the clock references.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (67)~~		~~State that the navigation message is 'up-converted' on four navigation signal carriers and the outputs are combined in a multiplexer before transmission in the transmit section.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (68)~~		~~State that the navigation antenna has been designed to minimise interference between satellites by having equal power level propagation paths independent of elevation angle.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (69)~~		~~State that the system is monitored in a similar way for both GPS NAVSTAR and GLONASS, but also by a new method based on spread-spectrum signals.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (70)~~		~~State that tracking, telemetry and command operations are controlled by sophisticated data encryption and authentication procedures.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~LO (71)~~		~~GPS, EGNOS and GALILEO are compatible, will not~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~interfere with each other, and the performance of the receiver will be enhanced by the interoperability of the systems.~~								
		~~*GALILEO future developments*~~ ~~*Info: Further Learning Objectives will be written as details are released.*~~								
062 06 01 03		***Errors and factors affecting accuracy***								
(01)		List the most significant factors that affecti~~ng~~ accuracy: — ionospheric propagation delay; — dilution of position; — satellite clock error; — satellite orbital variations; — multipath.	X	X	X	X	X	X	X	
(01a)		State that a user equivalent range error (UERE) can be computed from all these factors	X	X	X	X	X	X		
(02)	X	State that the error from the i~~I~~onospheric p~~P~~ropagation d~~D~~elay (IPD) can be reduced by modelling, using a model of the ionosphere, or can almost be eliminated by using two frequencies.	X	X	X	X	X	X		
~~LO (03)~~		~~State that in SPS receivers, IPD is currently corrected by using the ionospheric model from the navigation message, but the error is only reduced by 50 %.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(04)	X	State that ionospheric delay is the most significant error.	X	X	X	X	X	X		
(05)		State that dilution of position arises from the geometry and number of satellites in view. It is called geometric ~~pPosition~~ d~~D~~ilution of p~~P~~recision (~~P~~GDOP).	X	X	X	X	X	X		
(05a)		State that the user UERE in combination with the geometric dilution of precision (GDOP) allows for an estimation of position accuracy.	X	X	X	X	X	X		
(06)	X	State that errors in the satellite orbits are due to: — solar winds; — gravitation of the Sun and the Moon ~~Sun, Moon and planets~~.	X	X	X	X	X	X		
~~(07)~~		~~State that multipath is when the signal arrives at the receiver via more than one path (the signal being reflected from surfaces near the receiver).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
062 06 02 00		**Ground-, satellite- and airborne-based augmentation systems**								
062 06 02 01		***Ground-b~~B~~ased a~~A~~ugmentation s~~S~~ystems (GBASs)***								
(01)		Explain the principle of a GBAS: to measure on the ground the ~~signal~~ errors in the signals transmitted by GNSS satellites and relay the measured errors to the user for correction.	X	X	X	X	X	X	X	
(02)	X	State that the ICAO GBAS standard is based on this	X	X	X	X	X	X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		technique through the use of a data link in the VHF band of ILS–VOR systems (108–118 MHz).								
(03)		State that for a GBAS station the coverage is about 20 NM ~~30 km~~.	X	X	X	X	X	X	X	
~~(04)~~	~~X~~	~~Explain that ICAO Standards provide the possibility to interconnect GBAS stations to form a network broadcasting large-scale differential corrections. Such a system is identified as Ground Regional Augmentation System (GRAS).~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(05)		~~Explain~~ State that GBAS ~~ground~~ information for guidance in the terminal area, and for three-dimensional guidance in the final approach segment (FAS) by transmitting the FAS data block. ~~subsystems provide two services: precision approach service and GBAS positioning service.~~ ~~The precision approach service provides deviation guidance for final-approach Segments, while the GBAS positioning service provides horizontal position information to support RNAV operations in terminal areas.~~	X	X	X	X	X	X	X	
(06)		~~Explain~~ State that one ground station can support all the aircraft subsystems within its coverage providing the aircraft with approach data, corrections and integrity information for GNSS satellites in view via a VHF ~~D~~data ~~B~~broadcast (VDB).	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(07)	X	~~State that the minimum GBAS plan coverage is 15 NM from the landing threshold point within 35° apart the final approach path and 10° apart between 15 and 20 NM.~~ State that the minimum software designed coverage area is 10° on either side of the final approach path to a distance between 15 and 20 NM, and 35° on either side of the final approach path up to a distance of 15 NM.	X	X	X	X	X	X		
(07)		State that outside this area the FAS data of GBAS are not used.	X	X	X	X	X	X		
(08)	X	State that GBAS based on GPS is sometimes called l~~L~~ocal a~~A~~rea a~~A~~ugmentation s~~S~~ystem (LAAS).	X	X	X	X	X	X		
(09)		~~Describe the characteristics of a Local Area Augmentation System (LAAS) with respect to:~~ ~~— differential corrections applied to a satellite signal by a ground-based reference station;~~ ~~— regional service providers to compute the integrity of the satellite signals over their region;~~ ~~— extra accuracy for extended coverage around airports, railways, seaports and urban areas as required by the user.~~ State that a GBAS based approach is called GLS	X	X	X	X	X	X		

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		approach (GLS -GNSS landing system).								
062 06 02 02		***Satellite-~~b~~Based ~~a~~Augmentation ~~s~~Systems (SBASs)***								
(01)	X	Explain the principle of an SBAS: to measure on the ground the ~~signal~~ errors in the signals received from the ~~transmitted by GNSS~~ satellites and transmit differential corrections and integrity messages for navigation satellites.	X	X	X	X	X	X	X	
(02)	X	State that the frequency band of the data link is identical to that of the GPS signals.	X	X	X	X	X	X	X	
(03)	X	Explain that the use of geostationary satellites enables messages to be broadcast over very wide areas.	X	X	X	X	X	X	X	
(04)	X	~~Explain~~ Statethat pseudo-range measurements to these geostationary satellites can also be made, as if they were GPS satellites.	X	X	X	X	X	X	X	
(05)	X	State that SBAS consists of ~~three~~ two elements: — ~~the~~ ground infrastructure (monitoring and processing stations); — ~~the SBAS~~ communication satellites~~;~~. ~~— the SBAS airborne receivers.~~	X	X	X	X	X	X	X	
~~(06)~~	~~X~~	~~Explain that the SBAS station network measures the pseudo-range between the ranging source and an SBAS receiver at the known locations and provides separate corrections for ranging source ephemeris errors, clock~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/ IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~errors and ionospheric errors. The user applies corrections for tropospheric delay.~~								
(07)		~~ain~~ State that SBAS allows the implementation of ~~3D~~ three-dimensional Type A and Type B approaches. ~~can provide approach and landing operations with vertical guidance (APV) and precision approach service~~.	X	X	X	X	X	X	X	
~~LO (08)~~		~~Explain the difference between 'coverage area' and 'service area'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(09)	X	State the following examples of ~~that Satellite-Based Augmentation Systems~~SBASs ~~include~~: — European geostationary navigation overlay service (EGNOS) in western Europe and the Mediterranean; — wide area augmentation system (WAAS) in the USA; — multi-functional transport satellite (MTSAT) based augmentation system (MSAS) in Japan; — GPS and geostationary earth orbit augmented navigation (GAGAN) in India.	X	X	X	X	X	X	X	
~~(10)~~		~~Explain that SBASs systems regionally augment GPS and GLONASS by making them suitable for safety-critical applicationsoperations such as landing aircraft.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		
~~062 06 02 03~~		***~~European gGeostationary nNavigation oOverlay sService (EGNOS)~~***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
~~(01)~~	~~X~~	~~State that EGNOS consists of three geostationary Inmarsat satellites which broadcast GPS lookalike signals.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(02)	X	State that ~~EGNOS~~ SBAS is designed to significantly improve accuracy ~~to 1–2 m horizontally and 3–5 m vertically~~ and integrity.	X	X	X	X	X	X	X	
(03)		Explain that integrity and safety are improved by alerting SBAS users within 6 seconds if a GPS malfunction occurs ~~(up to 3 hours GPS alone).~~	X	X	X	X	X	X	X	
062 06 02 04		***Airborne-b~~B~~ased a~~A~~ugmentation s~~S~~ystems (ABASs)***								
(01)		Explain the principle of ABAS: to use redundant elements within the GPS constellation (e.g. multiplicity of distance measurements to various satellites) or the combination of GNSS measurements with those of other navigation sensors (such as inertial systems) in order to develop integrity control.	X	X	X	X	X	X	X	
(02)		State that the type of ABAS using only GNSS information is named r~~R~~eceiver a~~A~~utonomous i~~I~~ntegrity m~~M~~onitoring (RAIM).	X	X	X	X	X	X	X	
(03)		State that a system using information from additional on-board sensors is named a~~A~~ircraft a~~A~~utonomous i~~I~~ntegrity m~~M~~onitoring (AAIM).	X	X	X	X	X	X	X	
(04)		Explain that the typical sensors used are barometric altimeter and inertial reference system (IRS).~~inertial~~	X	X	X	X	X	X	X	

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~navigation system.~~								
~~LO (05)~~		~~Explain that unlike GBAS and SBAS, ABAS does not improve positioning accuracy.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	
(05)		Define 'receiver autonomous integrity monitoring (RAIM)' as a technique that ensures the integrity of the provided data by redundant measurements.	X	X	X	X	X	X	X	
(06)		State that RAIM is achieved by consistency checks among range measurements.	X	X	X	X	X	X	X	
(07)		State that basic RAIM requires five satellites. A sixth one is for isolating a faulty satellite from the navigation solution.	X	X	X	X	X	X	X	
062 07 00 00		**PERFORMANCE-BASED NAVIGATION (PBN)**								
062 07 01 00		**Performance-based navigation (PBN) concept (as described in ICAO D~~d~~oc 9613)**								
062 07 01 01		***PBN principles***								
(01)		List the factors used to define area navigation (RNAV) or required navigation performance (RNP) system performance requirements (accuracy, integrity~~,~~ and continuity ~~and functionality~~).	X		X		X	X	X	
(02)	X	State that these RNAV and RNP systems are necessary to optimise the utilisation of available airspace.	X		X			X		
(03)		State that it is necessary for flight crew and air traffic	X		X			X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		controllers to be aware of the on-board RNAV or RNP system capabilities in order to determine whether the performance of the RNAV or RNP system is appropriate for the specific airspace requirements.								
(04)		Define accuracy as the conformance of the true position and the required position.	X		X			X		
(05)		~~Explain the concept of continuity.~~ Define continuity as the capability of the system to perform its function without unscheduled interruptions during the intended operation.	X		X			X	X	
(06)		~~Explain the concept of integrity.~~ Define integrity as a measure of the trust that can be placed in the correctness of the information supplied by the total system. Integrity includes the ability of a system to provide timely and valid alerts to the user.	X		X			X	X	
(07)		State that, unlike conventional navigation, ~~performance-based navigation~~ PBN is not sensor-specific.	X		X			X	X	
(08)		Explain the difference between raw data and computed data.	X		X			X	X	
(09)		Define availability as the percentage of time (annually) during which the system is available for use.	X		X			X	X	
062 07 01 02		***PBN components***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)		List the components of PBN as navigational aid (NAVAID) infrastructure, navigation specification and navigation application.	X		X			X		
~~LO (02)~~		~~Identify the components from an example.~~	~~X~~		~~X~~			~~X~~		
062 07 01 03		***PBN scope***								
(01)		State that in oceanic/remote, en-route and terminal phases of flight, PBN is limited to operations with linear lateral performance requirements and time constraints.	X		X			X		
(02)		State that in the approach phases of flight, PBN accommodates both linear and angular laterally guided operations, and explain the difference between the two.	X		X			X		
062 07 02 00		**Navigation s~~S~~pecifications**								
062 07 02 01		***Area navigation (RNAV) and required navigation performance (RNP)***								
(01)		State the difference between RNAV and RNP in terms of the requirement for on-board performance monitoring and alerting.	X		X			X	X	
062 07 02 02		***Navigation functional requirements***								
(01)	X	List the basic functional requirements of the RNAV and RNP specifications (continuous indication of lateral deviation, distance/bearing to active waypoint, ~~g/s~~ GS or time to active waypoint, navigation data storage and	X		X			X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		failure indication).								
062 07 02 03		***Designation of RNP and RNAV specifications***								
(01)		Interpret X in RNAV X or RNP X as the lateral navigation (LNAV) accuracy (total system error) in nautical miles, which is expected to be achieved at least 95% ~~per cent~~ of the flight time by the population of aircraft operating within the given airspace, route or procedure.	X		X			X		
(02)		State that aircraft approved to the more stringent accuracy requirements may not necessarily meet some of the functional requirements of the navigation specification that hav~~eing~~ a less stringent accuracy requirement.	X		X			X	X	
(03)		State that RNAV 10 and RNP 4 are used in the oceanic/remote phase of flight.	X		X			X		
(04)		State that RNAV 5 is used in the en-route and arrival phases of flight.	X		X			X	X	
(05)		State that RNAV 2 and RNP 2 are also used as navigation specifications.	X		X			X		
(06)		State that RNP 2 is used in the en-route~~,~~ and oceanic/remote phases of flight.	X		X			X		
(06)		State that RNAV 2 might be used in the en-route continental, arrival and departure phases of flight.	X		X			X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(07)		State that RNAV 1 and RNP 1 are used in the arrival and departure phases of flight.	X		X			X	X	
(08)		State that required navigation performance approach (RNP APCH) is used in the approach phase of flight.	X		X			X	X	
(09)		State that required navigation performance authorisation required approach (RNP AR APCH) is used in the approach phase of flight.	X		X			X	X	
(10)		State that RNP 0.3 navigation specification is used in all phases of flight except for oceanic/remote and final approach, primarily for helicopters.	X		~~X~~			~~X~~		
(11)		State that RNAV 1, RNP 1 and RNP 0.3 may also be used in en-route phases of low-level instrument flight rules (IFR) helicopter flights.	X		~~X~~			~~X~~		
062 07 03 00		**Use of performance-based navigation (PBN)**								
062 07 03 01		***Airspace ~~p~~Planning***								
~~LO (01)~~		~~State that navigation performance is one factor used to determine minimum route spacing.~~	~~X~~		~~X~~			~~X~~	~~X~~	
062 07 03 02		***~~Approval~~ Intentionally left blank***								
~~LO (01)~~		~~State that the airworthiness approval process assures that each item of the area navigation equipment installed is of a type and design appropriate to its intended function and that the installation functions properly~~	~~X~~		~~X~~			~~X~~		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		~~under foreseeable operating conditions.~~								
~~LO (02)~~		~~State that some PBN specifications require operational approval.~~	~~X~~		~~X~~			~~X~~	~~X~~	
062 07 03 03		***Specific RNAV and RNP system functions***								
(01)		Recognise the definition of ~~an~~ radius to fix (RF) leg.	X		X			X	X	
(02)		Recognise the definition of a fixed radius transition (FRT).	X		X			X	X	
(03)		State the importance of respecting the flight director guidance and the speed constraints associated with an RF procedure.	X		X			X	X	
(04)		~~Recognise the definition of~~ Explain the difference between a fly-by-turn and a fly-over.	X		X			X	X	
~~LO (05)~~		~~Recognise the definition of a holding pattern.~~	~~X~~		~~X~~			~~X~~	~~X~~	
(06)		~~Recognise the definition of an 'ARINC 424 path terminator'.~~ State that the Aeronautical Radio, Incorporated (ARINC) 424 path terminators set the standards for coding the SIDs, STARs and instrument approach procedures (IAPs) from the official published government source documentation into the ARINC navigation database format.	X		X			X		
(07)		~~Recognise the definition of the following path terminators: IF, TF, CF, DF, FA, CA.~~	X		X			X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		State that the path terminators define a specific type of termination of the previous flight path.								
(08)		~~Recognise the definition of an~~ Define the term offset flight path.	X		X			X	X	
062 07 03 04		***~~Data processes~~ Intentionally left blank***								
~~LO (01)~~		~~State that the safety of the application is contingent upon the accuracy, resolution and integrity of the data.~~	~~X~~		~~X~~			~~X~~	~~X~~	
~~LO (02)~~		~~State that the accuracy of the data depends upon the processes applied during the data origination.~~	~~X~~		~~X~~			~~X~~		
062 07 04 00		**Performance-based navigation (PBN) operations**								
062 07 04 01		***Performance-based navigation (PBN) principles***								
(01)		~~Recognise the definition of path definition error.~~ Define ‘path definition error’ (PDE).	X		X			X	X	
(02)		~~Recognise the definition of flight technical error.~~ Define ‘navigation system error’ (NSE) and state that the accuracy of a navigation system may be referred to as NSE.	X		X			X	X	
(03)		~~Recognise the definition of navigation system error.~~ Define the navigation system error (NSE) and state that the accuracy of a navigation system may be referred to as NSE.	X		X			X	X	

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(04)		~~Recognise the definition of total system error.~~ Define ‘total system error’ (TSE) and state that the geometric sum of the PDE, FTE and NSE equals the TSE.	X		X			X	X	
(05)		State that navigation accuracy depends on the TSE.	X		X			X		
062 07 04 02		***On-board performance monitoring and alerting***								
(01)		State that on-board performance monitoring and alerting of flight technical errors is managed by on-board systems or flight crew procedures.	X		X			X	X	
(02)		State that on-board performance monitoring and alerting of navigation system errors is a requirement of on-board equipment for RNP.	X		X			X	X	
(03)		State that, dependent on the navigation sensor, the estimated position error (EPE) is compared with the required navigation specification.	X		X			X		
(04)		Explain how a navigation system assesses the EPE.	X		X			X		
(05)		Give an example of how the loss of the ability to operate in RNP airspace may be indicated by the navigation system.	X		X			X		
(06)		State that on-board performance monitoring and alerting of path definition error ~~are~~ is managed by gross reasonableness checks of navigation data.	X		X			X	X	
062 07 04 03		***Abnormal situations***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(01)		State that abnormal and contingency procedures are to be used in case of ~~the~~ loss of the PBN capability.	X		X			X	X	
062 07 04 04		***Database management***								
(01)		State that, unless otherwise specified in the operations documentation or acceptable means of compliance (AMCs), the navigational database must be valid for the current aeronautical information regulation and control (AIRAC) cycle.	X		X			X	X	
062 07 05 00		**Requirements of specific RNAV and RNP specifications**								
062 07 05 01		***RNAV 10***								
(01)		State that RNAV 10 requires that aircraft operating in oceanic and remote areas be equipped with at least two independent and serviceable long-range navigation systems (LRNSs) comprising an INS, an inertial reference system (IRS)/flight management system ~~IRS~~ (FMS) or a GNSS.	X		X			X		
~~(02)~~		~~State that aircraft incorporating dual inertial navigation systems (INSs) or inertial reference units (IRUs) have a standard time limitation.~~	~~X~~		~~X~~			~~X~~		
(03)		State that operators may extend their RNAV 10 navigation capability time by updating.	X		X			X		
062 07 05 02		***RNAV 5***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(01)		State that manual data entry is acceptable for RNAV 5.	X		X			X	X	
062 07 05 03		***~~RNAV/RNP1/2~~ RNAV 1/RNAV 2/RNP 1/RNP 2***								
(01)		State that pilots must not fly an ~~RNAV/RNP1/2~~ RNAV 1, RNAV 2, RNP 1 or RNP 2 standard instrument departure (SID) or standard instrument arrival (STAR) unless it is retrievable by route name from the on-board navigation database and conforms to the charted route.	X		X			X	X	
(02)		State that the route may subsequently be modified through the insertion (from the database) or deletion of specific waypoints in response to ATC clearances.	X		X			X	X	
(03)		State that the manual entry, or creation of new waypoints by manual entry~~,~~ of either latitude and longitude or place/bearing/distance values is not permitted.	X		X			X	X	
~~062 07 05 04~~		***~~RNP 4~~ Intentionally left blank***								
~~(01)~~		~~State that at least two LRNSs, capable of navigating to RNP 4, and listed in the flight manual, must be operational at the entry point of the RNP airspace.~~	~~X~~		~~X~~			~~X~~		
062 07 05 05		***Required navigation performance approach (RNP APCH)***								
(01)		State that pilots must not fly an RNP APCH unless it is retrievable by procedure name from the on-board navigation database and conforms to the charted procedure.	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(02)		State that an RNP APCH to LNAV minima is a non-precision ~~instrument approach procedure~~IAP designed for ~~2D~~two-dimensional approach operations.	X		X			X	X	
(03)		State that an RNP APCH to lateral navigation (LNAV)/vertical navigation (VNAV) minima has lateral guidance based on GNSS and vertical guidance based on either SBAS or barometric vertical navigation (BaroVNAV).	X		X			X	X	
(04)		State that an RNP APCH to LNAV/VNAV minima may only be conducted with vertical guidance certified for the purpose.	X		X			X	X	
(05)		Explain why an RNP APCH to LNAV/VNAV minima based on BaroVNAV may only be conducted when the aerodrome temperature is within a promulgated range if the barometric input is not automatically temperature-compensated.	X		X			X	X	
(06)		State that the correct altimeter setting is critical for the safe conduct of an RNP APCH using BaroVNAV.	X		X			X	X	
(07)		State that an RNP APCH to LNAV/VNAV minima is a ~~3D~~three-dimensional operation.	X		X			X	X	
(08)		State that an RNP APCH to localiser performance with vertical guidance (LPV) minima is a ~~3D~~three-dimensional operation.	X		X			X	X	

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
(09)		State that RNP APCH to LPV minima requires a final approach segment (FAS) data block.	X		X			X	X	
(10)		State that RNP approaches to LPV minima require SBAS.	X		X			X	X	
(11)		State that the FAS data block is a standard data format to describe the final approach path.	X		X			X	X	
062 07 05 06		***Required navigation performance authorisation required approach (RNP AR APCH)***								
(01)		State that RNP AR APCH requires authorisation.	X		X			X	X	
062 07 05 07		***Advanced required navigation performance (A-RNP)***								
(01)		State that ~~Advanced~~ A-RNP incorporates the navigation specifications RNAV 5, RNAV 2, RNAV 1, RNP 2, RNP 1 and RNP APCH.	X		X			X		
~~LO (02)~~		~~State that Advanced RNP may be associated with other functional elements.~~	~~X~~		~~X~~			~~X~~		
062 07 05 08		***PBN p~~P~~oint-in-s~~S~~pace (PinS) d~~D~~eparture***								
(01)		State that a PinS departure is a departure procedure designed for helicopters only.			X			X		
(02)		State that a PinS departure procedure includes either a ‘proceed VFR’ or a ‘proceed visually’ instruction from the landing location to the initial departure fix (IDF).			X			X		
(03)		Recognise the differences ~~between~~ in the instructions			X			X		

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/ IR	ATPL	CPL			
		‘proceed VFR’ and ‘proceed visually’ ~~instruction~~.								
062 07 05 09		***PBN p~~P~~oint-in-s~~S~~pace (PinS) a~~A~~pproach***								
(01)		State that a PinS approach procedure is an instrument RNP APCH procedure designed for helicopters only, and that it may be published with LNAV minima or LPV minima.			X			X		
(02)		State that a PinS approach procedure includes either a ‘proceed VFR’ or a ‘proceed visually’ instruction from the missed approach point (MAPt) to a landing location.			X			X		
(03)		Recognise the differences between ‘proceed VFR’ and ‘proceed visually’ ~~instruction~~.			X			X		

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Appendix to Annex I to ED Decision 2018/001/R

'Acceptable Means of Compliance (AMCs) and Guidance Material (GM) to Part-FCL Amendment 4'

Appendix
'SUBJECT 070 — OPERATIONAL PROCEDURES'
to
AMC1 FCL.310; FCL.515(b); FCL.615(b)
'Theoretical knowledge examinations'
of Annex I

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SUBJECT 070 — OPERATIONAL PROCEDURES

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
070 00 00 00		**OPERATIONAL PROCEDURES**								
071 01 00 00		**GENERAL REQUIREMENTS**								
071 01 01 00		**ICAO Annex 6**								
071 01 01 01		***Definitions***								
(01)		Define the following: a~~A~~lternate aerodrome: take-off alternate~~,~~; en-route alternate~~,~~; ETOPS en route alternate~~,~~; destination alternate ~~(~~ ***Source:*** **ICAO Annex 6, Part I, Chapter 1**~~).~~	X	X						
(02)		Define 'a~~A~~lternate heliport'; 'flight time (helicopters)'. ~~(~~ ***Source:*** **ICAO Annex 6, Part III, Section 1, Chapter 1**~~).~~			X	X	X			
~~(03)~~		~~Fligt time — aeroplanes (ICAO Annex 6, Part I, Chapter 1).~~	~~X~~	~~X~~						
~~(04)~~		~~Flight time — helicopters (ICAO Annex 6, Part III, Section 1, Chapter 1).~~			~~X~~	~~X~~	~~X~~			
071 01 01 02		***Applicability***								
(01)		State that Part I shall be applicable to the operation of aeroplanes by operators authorised to conduct international commercial air transport (CAT) operations. ~~(~~ ***Source:*** **ICAO Annex 6, Part I, Chapter 2**~~).~~	X	X						
(02)		State that Part III shall be applicable to all helicopters			X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		engaged in international ~~commercial air transport~~ CAT operations or in international general aviation operations, except~~ it is not applicable to~~ helicopters engaged in aerial work. ~~(~~ ***Source:*** **ICAO Annex 6, Part III, Section 1, Chapter 2**~~).~~								
071 01 01 03		***General***								
(01)		~~State~~ Explain the compliance with laws, regulations and procedures ~~(~~ ***Source*****: ICAO Annex 6, Part I, Chapter 3.1**~~/~~ **Part III, Section 2, Chapter 1.1**~~).~~	X	X	X	X	X			
(02)		~~State accident prevention and flight safety programme (ICAO Annex 6, Part I, Chapter 3.2.~~ State the condition(s) required for the establishment of a flight data analysis programme and state what this programme is part of. **Source: ICAO Annex 6, Part I, Chapter 3.3**	X	X	X	X	X			
(03)		~~State~~ Explain what is a flight safety documents system ~~(~~ ***Source*****: ICAO Annex 6, Part I, Chapter 3.3**~~).~~	X	X	X	X	X			
(04)		~~State~~ Explain what is maintenance release.~~ (~~ ***Source*****: ICAO Annex 6, Part I, Chapter 8.8**~~/~~ ***Source*****: Part III, Section 2, Chapter 6.7**~~).~~	X	X	X	X	X			
(05)		List and describe the lights to be displayed by aircraft.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~(~~ ***Source***: **ICAO Annex 6, Part I, Appendix** 1~~).~~ **2. Navigation lights to be displayed in the air**								
071 01 02 00		**Operational requirements**								
071 01 02 01		***Applicability***								
(01)	X	State the operational regulations applicable to ~~commercial air transportation~~ CAT and other activities (e.g. specialised operations (SPO)). ***Source***: **Regulation (EU) No 965/2012 on air operations Regulation (EU) No 1178/2011 on aircrew requirements.**	X	X	X	X	X			
(02)		State the n~~N~~ature of CAT operations and exceptions **Regulation (EU) No 965/2012: Articles 1 and 5, points ORO.GEN.005 ‘Scope’ and CAT.GEN.100 ‘Competent authority’;** **Regulation (EC) No 216/ 2008: Article 1**	X	X	X	X	X			
071 01 02 02		***General***								
(01)	X	~~State~~ Explain why ~~that~~ a ~~commercial air transportation~~ CAT flights must meet the applicable operational requirements. ***Source:*** **Point ORO.GEN.105 ‘Competent authority’ and related AMCs/GM;** **Point ORO.GEN.110 ‘Operator responsibilities’ and related AMCs/GM**	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		Define ‘f~~F~~light m~~M~~anual limitations — f~~F~~light through the h~~H~~eight v~~V~~elocity (HV) envelope’.			X	X	X			
(03)		Define ‘h~~H~~elicopter e~~E~~mergency m~~M~~edical s~~S~~ervice (HEMS)’.			X	X	X			
(04)		Define ~~O~~’operations over a hostile environment — a~~A~~pplicability’. Explain that there are certain areas which should not be overflown and state possible sources of that information (e.g. governmental warnings, operator risk assessment).			X	X	X			
(05)		Define ‘l~~L~~ocal area operations — a~~A~~pproval’.			X	X	X			
(06)		~~State~~ Explain the requirements about language used for crew communication and in the operations manual. ***Source***: Point **CAT.GEN.MPA.120 Common language**	X	X	X	X	X			
~~LO (07)~~		~~Explain the relation between MMEL and MEL.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(08)		~~State~~ Explain which are the operator~~’s~~ requirements regarding ~~a~~the management system. ***Source:*** **Point ORO.GEN.200 ‘Management system’;** **AMCs/GM to ORO.GEN.205 ‘Contracted activities’ and to ORO.GEN.220 ‘Record-keeping’**	X	X	X	X	X			
(09)		~~State~~ Explain which are the operator~~’s~~ requirements regarding accident prevention and the flight safety programme.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **Point ORO.GEN.200 'Management system'; AMCs/GM to ORO.GEN.205 'Contracted activities', to ORO.GEN.220 'Record-keeping', and to ORO.AOC.130 'Flight data monitoring — aeroplanes'**								
~~LO (10)~~		~~State the operator's responsibility regarding the distinction between cabin crew members and additional crew members.~~	~~X~~	~~X~~						
~~LO (11)~~		~~State the operations limitations regarding ditching requirements.~~	~~X~~	~~X~~						
(12)		~~State~~ Explain which are the regulations concerning the carriage of persons on an aircraft. ***Source:*** **Point CAT.GEN.MPA.165 'Method of carriage of persons'**	X	X	X	X	X			
~~LO (13)~~		~~State the crew members' responsibilities in the execution of their duties, and define the commander's authority.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (14)~~		~~State the operator's and commander's responsibilities regarding admission to the flight deck and carriage of unauthorised persons or cargo.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(15)		~~State~~ Explain the operator's and commander's responsibility concerning portable electronic devices(PEDs). ***Source:*** **Point CAT.GEN.MPA.140 'Portable electronic devices'**	X	X	X	X	X			
(16)		~~State~~Explain the operator's and commander's	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		responsibility~~ies~~ regarding admission in an aircraft of a person under the influence of drug or alcohol. *Source:* **Point CAT.GEN.MPA.170 'Alcohol and drugs'**								
(17)		~~State~~ Explain the regulations concerning the endangeri~~ng~~ment of safety. ***Source:*** **Point CAT.GEN.MPA.175 'Endangering safety'**	X	X	X	X	X			
(18)		List the documents to be carried on each flight. ***Source:*** **Point CAT.GEN.MPA.180 'Documents, manuals and information to be carried' and related AMCs/GM**	X	X	X	X	X			
(19)		~~State~~ Explain the operator's responsibility regarding manuals to be carried on board an aircraft. ***Source:*** **Point CAT.GEN.MPA.180 'Documents, manuals and information to be carried on board an aircraft' and related AMCs/GM**	X	X	X	X	X			
(20)		List the additional information and forms to be carried on board an aircraft. ***Source*:** **CAT.GEN.MPA.180 and related AMC/GM Documents, manuals and information to be carried**	X	X	X	X	X			
(21)		List the copies of items of information to be retained on the ground by the operator. ***Source:*** **Point CAT.GEN.MPA.185 'Information to be retained on the ground'**	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(22)		~~State the operator's responsibility regarding inspections.~~	X	X	X	X	X			
(23)		~~State the~~ Explain what responsibility~~y~~ies ~~of~~ the operator and ~~of~~ the commander have regarding the production of and access to records and documents. ***Source:* Point CAT.GEN.MPA.190 'Provision of documentation and records'**	X	X	X	X	X			
~~LO (24)~~		~~State the operator's responsibility regarding the preservation of documentation and recordings, including recorders recordings.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (25)~~		~~Define the terms used in leasing and state the responsibility and requirements of each party in various case.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
071 01 02 03		***Operator certification and supervision***								
(01)		~~State~~ Explain what ~~the~~ requirement has to be satisfied for the issue of an a~~A~~ir o~~O~~perator~~'s~~ c~~C~~ertificate (AOC). ***Source:*** **Point ARO.OPS.100 'Issue of the air operator certificate';** **Point ORO.GEN.210 'Personnel requirements';** **Point ORO.AOC.100 'Application for an air operator certificate'**	X	X	X	X	X			
(02)		~~State~~ Explain what the rules applicable to air operator certification are. ***Source:*** **Point ORO.AOC.100 'Application for an air operator**	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		certificate'; **Point ORO.AOC.105 'Operations specifications and privileges of an AOC holder'**								
(03)		~~State~~ Explain the conditions to be met for the issue or revalidation of an AOC. ***Source:*** **ARO.GEN.310 'Initial certification procedure — organisations'**	X	X	X	X	X			
(04)		~~State~~ Explain the contents and conditions of the AOC. ***Source:*** **Regulation (EU) No 956/2012, Appendix I 'AIR OPERATOR CERTIFICATE'**	X	X	X	X	X			
071 01 02 04		***Operational procedures (except preparation for long-range flight ~~preparation~~)***								
(01)		Define the terms used for operational procedures. ***Source:*** **Point CAT.OP.MPA.106 'Use of isolated aerodromes — aeroplanes';** **Point CAT.OP.MPA.107 'Adequate aerodrome'**	X	X						
~~(02)~~		~~State the operator's responsibilities regarding Operations Manual.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~State the operator's responsibilities regarding competence of operations personnel.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~(04)~~		~~State the operator's responsibilities regarding establishment of procedures.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(05)		State the operator~~'s~~ responsibilities regarding the use of air traffic services (ATS). ***Source:* Point CAT.OP.MPA.100 'Use of air traffic services'**	X	X	X	X	X			
(06)		State the operator~~'s~~ responsibilities regarding authorisation of aerodromes/heliports by the operator. ***Source:*** **Point CAT.OP.MPA.105 'Use of aerodromes and operating sites';** **Point CAT.OP.MPA.106 'Use of isolated aerodromes — aeroplanes';** **Point CAT.OP.MPA.107 'Adequate aerodrome'**	X	X	X	X	X			
(07)		Explain which elements must be considered by the operator when specifying aerodrome/heliport operating minima. ***Source:*** **Point CAT.OP.MPA.110(a)&(c) 'Aerodrome operating minima',** **Point CAT.OP.115 'Approach flight technique - aeroplanes',** **Point SPA.LVO.100 'Low visibility operations' and related AMCs/GM;** **Point SPA.LVO.110 'General operating requirements'**	X	X	X	X	X			
(08)		~~State~~ Explain what the operator~~'s~~ responsibilities are regarding departure and approach procedures. ***Source:* Point CAT.OP.MPA.125 'Instrument departure and**	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		approach procedures'								
(09)		~~State~~ Explain which ~~the~~ parameters ~~to~~ should be considered in noise-abatement procedures. ***Source:*** **Point CAT.OP.MPA.130 'Noise abatement procedures — aeroplanes';** **AMC1 CAT.OP.MPA.130;** **GM1 CAT.OP.MPA.130**	X	X						
(10)		~~State~~ Explain which ~~the~~ elements ~~to~~ should be considered regarding routes and areas of operation. ***Source:*** **Point CAT.OP.MPA.135 'Routes and areas of operation — general';** **Point CAT.OP.MPA.136 'Routes and areas of operation — single-engined aeroplanes'**	X	X	X	X	X			
(11)		~~State~~ Explain the ~~additional specific navigation performance~~ requirements for flights in reduced vertical separation minima (RVSM) airspace. ***Source:*** **Point SPA.RVSM.100 'RVSM operations';** **Point SPA.RVSM.105 'RVSM operational approval';** **Point SPA.RVSM.110 'RVSM equipment requirements' and AMC1 SPA.RVSM.110(a);** **Point SPA.RVSM.115 'RVSM height-keeping errors'**	X	X	~~X~~	~~X~~	~~X~~			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (12)~~		~~State the maximum distance from an adequate aerodrome for two-engine aeroplanes without an ETOPS approval.~~	~~X~~	~~X~~						
~~LO (13)~~		~~State the requirement for alternate-airport accessibility check for ETOPS operations.~~	~~X~~	~~X~~						
(14)		List the factors to be considered when establishing minimum flight altitude. ***Source:*** **Point CAT.OP.MPA.145 'Establishment of minimum flight altitudes' and related AMCs/GM; AMC1 CAT.OP.MPA.145(a); AMC1.1 CAT.OP.MPA.145(a)**	X	X	X	X	X			
~~LO (15)~~		~~Describe the components of the fuel policy.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(16)		~~State~~ Explain the requirements for carrying persons with reduced mobility. ***Source:*** **Point CAT.OP.MPA.155 'Carriage of special categories of passengers (SCPs)'**	X	X	X	X	X			
(17)		~~State~~ Explain the operator~~'s~~ responsibilities for the carriage of inadmissible passengers, deportees or persons in custody. ***Source:*** **Point CAT.OP.MPA.155 'Carriage of special categories of passengers (SCPs)'**	X	X	X	X	X			
~~LO (18)~~		~~State the requirements for the stowage of baggage and cargo in the passenger cabin.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(19)		~~State~~ Explain which are the requirements regarding	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		passenger seating and emergency evacuation. *Source:* **Point CAT.OP.MPA.165 'Passenger seating' and related AMCs/GM**								
(20)		Detail the procedures for ~~a~~ passenger briefing in respect of emergency equipment and exits. ***Source:*** **Point CAT.OP.MPA.170 'Passenger briefing';** **AMC1 CAT.OP.MPA.170;** **AMC2 CAT.OP.MPA.170**	X	X	X	X	X			
(21)		State the flight preparation forms to be completed before flight. ***Source:*** **Point CAT.OP.MPA.175 'Flight preparation' and related AMCs/GM;** **AMC1 CAT.OP.MPA.175(a)**	X	X	X	X	X			
(22)		State the commander's responsibilities during flight preparation. *Source:* **Point CAT.OP.MPA.175 'Flight preparation'**	X	X	X	X	X			
(23)		State the rules for aerodrome~~s~~/heliport~~s~~ selection ~~(including ETOPS configuration).~~ ***Source:*** **Point CAT.OP.MPA.180 'Selection of aerodromes — aeroplanes';**	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Point CAT.OP.MPA.181 'Selection of aerodromes and operating sites — helicopters'								
(24)		Explain the planning minima for instrument flight rule (IFR) flights. ***Source:* Point CAT.OP.MPA.185 'Planning minima for IFR flights — aeroplanes'**	X		X					
(25)		~~State~~ Explain the rules for refuelling/defueling with passengers on board. ***Source:*** **Point CAT.OP.MPA.195 'Refuelling/defuelling with passengers embarking, on board or disembarking' and related AMCs;** **AMC1 CAT.OP.MPA.195;** **Point CAT.OP.MPA.200 'Refuelling/ defuelling with wide-cut fuel' and related AMCs;** **GM1 CAT.OP.MPA.200**	X	X	X	X	X			
(26)		~~State~~ Explain the 'crew members at ~~duty~~ station' policy. ***Source:*** **CAT.OP.MPA.210 'Crew members at stations' and related AMCs**	X	X	X	X	X			
(27)		~~State~~ Explain the use of seats, safety belts and harnesses. ***Source:* Point CAT.OP.MPA.225 'Seats, safety belts and restraint systems'**	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(28)		~~State~~ Explain the requirements for securing ~~of~~ passenger cabin and galley. ~~Requirements~~ ***Source:* Point CAT.OP.MPA.230 'Securing of passenger compartment and galley(s)'**	X	X	X	X	X			
(29)		~~State~~ Explain the commander's responsibility regarding smoking on board. ***Source:* Point CAT.OP.MPA.240 'Smoking on board'**	X	X	X	X	X			
(30)		State under which conditions a commander can commence or continue a flight regarding meteorological conditions. **Point CAT.OP.MPA.245 'Meteorological conditions — all aircraft';** **Point CAT.OP.MPA.246 'Meteorological conditions — aeroplanes';** **Point CAT.OP.MPA.265 'Take-off conditions'**	X	X	X	X	X			
(31)		~~State~~ Explain the commander's responsibility regarding ice and other contaminants. ***Source:*** **Point CAT.OP.MPA.250 'Ice and other contaminants — ground procedures' and related AMCs/GM;** **Point CAT.OP.MPA.255 'Ice and other contaminants — flight procedures' and related AMCs/GM;** **GM1 CAT.OP.MPA.250 (a) to (l);** **GM2 CAT.OP.MPA.250 (a) to (f);** **GM3 CAT.OP.MPA.250 (a)(1) to (3);**	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		AMC1 CAT.OP.MPA.255 (a)								
(32)		~~State~~ Explain the commander~~'s~~ responsibility regarding fuel to be carried and in-flight fuel management. ***Source:*** **Point CAT.OP.MPA.260 'Fuel and oil supply';** **Point CAT.OP.MPA.280 'In-flight fuel management — aeroplanes';** **Point CAT.OP.MPA.281 'In-flight fuel management — helicopters' and AMC1 CAT.OP.MPA.281**	X	X	X	X	X			
(33)		~~State the requirements regarding the use of supplemental oxygen.~~ Detail the rules regarding carriage and use of supplemental oxygen for passengers and aircrew. ***Source:*** **Point CAT.OP.MPA.285 'Use of supplemental oxygen';** **Point CAT.IDE.A.235 'Supplemental oxygen — pressurised aeroplanes' and related AMCs/GM**	X	X	X	X	X			
		Flight preparation								
~~LO (34)~~		~~State the ground-proximity detection reactions. (CAT.OP.MPA.290)~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (35)~~		~~State the requirements for use of ACAS.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(36)		~~State~~ Explain the commander's responsibility regarding approach and landing. ***Source:***	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Point CAT.OP.MPA.300 'Approach and landing conditions' and AMC1 CAT.OP.MPA.300; **Point CAT.OP.MPA.305 'Commencement and continuation of approach' and related AMCs/GM**								
(37)		~~State~~ Explain the circumstances under which a report shall be submitted. ***Source:* Point ORO.GEN.160 'Occurrence reporting' and related AMCs/GM**	X	X	X	X	X			
071 01 02 05		***All-weather operations***								
(01)		~~State~~ Explain the operator's responsibility regarding aerodrome/heliport operating minima. ***Source:*** **Point CAT.OP.MPA.110 'Aerodrome operating minima' and related AMCs/GM;** **Point CAT.OP.MPA.115 'Approach flight technique — aeroplanes' and related AMCs/GM**	X		X					
~~LO (02)~~		~~List the parameters to be considered in establishing the aerodrome operating minima.~~	~~X~~		~~X~~					

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (03)~~		~~Define the criteria to be taken into consideration for the classification of aeroplanes.~~	~~X~~							
(04)		Define the following terms: 'circling', 'low-visibility procedures', 'low-visibility take-off', 'visual approach'. ***Source:* Regulation (EU) No 965/2012, Annex 1**	X		X					
(05)		Define the following terms: 'flight control system', 'fail-passive flight control system', 'fail-operational flight control system', 'fail-operational hybrid landing system'. ***Source:* Regulation (EU) No 965/2012, Annex 1**	X							
(06)		Define the following terms: 'final approach and take-off area'. ***Source:* Regulation (EU) No 965/2012, Annex 1**			X					
(07)		~~State~~ Explain the general operating rules for low-visibility operations. ***Source:*** **Point SPA.LVO.100 'Low visibility operations' and related AMCs;** **Point SPA.LVO.105 'LVO approval';** **Point SPA.LVO.110 'General operating requirements';** **Point SPA.LVO.115 'Aerodrome related requirements'**	X		X					
(08)		Define ~~Low visibility operations a~~Aerodrome/heliport considerations regarding low-visibility operations.	X		X					

Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
		Source: **SPA.LVO.115 'Aerodrome related requirements'**								
(09)		Explain ~~State~~ the training and qualification requirements for flight crew to conduct low-visibility operations. ***Source:*** **Point SPA.LVO.120 'Flight crew training and qualifications' and related AMCs**	X		X					
(10)		~~State~~Explain the operating procedures for low-visibility operations. ***Source:*** **Point SPA.LVO.125 'Operating procedures and AMC1 SPA.LVO.125**	X		X					
(11)		~~State~~Explain the operator's and commander's responsibilities regarding minimum equipment for low-visibility operations. ***Source:*** **Point SPA.LVO.130 'Minimum equipment'**	X		X					
(12)		Explain the VFR operating minima. ***Source:*** **AMC12 CAT.OP.MPA.110 'Aerodrome operating minima — VFR OPERATIONS WITH OTHER-THAN-COMPLEX MOTOR-POWERED AIRCRAFT'**	X		X					
(13)		Aerodrome operating minima: ~~State~~ explain under which conditions the commander can commence take-off. ***Source:*** **Point CAT.OP.MPA.110 'Aerodrome operating minima' and related AMCs/GM;** **Point SPA.LVO.110 'General operating requirements' and**	X		X					

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		related AMCs/GM								
(14)		Aerodrome operating minima: ~~State~~ explain that take-off minima are expressed as visibility or runway visual range (RVR). ***Source:*** **Point CAT.OP.MPA.110 'Aerodrome operating minima';** **AMC1 CAT.OP.MPA.110;** **AMC2 CAT.OP.MPA.110**	X		X					
(15)		Aerodrome operating minima: ~~State~~ explain the take-off RVR value depending on the aerodrome ~~facilities~~. ***Source:*** **AMC1 CAT.OP.MPA.110 'Aerodrome operating minima', Table 1.A;** **AMC2 CAT.OP.MPA.110 'Aerodrome operating minima', Table 1.H**	X		X					
(16)		Aerodrome operating minima: ~~State~~ explain the system minima for non-precision approach (NPA) (minimum descent altitude/height (MDA/H) and decision altitude/height (DA/H), not RVR). ***Source:*** **AMC3 CAT.OP.MPA.110 'Aerodrome operating minima' (Table 3: ILS/MLS/GLS; SRA 1NM; VOR; NDB);** **AMC6 CAT.OP.MPA.110 'Aerodrome operating minima'**	X		X					

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(17)		Aerodrome operating minima: ~~State~~ explain under which conditions a pilot can continue the approach below MDA/H or DA/H. ***Source:*** **Point CAT.OP.MPA.305 'Commencement and continuation of approach';** **AMC1 CAT.OP.MPA.305(e)**	X		X					
(18)		Aerodrome operating minima: ~~State~~ explain the lowest minima for precision approach category 1 (including single-pilot operations). ***Source:* AMC3 SPA.LVO.100 'Low visibility operations'**	X		X					
(19)		Aerodrome operating minima: ~~State~~ explain the lowest minima for precision approach category 2 operations. ***Source:* AMC4 SPA.LVO.100 'Low visibility operations'**	X		X					
(20)		Aerodrome operating minima: ~~State~~ explain the lowest minima for precision approach category 3 operations. ***Source:* AMC5 SPA.LVO.100 'Low visibility operations'**	X							
(21)		Aerodrome operating minima: ~~State~~ explain the lowest minima for circling and visual approach. ***Source:*** **AMC7 CAT.OP.MPA.110'Aerodrome operating minima';** **AMC9 CAT.OP.MPA.110;** **AMC8 CAT.OP.MPA.110**	X		X					

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(22)		Aerodrome operating minima: ~~State~~ explain the RVR value and cloud ceiling depending on the aerodrome facilities ~~(class 1, 2 and 3)~~. ***Source:*** **Point CAT.OP.MPA.110 'Aerodrome operating minima' and related AMCs/GM;** **Point SPA.LVO.110 'General operating requirements' and related AMCs**			X					
(23)		Aerodrome operating minima: ~~State~~ explain under which conditions an airborne radar approach can be performed and state the relevant minima. ***Source:*** **Point CAT.OP.MPA.120 'Airborne radar approaches (ARAs) for overwater operations — helicopters';** **AMC1 SPA.HOFO.120 'Selection of aerodromes and operating sites — COASTAL AERODROME';** **AMC2 SPA.HOFO.120 'Selection of aerodromes and operating sites — OFFSHORE DESTINATION ALTERNATE AERODROME';** **AMC1 SPA.HOFO.125 'Airborne radar approach (ARA) to offshore locations — GENERAL';** **GM1 SPA.HOFO.125 'Airborne radar approach (ARA) to offshore locations — GENERAL';** **GM2 SPA.HOFO.125 'Airborne radar approach (ARA) to offshore locations — GLOBAL NAVIGATION SATELLITE**			X					

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
		SYSTEM (GNSS)/AREA NAVIGATION SYSTEM'								
071 01 02 06		***Instruments and equipment***								
(01)		~~State~~ Explain which items do not require an equipment approval. ***Source:*** **Point CAT.IDE.A.100 'Instruments and equipment — general' and related GM, and** **point CAT.IDE.H.100 'Instruments and equipment — general';** **Points CAT.IDE.A.105/CAT.IDE.H.105 'Minimum equipment for flight'**	X	X	X	X	X			
(02)		~~State~~ Explain the requirements regarding availability of electrical spare fuses ~~availability~~. ***Source:* Point CAT.IDE.A.110 'Spare electrical fuses' and related GM**	X	X	X	X	X			
~~LO (03)~~		~~State the requirements regarding operating lights. (CAT.IDE.A/H.115)~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(04)		~~State~~ Explain the requirements regarding windshield wipers. ***Source:* Point CAT.IDE.A.120 'Equipment to clear windshield' and related AMCs**	X	X						
~~LO (05)~~		~~List the equipment for operations requiring a radio communication.~~			~~X~~	~~X~~	~~X~~			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (06)~~		~~List the equipment for operations requiring a radio-navigation system.~~			~~X~~	~~X~~	~~X~~			
(07)		List the minimum equipment required for day and night VFR flights. ***Source:* Point CAT.IDE.A.125 'Operations under VFR by day' and related AMCs/GM**	X	X	X	X	X			
(08)		List the minimum equipment required for IFR flights. ***Source:*** **Point CAT.IDE.A.130 'Operations under IFR or at night — flight and navigational instruments and associated equipment' and related AMCs/GM;** **Point CAT.IDE.H.130 'Operations under IFR or at night — flight and navigational instruments and associated equipment' and related AMCs/GM**	X		X					
(09)		~~State~~ Explain the required additional equipment for single-pilot operations under IFR. ***Source:* Points CAT.IDE.A.135/CAT.IDE.H.135 'Additional equipment for single-pilot operation under IFR'**	X		X					
(10)		State the requirements for an altitude alerting system. ***Source:* Point CAT.IDE.A.140 'Altitude alerting system'**	X	X						
(11)		State the requirements for radio altimeters. ***Source:* Point CAT.IDE.H.145 'Radio altimeters'**			X	X	X			
(12)		State the requirements for ground proximity warning system	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		(GPWS)/terrain awareness and warning system (TAWS). ***Source:*** **Point CAT.IDE.A.150 'Terrain awareness warning system (TAWS)'**								
(13)		State the requirements for airborne collision avoidance system (ACAS). ***Source:*** **Point CAT.IDE.A.155 'Airborne collision avoidance system (ACAS)'**	X	X						
(14)		State the conditions under which an aircraft must be fitted with a weather radar. ***Source:*** **Points CAT.IDE.A.160/CAT.IDE.H.160 'Airborne weather detecting equipment'**	X	X	X	X	X			
~~LO (15)~~		~~State the requirements for operations in icing conditions.~~	X	X	X	X	X			
~~LO (16)~~		~~State the conditions under which a crew member interphone system and public address system are mandatory.~~	X	X	X	X	X			
(17)		State the circumstances under which a cockpit voice recorder (VCR) is compulsory (after 1998). ***Source:*** **Points CAT.IDE.A.185/CAT.IDE.H.185 'Cockpit voice recorder'**	X	X	X	X	X			
(18)		State the rules regarding the location, construction, installation, and operation of cockpit voice recorders (CVRs) (after 1998). ***Source:*** **Points CAT.IDE.A.185/CAT.IDE.H.185 'Cockpit voice**	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		recorder'								
(19)		State the circumstances under which a flight data recorder (FDR) is compulsory (after 1998). ***Source:* Points CAT.IDE.A.190/CAT.IDE.H.190 'Flight data recorder'**	X	X	X	X	X			
(20)		State the rules regarding the location, construction, installation and operation of flight data recorders (FDRs). ***Source:* Points CAT.IDE.A.190/CAT.IDE.A.190 'Flight data recorder' and related AMCs/GM**	X	X	X	X	X			
(21)		~~State~~ Explain the requirements about seats, seat safety belts, harnesses, and child-restraint devices. ***Source:*** **Points CAT.IDE.A.205/CAT.IDE.H.205 'Seats, seat safety belts, restraint systems and child restraint devices' and related AMCs/GM**	X	X	X	X	X			
(22)		~~State~~ Explain the requirements about 'Fasten seat belt' and 'No smoking' signs. ***Source:* Points CAT.IDE.A.210/CAT.IDE.H.210 'Fasten seat belt and no smoking signs'**	X	X	X	X	X			
(23)		~~State~~ Explain the requirements regarding internal doors and curtains. ***Source:* Point CAT.IDE.A.215 'Internal doors and curtains'**	X	X						

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		First-aid and emergency equipment								
(24)		~~State~~ Explain the requirements regarding first-aid kits. ***Source:*** **Points CAT.IDE.A.220/CAT.IDE.H.220 'First-aid kit' and related AMCs/GM**	X	X	X	X	X			
(25)		~~State~~ Explain the requirements regarding emergency medical kits and first-aid oxygen. Explain the requirements regarding emergency medical kits and first-aid oxygen. ***Source:*** **Point CAT.IDE.A.225 'Emergency medical kit';** **AMC1 CAT.IDE.A.225;** **AMC2 CAT.IDE.A.225;** **AMC3 CAT.IDE.A.225;** **AMC4 CAT.IDE.A.225;** **GM1 CAT.IDE.A.225;** **Point CAT.IDE.A.230 'First-aid oxygen'**	X	X						
~~LO (26)~~		~~Detail the rules regarding the carriage and use of supplemental oxygen for passengers and crew. CAT.IDE.A.235 + AMC CAT.IDE.A.240 + AMC~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(27)		Detail the rules regarding crew protective breathing equipment. ***Source:*** **Point CAT.IDE.A.245 'Crew protective breathing equipment';**	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		AMC1 CAT.IDE.A.245								
(28)		Describe the ~~minimum number,~~ type and location of handheld fire extinguishers. ***Source:*** **Points CAT.IDE.A.250/CAT.IDE.H.250 'Hand fire extinguishers' and related AMCs/GM**	X	X	X	X	X			
(29)		Describe the ~~minimum number and~~ location of crash axes and crowbars. ***Source:*** **Point CAT.IDE.A.255 'Crash axe and crowbar';** **AMC1 CAT.IDE.A.255**	X	X						
(30)		Specify the colours and markings used to indicate break-in points. ***Source:*** **Points CAT.IDE.A.260/CAT.IDE.H.260 'Marking of break-in points' and related AMCs/GM**	X	X	X	X	X			
(31)		~~State~~ Explain the requirements for means of emergency evacuation. ***Source:*** **Point CAT.IDE.A.265 'Means for emergency evacuation'**	X	X						
(32)		~~State~~ Explain the requirements for megaphones. ***Source:***	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Points CAT.IDE.A.270/CAT.IDE.H.270 'Megaphones' and related AMCs/GM								
(33)		~~State~~ Explain the requirements for emergency lighting and marking. ***Source:* Points CAT.IDE.A.275/CAT.IDE.H.275 'Emergency lighting and marking**	X	X	X	X	X			
(34)		~~State~~ Explain the requirements for an emergency locator transmitter (ELT). **Source: CAT.IDE.A/H.280 Emergency locator transmitter (ELT); AMC2 CAT.IDE.A.280; GM1 CAT.IDE.A.280**	X	X	X	X	X			
(35)		~~State~~ Explain the requirements for life jackets, life rafts, survival kits, and ELTs. ***Source:*** **Point CAT.IDE.A.285 'Flight over water';** **Point CAT.IDE.A.305 'Survival equipment'** **Point CAT.IDE.H.280 'Emergency locator transmitter (ELT)';** **Point CAT.IDE.H.290 'Life-jackets';** **Point CAT.IDE.H.295 'Crew survival suits';** **Point CAT.IDE.H.300 'Life-rafts, survival ELTs and survival equipment on extended overwater flights'**	X	X	X	X	X			
(36)		~~State~~ Explain the requirements for crew survival suit. ***Source:*** **Point CAT.IDE.H.295 'Crew survival suits';**			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		GM1 CAT.IDE.H.295								
(37)		~~State~~ Explain the requirements for survival equipment. ***Source:* Points CAT.IDE.A.305/CAT.IDE.H.305 'Survival equipment'**	X	X	X	X	X			
(38)		~~State~~ Explain the additional requirements for helicopters operating to or from helidecks located in ~~a~~ hostile sea areas. ***Source:* Point CAT.IDE.H.310 'Additional requirements for helicopters conducting offshore operations in a hostile sea area'**			X	X	X			
(39)		~~State~~ Explain the requirements for ~~an~~ emergency flotation equipment. ***Source:*** **Point CAT.IDE.H.315 'Helicopters certified for operating on water — miscellaneous equipment';** **Point CAT.IDE.H.320 'All helicopters on flights over water — ditching'**			X	X	X			
071 01 02 07		***Communication and navigation equipment***								
(01)		Explain the general requirements for communication and navigation equipment. ***Source:* Point CAT.IDE.A.325 'Headset' and related AMCs/GM**	X	X	X	X	X			
(02)		~~State~~ Explain ~~that~~ why the radio-communication equipment must ~~provide communications~~ be able to send and receive	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		on 121.5 MHz. **_Source:_ Points CAT.IDE.A.330/CAT.IDE.H.330 'Radio communication equipment'**								
(03)		~~State~~ Explain the requirements regarding the provision of an audio selector panel. **_Source:_ Points CAT.IDE.A.335/CAT.IDE.H.335 'Audio selector panel'**	X	X	X	X	X			
(04)		List the requirements for radio equipment when flying under VFR by reference to visual landmarks. **_Source:_ Points CAT.IDE.A.340/CAT.IDE.H.340 'Radio equipment for operations under VFR over routes navigated by reference to visual landmarks'**	X	X	X	X	X			
(05)		List the requirements for communication~~s~~ and navigation equipment when operating under IFR or under VFR over routes not navigated by reference to visual landmarks. **_Source:_** **Points CAT.IDE.A.345/CAT.IDE.H.345 'Communication and navigation equipment for operations under IFR or under VFR over routes not navigated by reference to visual landmarks'**	X	X	X	X	X			
(06)		~~State~~ Explain what ~~the~~ equipment is required to operate ~~with~~in ~~RVSM~~ airspace with reduced vertical separation minima (RVSM).	X	X						

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **Point SPA.RVSM.110 'RVSM equipment requirements'**								
(07)		~~State~~ Explain the conditions under which a crew member interphone system and public address system are mandatory. ***Source:*** **Points CAT.IDE.A.170/CAT.IDE.H.170 'Flight crew interphone system';** **AMC1 CAT.IDE.A.170/CAT.IDE.H.170;** **Points CAT.IDE.A.175/CAT.IDE.H.175 'Crew member interphone system';** **AMC1 CAT.IDE.A.175/CAT.IDE.H.175;** **Points CAT.IDE.A.180/CAT.IDE.H.180 'Public address system';** **AMC1 CAT.IDE.A.180/CAT.IDE.H.180**	X	X	X	X	X			
(08)		List the equipment for operations requiring a radio communication. ***Source:*** **Point CAT.IDE.H.325 'Headset';** **Point CAT.IDE.H.330 'Radio communication equipment';** **Point CAT.IDE.H.335 'Audio selector panel';** **Point CAT.IDE.H.340 'Radio equipment for operations under VFR over routes navigated by reference to visual landmarks'**			X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(09)		List the equipment for operations that require~~ing~~ a radio navigation system. ***Source:*** **Point CAT.IDE.H.325 'Headset';** **AMC1 CAT.IDE.H.325;** **Point CAT.IDE.H.345 'Communication and navigation equipment for operations under IFR or under VFR over routes not navigated by reference to visual landmarks'**			X	X	X			
(10)		Explain the requirements regarding the provision of a transponder. ***Source:*** **Points CAT.IDE.A.350/CAT.IDE.H.350 'Transponder';** **AMC1 CAT.IDE.A.350/CAT.IDE.H.350**	X	X	X	X	X			
(11)		Explain the requirements regarding the provision of electronic data management products. ***Source:*** **Point CAT.IDE.A.355 'Electronic navigation data management';** **AMC1 CAT.IDE.A.355 'Electronic navigation data management — ELECTRONIC NAVIGATION DATA PRODUCTS'**	X	X						
071 01 02 08		***Intentionally left blank***								
071 01 02 09		***Flight crew***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		~~State~~ Explain the requirement regarding flight crew composition and in-flight relief. ***Source:*** **Point ORO.FC.100 'Composition of flight crew;** **AMC1 ORO.FC.100(c);** **Point ORO.FC.105 'Designation as pilot-in-command/commander';** **AMC1 ORO.FC.105(b)(2);(c);** **GM1 ORO.FC.105 (b)(2);** **AMC1 ORO.FC.105(c);** **Point ORO.FC.110 'Flight engineer';** **Point ORO.FC.115 'Crew resource management (CRM) training';** **Point ORO.FC.200 'Composition of flight crew';** **AMC1 ORO.FC.200(a);** **Point ORO.FC.A.201 'In-flight relief of flight crew members';** **Point ORO.FC.202 Single-pilot operations under IFR or at night**	X	X	X	X	X			
(02)		~~State~~ Explain the requirement for conversion training and checking. ***Source:*** **Point ORO.FC.120 'Operator conversion training';** **Point ORO.FC.145 'Provision of training';** **Point ORO.FC.220 'Operator conversion training and checking';**	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		and related AMCs/GM								
(03)		~~State~~ Explain the requirement for differences training and familiarisation training. ***Source:*** **Point ORO.FC.125 'Differences training and familiarisation training';** **AMC1 ORO.FC.125**	X	X	X	X	X			
(04)		~~State~~ Explain the conditions for upgrade from co-pilot to commander. ***Source:*** **Point ORO.FC.205 'Command course'**	X	X	X	X	X			
(05)		~~State~~ Explain the minimum qualification requirements to operate as a commander. ***Source:*** **Point ORO.FC.A.250 'Commanders holding a CPL(A)'**	X	X	X	X	X			
(06)		~~State~~ Explain the requirement for recurrent training and checking. ***Source:*** **Point ORO.FC.230 'Recurrent training and checking'**	X	X	X	X	X			
(07)		~~State~~ Explain the requirement for a pilot to operate on either pilot's seat. ***Source:*** **Point ORO.FC.235 'Pilot qualification to operate in either pilot's seat';** **AMC1 ORO.FC.235(d);**	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		GM1 ORO.FC.235(f);(g)								
(08)		~~State~~ Explain which is the minimum recent experience for the commander and the co-pilot. ***Source:*** **Point FCL.060 'Recent experience';** **AMC1 FCL.060(b)(1);** **GM1 FCL.060(b)(1)**	X	X	X	X	X			
(09)		Specify the route and aerodrome/heliport knowledge ~~qualification~~ required for a PIC/commander ~~or a pilot flying~~. ***Source:*** **Point ORO.FC.105 'Designation as pilot-in-command/ commander';** **AMC1 ORO.FC.105(b)(2);(c);** **GM1 ORO.FC.105(b)(2);** **AMC1 ORO.FC.105(c)**	X	X	X	X	X			
(10)		~~State~~ Explain the requirement to operate on more than one aircraft type or variant. **Source: ORO.FC.140 Operation on more than one type or variant; ORO.FC.240 Operation on more than one type or variant; AMC1 ORO.FC.240 ((a)(1))**	X	X	X	X	X			
(11)		~~State~~ Explain that when a flight crew member operates both helicopters and aeroplanes, the operations are limited to one ~~type~~ of each type.	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		***Source:* Point ORO.FC.240 'Operation on more than one type or variant'**								
(12)		~~State~~ Explain the requirement(s) for training records ~~requirement~~. ***Source:* Point ORO.MLR.115 'Record-keeping'**	X	X	X	X	X			
(13)		~~State~~ Explain the crew members' responsibilities in the execution of their duties, and define the commander's authority. ***Source:*** **Point CAT.GEN.MPA.100 'Crew responsibilities;** **Point CAT.GEN.MPA.105 'Responsibilities of the commander;** **Point CAT.GEN.MPA.110 'Authority of the commander'**	X	X	X	X	X			
(14)		~~State~~ Explain the operator~~'~~s and commander's responsibilities ~~are~~ regarding persons on-board admission to the flight crew compartment ~~deck~~ and carriage of unauthorised persons or cargo. ***Source:*** **Point CAT.GEN.MPA.135 'Admission to the flight crew compartment;** **Point CAT.GEN.MPA.165 'Method of carriage of persons;** **Point CAT.GEN.MPA.105 'Responsibilities of the commander'**	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(15)		Explain the requirements for the initial operator's crew resource management (CRM) training. ***Source:* Point ORO.FC.215 'Initial operator's crew resource management (CRM) training'**	X	X	X	X	X			
071 01 02 10		***Cabin crew/crew members other than flight crew***								
(01)		~~State~~ Explain who is regarded as ~~a~~ cabin crew member. ***Source:* Regulation (EU) No 965/2012, Annex 1 'Definitions'**	X	X	X	X	X			
(02)		~~Detail the requirements regarding the numbers required IAW Ops Regulations cabin crew members.~~ Detail the requirements regarding the number and composition of cabin crew. ***Source:*** **Point ORO.CC.100 'Number and composition of cabin crew;** **AMC1 ORO.CC.100;** **GM1 ORO.CC.100;** **Point ORO.CC.205 'Reduction of the number of cabin crew during ground operations and in unforeseen circumstances'**	X	X	X	X	X			
(03)		~~State the acceptability criteria. Minimum age for Cabin Crew State.~~ Explain the conditions and the additional conditions for assignment to duties. ***Source:*** **Point ORO.CC.110 'Conditions for assignment to duties;** **Point ORO.CC.210 'Additional conditions for assignment to**	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		duties; **GM1 ORO.CC.210(d)**								
(04)		~~State~~ Explain the requirements regarding senior cabin crew members. ***Source:*** **Point ORO.CC.200 'Senior cabin crew member;** **AMC1 ORO.CC.200(c);(d);(e)**	X	X	X	X	X			
(05)		~~State~~ Explain the conditions ~~to~~ for operat~~e~~ing on more than one aircraft type or variant. ***Source:*** **Point ORO.CC.250 'Operation on more than one aircraft type or variant;** **AMC1 ORO.CC.250(b);** **GM1 ORO.CC.250**	X	X	X	X	X			
(06)		~~State~~ Explain what is the operator~~'s~~ responsibility regarding the distinction between cabin crew members and additional crew members. ***Source:*** **Point CAT.GEN.MPA.115 'Personnel or crew members other than cabin crew in the passenger compartment'**	X	X	X	X	X			
071 01 02 11		***~~Manuals, logs and records~~ Intentionally left blank***								
~~LO (01)~~		~~State the general rules for the operations manual.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			

FOR INFORMATION ONLY

Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
~~LO (02)~~		~~State the structure and subject headings of the operations manual.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~State the requirements for a journey logbook.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (04)~~		~~Describe the requirements regarding the operational flight plan.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (05)~~		~~State the requirements for document-storage document storage periods.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
071 01 02 12		***Flight and duty time limitations and rest requirements***								
(01)		~~State~~ Explain the definitions used for the regulation of flight time limitations ~~regulation.~~ ***Source:*** **Point ORO.FTL.100 'Scope';** **Point ORO.FTL.105 'Definitions' (values of Table 1 excluded)**	X	X						
(02)		~~State~~ Explain the flight and duty time limitations. ***Source:*** **Point ORO.FTL.200 'Home base';** **Point ORO.FTL.210 'Flight times and duty periods'**	X	X						
(03)		~~State~~ Explain the requirements regarding the maximum daily flight duty period. ***Source:*** **Point ORO.FTL.205 'Flight duty period (FDP)';**	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Point ORO.FTL.205(b) 'Basic maximum daily FDP' (use of the tables but not memorisation)								
(04)		~~State~~ Explain the requirements regarding rest periods ***Source:*** **Point ORO.FTL.235 'Rest periods'**	X	X						
(05)		~~State~~ Explain the possible extension of flight duty period due to in-flight rest. ***Source:*** **Point ORO.FTL.205 'Flight duty period (FDP)';** **Point ORO.FTL.205(e) 'Maximum daily FDP with the use of extensions due to in-flight rest'**	X	X						
(06)		~~State~~ Explain that it is the captain's discretion to extend flight duty in case of unforeseen circumstances in actual flight operations. ***Source:*** **Point ORO.FTL.205 'Flight duty period (FDP)';** **Point ORO.FTL.205(f) 'Unforeseen circumstances in flight operations — commander's discretion'**	X	X						
(07)		~~State~~ Explain the ~~regulation~~ requirement regarding standby. ***Source:*** **Point ORO.FTL.225 'Standby and duties at the airport'**	X	X						
~~(08)~~		~~State the requirements regarding flight duty, duty and rest period records~~	X	X						

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~***Transport of dangerous goods by air***~~								
~~(01)~~		~~State the terminology relevant to dangerous goods.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~(02)~~		~~State the scope of the regulation.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~(03)~~		~~State the limitations on the transport of dangerous goods.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~(04)~~		~~State the requirements for the acceptance of dangerous goods.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~(05)~~		~~State the requirements regarding inspection for damage, leakage or contamination.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~(06)~~		~~State the loading restrictions.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~(07)~~		~~State the requirement for provision of information to the crew.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~(08)~~		~~State the requirements for dangerous goods incident and accident reports.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
071 01 03 00		**Long-range flights**								
071 01 03 01		***Flight management***								
~~LO (01)~~		~~Navigation planning procedures:~~ ~~– Describe the operator's responsibilities concerning ETOPS routes;~~ ~~– List the factors to be considered by the commander before commencing the flight.~~	~~X~~							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (02)~~		~~Selection of a route:~~ ~~— Describe the meaning of the term 'adequate aerodrome';~~ ~~— Describe the limitations on extended-range operations with two-engine aeroplanes with and without ETOPS approval.~~	~~X~~							
~~LO (03)~~		~~Selection of cruising altitude (MNPSA Manual Chapter 4):~~ ~~— Specify the appropriate cruising levels for normal long-range IFR flights and for those operating on the North Atlantic Operational Track Structure.~~	~~X~~							
~~LO (04)~~		~~Selection of alternate aerodrome:~~ ~~— State the circumstances in which a take-off alternate must be selected;~~ ~~— State the maximum flight distance of a take-off alternate for: two-engine aeroplane, ETOPS-approved aeroplane, three or four-engine aeroplane;~~ ~~— State the factors to be considered in the selection of a take-off alternate;~~ ~~— State when a destination alternate need not be selected;~~ ~~— State when two destination alternates must be selected;~~ ~~— State the factors to be considered in the selection of a~~	~~X~~							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~destination alternate aerodrome;~~ ~~— State the factors to be considered in the selection of an en route alternate aerodrome.~~								
(05)		Minimum time routes: ~~D~~define~~,~~ ~~construct~~ and interpret minimum time route (route that give~~ing~~ the shortest flight time from departure to destination adhering to all ATC and airspace restrictions). ***Source:* N/A**	X							
(06)		State the circumstances in which a take-off alternate must be selected. ***Source:*** **Point CAT.OP.MPA.180 'Selection of aerodromes — aeroplanes;** **Point CAT.OP.MPA.181 'Selection of aerodromes and operating sites — helicopters'**	X		X					
(07)		State the maximum flight distance of a take-off alternate for: — two-engined aeroplanes; — ETOPS-approved aeroplanes; — three- or four-engined aeroplanes. ***Source:*** **Point CAT.OP.MPA.180 'Selection of aerodromes — aeroplanes';** **Point CAT.OP.MPA.181 'Selection of aerodromes and operating sites — helicopters'**	X		X					

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(08)		State the factors to be considered in the selection of a take-off alternate. *Source:* **Point CAT.OP.MPA.185 'Planning minima for IFR flights — aeroplanes'; Point CAT.OP.MPA.186 'Planning minima for IFR flights — helicopters'**	X		X					
(09)		State when a destination alternate need not be selected. *Source:* **Point CAT.OP.MPA.180 'Selection of aerodromes — aeroplanes'; Point CAT.OP.MPA.181 'Selection of aerodromes and operating sites — helicopters'**	X		X					
(10)		State when two destination alternates must be selected. *Source:* **Point CAT.OP.MPA.180 'Selection of aerodromes — aeroplanes'; Point CAT.OP.MPA.181 'Selection of aerodromes and operating sites — helicopters'**	X		X					
(11)		State the factors to be considered in the selection of a destination alternate aerodrome. *Source:* **Point CAT.OP.MPA.185 'Planning minima for IFR flights — aeroplanes'; Point CAT.OP.MPA.186 'Planning minima for IFR flights — helicopters'**	X		X					

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(12)		State the factors to be considered in the selection of an en-route alternate aerodrome. ***Source:*** **Point CAT.OP.MPA.185 'Planning minima for IFR flights — aeroplanes'**	X		X					
071 01 03 02		***Transoceanic and polar flights*** ***(ICAO Doc 7030 Regional Supplementary Procedures / North Atlantic Operations and Airspace Manual)***								
(01)		~~(ICAO Doc 7030 procedures)~~ According to ICAO Doc 7030, explain that special rules apply to the North Atlantic (NAT) Region, and crews need to be specifically trained before flying in this area. ***Source:*** **NAT 007, 1.3.8 Crew Training** ~~— Describe the possible indications of navigation-system degradation.~~ ~~— Describe by what emergency means course and INS can be cross-checked in the case of: three navigation systems, two navigation systems.~~ ~~— Interpret VOR, NDB, VOR/DME information to calculate aircraft position and aircraft course.~~ ~~— Describe the general ICAO procedures applicable in North Atlantic airspace (NAT) if the aircraft is unable to continue the flight in accordance with its air traffic~~	X							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~control clearance.~~ ~~— Describe the ICAO procedures applicable in North Atlantic Airspace (NAT) in case of radio-communication failure.~~ ~~— Describe the recommended initial action if an aircraft is unable to obtain a revised air traffic control clearance.~~ ~~— Describe the subsequent action for: aircraft able to maintain assigned flight level, and aircraft unable to maintain assigned flight level.~~ ~~— Describe determination of tracks and courses for random routes in NAT.~~ ~~— Specify the method by which planned tracks are defined (by latitude and longitude) in the NAT region: when operating predominately in an east–west direction south of 70°N, when operating predominately in an east–west direction north of 70°N.~~ ~~— State the maximum flight time recommended between significant points.~~ ~~— Specify the method by which planned tracks are defined for flights operating predominantly in a north–south direction.~~ ~~— Describe how the desired route must be specified in~~								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~the air traffic control flight plan.~~								
(02)		Describe the possible indications of navigation system degradation, including any system-generated warning. **_Source:_ NAT 007, Chapter 12 Procedures in the event of navigation system degradation or failure**	X							
(02)		Describe by what emergency means course and inertial navigation system (INS) can be cross-checked in the case of three navigation systems and two navigation systems. **_Source:_ NAT 007, Chapter 12 Procedures in the event of navigation system degradation or failure**	X							
(03)		Describe the general ICAO procedures applicable in NAT airspace if the aircraft is unable to continue the flight in accordance with its air traffic control (ATC) clearance. **_Source:_ NAT 007, 13.2 General procedures**	X							
(04)		Describe the ICAO procedures applicable in NAT airspace in case of radio communication failure. **_Source:_ NAT 007, 6.6 HF Communications failure**	X							
(05)		Describe the recommended initial action if an aircraft is unable to obtain a revised ATC clearance. **_Source:_ NAT 007, Chapter 13 Special procedures for in-flight contingencies**	X							
(06)		Describe the subsequent action for aircraft able to maintain	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		assigned flight level and for aircraft unable to maintain assigned flight level. ***Source:* NAT 007, Chapter 13 Special procedures for in-flight contingencies**								
(07)		Describe determination of tracks and courses for random routes in NAT airspace. ***Source:* ICAO Doc 7030, NAT 2.1.9.1 General; NAT 007, 2.1.3; NAT 007, Chapter 4 Flight Planning**	X							
(08)		Specify the method by which planned tracks are defined (by latitude and longitude) in the NAT airspace: when operating predominately in an east–west direction south of 70°N, and when operating predominately in an east–west direction north of 70°N. ***Source:* ICAO Doc 7030, NAT 2.1.9 Route; NAT 007, Chapter 4 (Flights Planning on Random Route Segments in a Predominantly East - West Direction)**	X							
(09)		State the maximum flight time recommended between significant points on random routes. ***Source:* ICAO Doc 7030, NAT 2.1.9 Route; NAT 007, Chapter 4 (Flights Planning on Random Route Segments in a Predominantly East - West Direction & Predominantly North - South Direction)**	X							
(10)		Specify the method by which planned tracks for random	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		routes are defined for flights operating predominantly in a north–south direction. **_Source:_ ICAO Doc 7030, NAT 2.1.9 Route; NAT 007, Chapter 4 (Flights Planning on Random Routes in a Predominantly North - South Direction)**								
(11)		Describe how the desired random route must be specified in the ATC flight plan. **_Source:_ NAT 007, 4.2 Flight planning requirements on specific routes**	X							
(13)		~~**Polar navigation**~~ ~~*Terrestrial magnetism characteristics in polar zones*~~ — ~~State why magnetic compasses become unreliable or useless in polar zones.~~ — ~~State in which area VORs are referenced to the true north.~~ ~~*Specific problems of polar navigation*~~ — ~~Describe the general problems of polar navigation.~~ — ~~Describe what precautions can be taken when operating in the area of compass unreliability as a contingency against INS failure.~~ — ~~Describe how grid navigation can be used in conjunction with a Directional Gyro (DG) in polar~~	X							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~areas.~~ — ~~Use polar stereographic chart and grid coordinates to solve polar navigation problems.~~ — ~~Use polar stereographic chart and grid coordinates to calculate navigation data.~~ — ~~Use INS information to solve polar navigation problems.~~ — ~~Define, calculate: transport precession, Earth-rate (astronomic) precession, convergence factor.~~ — ~~Describe the effect of using a free gyro to follow a given course.~~ — ~~Describe the effect of using a gyro compass with hourly rate corrector unit to follow a given course.~~ — ~~Convert grid navigation data into true navigation data, into magnetic navigation data, and into compass navigation data.~~ — ~~Justify the selection of a different 'north' reference at a given position.~~ — ~~Calculate the effects of gyro drift due to the Earth's rotation (15 degrees / h × sin Lm).~~								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(14)		Describe what precautions can be taken when operating in the area of compass unreliability as a contingency against INS failure. ***Source:*** **NAT 007, Chapter 12 Procedures in the event of navigation system degradation or failure (not including detailed information on route structures and their coordinates);** **NAT 007, Chapter 8 (Master document — position plotting)**	X							
071 01 03 03		***~~MNPS airspace~~ North Atlantic High Level Airspace (NAT HLA)***								
		NAT Region North Atlantic Operations and Airspace Manual (NAT Doc 007 and NAT Doc 7030)								
(01)		~~Geographical limits:~~ ~~— state the lateral dimensions (in general terms) and vertical limits of MNPS airspace (ICAO Doc 7030 NAT/RAC-2 3.2.1);~~ ~~— state that operators must ensure that crew follow NAT MNPSA Operations Manual procedures (ICAO Doc 7030 NAT/RAC-2 3.2.3).~~ State the lateral dimensions (in general terms) and vertical limits of the NAT HLA. ***Source:*** **NAT 007, 17.1 GENERAL: 17.1.1 and 17.1.2**	X							

FOR INFORMATION ONLY

Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
(02)		Define the following acronyms: ~~MNPS~~ LRNS, MASPS, NAT HLA, ~~MNPSA,~~ OCA, OTS, PRM~~, PTS~~, RVSM, ~~LRNS, MASPS~~, SLOP, and WATRS (~~MNPSA Manual~~ ***Source***:~~-~~**NAT Doc 007, Glossary of T~~t~~erms**~~).~~	X							
(03)		~~Aircraft System Requirements (MNPSA Manual Chap 1):~~ ~~— navigation requirements for unrestricted MNPS airspace operations;~~ ~~— routes for use by aircraft not equipped with two LRNSs: routes for aircraft with only one LRNS, routes for aircraft with short-range navigation equipment only;~~ ~~— performance monitoring.~~ State the NAT HLA operations. ***Source***: **NAT 007, 1.1.2; 1.1.3; 1.1.5; 1.1.6; 1.1.7; 1.2.1; 1.2.2; 1.3.1; 1.3.2; 1.3.6; 1.3.7; 1.3.8; 1.3.9; 1.3.10; 1.3.11; 1.3.12**	X							
(04)		Describe the routes for aircraft with only one long-range navigation system (LRNS). ***Source:* NAT 007, 1.4.1**	X							
(05)		Describe the routes for aircraft with short-range navigation equipment only. ***Source:* NAT 007, 1.4.2; 1.4.3**	X							
(06)		Explain why the horizontal (i.e. latitudinal and longitudinal)	X							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		and vertical navigation performance of operators within NAT HLA is monitored on a continual basis. ***Source:*** **NAT 007, 1.9.1**								
(07)		~~Organised Track System (MNPSA Manual Chap 2):~~ ~~Construction of the organised track system (OTS);~~ ~~— NAT track message;~~ ~~— OTS changeover periods.~~ Describe the organised track system (OTS). ***Source:*** **NAT 007, 2.1 GENERAL; 2.2 Construction of the organised track system (OTS)**	X							
(08)		State the OTS changeover periods. ***Source:*** **NAT 007, 2.4 OTS Changeover periods**	X							
(09)		Describe the NAT track message. ***Source:*** **NAT 007, 2.3 The NAT track message**	X							
(10)		~~Other routes and route structures within or adjacent to NAT MNPS airspace (MNPSA Manual Chap 3):~~ ~~— other routes within NAT MNPS airspace;~~ ~~— route structures adjacent to NAT MNPS airspace: North American routes (NARs), Canadian domestic track systems, Routes between north America and the Caribbean area.~~ Illustrate routes between northern Europe and the	X							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Spain/Canaries/Lisbon flight information region (FIR) (T9, T13 and T16) within NAT HLA. ***Source:* NAT 007, 3.2 Other routes within the NAT HLA**								
(11)		Describe the function of the North American Routes (NARs) and Shannon Oceanic Transition Area (SOTA) and Northern Oceanic Transition Area (NOTA). **Source:NAT 007, 3.3 Route structures adjacent to the NAT HLA**	X							
(12)		State that ~~a~~All flights should plan to operate on great circle tracks joining successive significant waypoints. ***Source:* NAT 007, 4.1.3** ~~— during the hours of validity of the OTS, operators are encouraged to flight plan in accordance with the OTS or along a route to join or leave an outer track of the OTS or on a random route to remain clear of the OTS~~ ~~— flight levels available on OTS tracks during OTS periods~~ ~~— flight levels on random tracks or outside OTS periods (appropriate direction Levels).~~	X							
(13)		State that during the hours of validity of the OTS, operators are encouraged to plan flights: — in accordance with the OTS; — or along a route to join or leave an outer track of the OTS; — or on a random route to remain clear of the OTS,	X							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		either laterally or vertically. ***Source:*** **NAT 007, 4.1.4**								
(14)		State which flight levels are available on OTS tracks during OTS periods. ***Source:*** **NAT 007, 4.1.10; 4.1.11 & 4.1.12 (dates not required)**	X							
(15)		State which flight levels are to be planned on random tracks or outside OTS periods. ***Source*****: NAT 007, 4.1.13**	X							
(16)		Selection of cruising altitude Specify the appropriate cruising levels for normal long-range IFR flights and for those operating on the North Atlantic OTS. ***Source:*** **NAT 007, Chapter 4 Flight Planning - Flight Levels; SERA**	X							
(17)		**Oceanic ATC c~~C~~learances ~~(MNPSA Manual Chap 5):~~** State that it is recommended that pilots should request their o~~O~~ceanic c~~C~~learance at least 40 minutes prior to the o~~O~~ceanic entry point estimated time of arrival (ETA). ***Source*****: NAT 007, 5.1.2** ~~— the pilot should notify the Oceanic Area control Centre (OAC) of the maximum acceptable flight level possible at the boundary.~~	X							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~— at some airports, which are situated close to oceanic boundaries, the Oceanic Clearance must be obtained before departure.~~ ~~— if an aircraft, which would normally be RVSM and/or MNPS approved, encounters, whilst en route to the NAT Oceanic Airspace, a critical in-flight equipment failure, or at dispatch is unable to meet the MEL requirements for RVSM or MNPS approval on the flight, then the pilot must advise ATC at initial contact when requesting Oceanic Clearance.~~ ~~— after obtaining and reading back the clearance, the pilot should monitor the forward estimate for oceanic entry, and if this changes by 3 minutes or more, should pass a revised estimate to ATC.~~ ~~— pilots should pay particular attention when the issued clearance differs from the flight plan as a significant proportion of navigation errors investigated in the NAT involve an aircraft which has followed its flight plan rather than its differing clearance.~~ ~~— if the entry point of the oceanic route on which the flight is cleared differs from that originally requested and/or the oceanic flight level differs from the current flight level, the pilot is responsible for requesting and obtaining the necessary domestic re-clearance.~~								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		– ~~there are three elements to an Oceanic Clearance: route, Mach number and flight level. These elements serve to provide for the three basic elements of separation: lateral, longitudinal and vertical.~~								
(18)		State that pilots should notify the oceanic area control centre (OAC) of the maximum acceptable flight level possible at the boundary. ***Source:* NAT 007, 5.1.3**	X							
(19)		State that at some aerodromes which are situated close to oceanic boundaries, the oceanic clearance must be obtained before departure. ***Source:* NAT 007, 5.1.5**	X							
(20)		State that if an aircraft, which would normally be RVSM- or NAT HLA-approved, encounters, whilst en-route to the NAT Oceanic Airspace, a critical in-flight equipment failure, or at dispatch is unable to meet the MEL requirements for RVSM or NAT HLA approval of the flight, then the pilot must advise ATC at initial contact when requesting oceanic clearance. ***Source:* NAT 007, 5.1.6**	X							
(21)		State that after obtaining and reading back the clearance, the pilot should monitor the forward estimate for oceanic entry, and if this changes by 3 minutes or more, unless providing position reports via automatic dependent surveillance — contract (ADS-C), the pilot must pass a revised estimate on to ATC.	X							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **NAT 007, 5.1.7**								
(22)		State that pilots should pay particular attention when the issued clearance differs from the flight plan as a significant proportion of navigation errors investigated in the NAT Region involve aircraft which have followed their flight plan rather than the differing clearance. ***Source:*** **NAT 007, 5.1.8**	X							
(23)		State that if the entry point of the oceanic route forwhich the flight is cleared differs from that originally requested or the oceanic flight level differs from the current flight level, the pilot is responsible for requesting and obtaining the necessary domestic reclearance. ***Source:*** **NAT 007, 5.1.9**	X							
(24)		State that there are three elements to an oceanic clearance: route, Mach number, and flight level, and that these elements serve to provide for the three basic elements of separation: lateral, longitudinal, and vertical. ***Source:*** **NAT 007, 5.1.1**	X							
(25)		***Communications and position-reporting procedures*** State that ~~p~~Pilots communicate with OACs via aeradio stations staffed by communicators who have no executive ATC authority. ***Source:*** **NAT 007, 6.1.1**	X							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~Messages are relayed, from the ground station to the air traffic controllers in the relevant OAC for action.~~ ~~— Frequencies from the lower HF bands tend to be used for communications during night-time and those from the higher bands during day-time.~~ ~~— When initiating contact with an aeradio station the pilot should state the HF frequency in use.~~ ~~_SATCOM voice communications_~~ ~~Since oceanic traffic typically communicate with ATC through aeradio facilities, a SATCOM call made due to unforeseen inability to communicate by other means should be made to such a facility rather than the ATC Centre, unless the urgency of the communication dictates otherwise.~~ ~~An air-to-air VHF frequency has been established for world-wide use when aircraft are out of range of VHF ground stations which utilise the same or adjacent frequencies. This frequency, 123.45 MHz, is intended for pilot-to-pilot exchanges of operationally significant information.~~ ~~Standard position report message type.~~ ~~Some aircraft flying in the NAT are required to report MET observations of wind speed and direction plus outside air temperature. Any turbulence encountered should be included in these reports.~~ ~~General guidance for aircraft operating in, or proposing to~~								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~operate in, the NAT Region, which experience a communications failure: General Provisions, On-board HF Equipment Failure, Poor HF Propagation Conditions, Loss of HF Communications Prior to Entry into the NAT, Loss of HF Communications after Entering the NAT.~~ ~~All turbine-engine aeroplanes having a maximum certificated take-off mass exceeding 5,700 kg or authorized to carry more than 19 passengers are required to carry and operate ACAS II in the NAT Region.~~								
(26)		State that messages are relayed from the ground station to the air traffic controllers of the relevant OAC for action. ***Source:* NAT 007, 6.1.1**	X							
(27)		State that frequencies from the lower HF bands tend to be used for communications during night-time and those from the higher bands during daytime. Generally, in NAT, frequencies of less than 7 MHz are utilised at night and frequencies greater than 8 MHz are utilised during the day. When initiating contact with an aeradio station, the pilot should state the HF frequency in use. ***Source:* NAT 007, 6.1.4 and 6.1.7**	X							
(28)		State that since oceanic traffic typically communicates with ATC through aeradio facilities, a satellite communication (SATCOM) call, made due to unforeseen inability to communicate by other means, should be made to such a facility rather than the ATC centre, unless the urgency of the	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		communication dictates otherwise. ***Source:*** **NAT 007, 6.1.17**								
		State that an air-to-air VHF frequency has been established for worldwide use when aircraft are out of range of VHF ground stations which utilise the same or adjacent frequencies. This frequency, 123.45 MHz, is intended for pilot-to-pilot exchanges of operationally significant information. ***Source:*** **NAT 007, 6.2.2**	X							
(29)		State that any pilot, who provides position reports via data link and encounters significant meteorological phenomena (such as moderate/severe turbulence or icing, volcanic ash or thunderstorms), should report this information. ***Source:*** **NAT 007, 6.5.2**	X							
(30)		State that all turbine-engined aeroplanes having a maximum certified take-off mass exceeding 5 700 kg or authorised to carry more than 19 passengers are required to carry and operate airborne collision avoidance system (ACAS) II in the NAT Region. ***Source:*** **NAT 007, 6.9.1**	X							
(31)		State that even with the growing use of data-link communications, a significant volume of NAT air–ground communications are conducted using voice on single sideband (SSB) HF frequencies. To support air–ground ATC communications in the North Atlantic Region, 24 HF	X							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		frequencies have been allocated, in bands ranging from 2.8 to 18 MHz. ***Source:* NAT 007, 6.1.3**								
(32)		**Application of the Mach number technique (NAT HLA): ~~MNPSA Manual Chap 7~~):** State that p~~P~~ractical experience has shown that when two or more turbojet aircraft, operating along the same route at the same flight level, maintain the same Mach number, they are more likely to maintain a constant time interval between each other than when using other methods~~;~~. ***Source:* NAT 007, 7.2.1** ~~— pilots must ensure that any required corrections to indicated Mach are taken into account when complying with the true Mach number specified in the ATC clearance;~~ ~~— after leaving oceanic airspace pilots must maintain their assigned Mach number in domestic controlled airspace unless and until the appropriate ATC unit authorises a change.~~	X							
(33)		State that after leaving oceanic airspace, pilots must maintain their assigned Mach number in domestic controlled airspace unless and until the appropriate ATC unit authorises a change. ***Source:* NAT 007, 7.4.1**	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		North Atlantic High Level Airspace (NAT HLA) flight operation and navigation procedures								
(34)		**~~MNPS~~ NAT HLA flight operation and~~&~~ navigation procedures ~~(MNPSA Manual Chap 8):~~** State that t~~T~~he pre-flight procedures for any NAT ~~MNPS~~ HLA flight must include a Universal Time Coordinated (UTC) time check. ***Source:*** **NAT 007, 8.2.2** ~~and resynchronisation of the aircraft master clock;~~ ~~– State the use of the Master Document;~~ ~~– State the requirements for position plotting;~~ ~~– PRE-FLIGHT PROCEDURES: alignment of IRS, Satellite Navigation Availability Prediction Programme for flights using GNSS LRNS, loading of initial waypoints, flight plan check;~~ ~~– IN FLIGHT PROCEDURES: ATC Oceanic Clearance, entering the MNPS airspace and reaching an oceanic waypoint, routine monitoring;~~ ~~– strategic Lateral Offset Procedure (SLOP) state that along a route or track there will be three positions that an aircraft may fly: centreline or one or two miles right.~~	X							
(35)		Describe the function and use of the master document.	X							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **NAT 007, 8.2.5 to 8.2.9**								
(36)		State the requirements for position plotting. ***Source:*** **NAT 007, 8.2.10 to 8.2.13**	X							
(37)		Describe the pre-flight procedures for: — the alignment of IRS; — the satellite navigation availability prediction programme for flights using global navigation satellite long-range navigation system (GNSS LRNS); — loading of initial waypoints; and — flight plan check. ***Source:*** **NAT 007, 8.3.2 to 8.3.5; 8.3.6 to 8.3.8; 8.3.13 to 8.3.17**	X							
(38)		Describe the strategic lateral offset procedure (SLOP) and state that along a route or track there will be three positions that an aircraft may fly: centre line, or 1 or 2 miles right. ***Source:*** **NAT 007, 8.5.1 to 8.5.5**	X							
(39)		State that RNAV 10 retains the RNP 10 designation, as specified in the Performance-based Navigation Manual (ICAO Doc 9613), 1.2.3.5. (ICAO Doc 7030, NAT Chapter 4). ***Source:*** **NAT 007, 1.3.4**	X							
(40)		State that both aircraft and operators must be RNP 10- or RNP 4-approved by the State of the Operator or the State of Registry, as appropriate.	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **NAT 007, 1.3.4**								
(41)		State that RNP 10 is the minimum navigation specification for the application of 93 km (50 NM) lateral separation ***Source:*** **NAT 007, 1.3.4 and 4.1.18**	X							
(42)		**Reduced vertical separation minima (RVSM) flight in ~~MNPS~~NAT HLA ~~airspace (MNPSA Manual Chap 9):~~** State the altimeter cross-check to be performed before entering NAT HLA ~~MNPS airspace~~. ***Source:*** **NAT 007, 9.1.10** ~~entry~~. ~~— State the altimeter cross-check to be performed into the MNPS airspace;~~ ~~— in NAT MNPS Airspace pilots always have to report to ATC immediately on reaching any new cruising level;~~ ~~— crews should report when a 300 ft or more deviation occurs.~~	X							
(43)		State the altimeter cross-check to be when entering and flying in NAT HLA. ***Source*****: NAT 007, 9.1.12**	X							
(44)		State that pilots not using controller–pilot data-link communications (CPDLC)/ADS-C always report to ATC immediately on leaving the current cruising level and on reaching any new cruising level.	X							

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **NAT 007, 9.1.15**								
(45)		State that flight crewshould report when a 300-ft deviation or more occurs. ***Source:*** **NAT 007, 11.3.4 and 11.3.6**	X							
(46)		Navigation planning procedures List the factors to be considered by the commander before commencing the flight. ***Source:*** **NAT 007, 8.3 Pre-flight procedures**	X							
(47)		**Navigation system degradation (NAT Doc 007, Chapter 12)**								
		For this part consider aircraft equipped with only two operational LRNSs~~;~~ and state the requirements for the following situations: — one system fails before take-off; — one system fails before the OCA boundary is reached; — one system fails after the OCA boundary is crossed; and — the remaining system fails after entering ~~MNPS~~ NAT HLA ~~airspace~~. ***Source:*** **NAT 007, 12.2**	X							
		Special procedures for in-flight contingencies (NAT Doc 007, Chapter 13)								
(48)		~~**Special procedures for in-flight contingencies** (MNPSA~~	X							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~Manual Chap 11~~) ~~*General*~~ – ~~Until a revised clearance is obtained the specified NAT in-flight contingency procedures should be carefully followed;~~ State the general procedures and also state that t~~T~~he general concept of these NAT in-flight contingency procedures is, whenever operationally feasible, to offset ~~from~~ the assigned route by 15 NM and climb or descend to a level which differs from those normally used by 500 ft if below FL410 or by 1 000 ft if above FL410. ***Source:* NAT 007, 13.1 and 13.2** – ~~State the factors which may affect the direction of turn: direction to an alternate airport, terrain clearance, levels allocated on adjacent routes or tracks and any known SLOP off sets adopted by other nearby traffic.~~ ~~*Deviations around severe weather*~~ – ~~State that if the deviation is to be greater than 10NM the assigned flight level must be changed by +/- 300 ft depending on the followed track and the direction of the deviation (table 1).~~								
(49)		State all the factors which may affect the direction of turn including:	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— direction to an alternate aerodrome; — terrain clearance; — levels allocated on adjacent routes or tracks and any known SLOP offsets adopted by other nearby traffic. ***Source:* NAT 007, 13.3.2**								
(50)		State that if the deviation around severe weather is to be greater than 10 NM, the assigned flight level must be changed by ± 300 ft depending on the followed track and the direction of the deviation. ***Source:* NAT 007, 13.4**	X							
071 01 03 04		***Extended-range operations with two-engined aeroplanes (ETOPS)***								
(01)		State that ETOPS approval is part of an AOC. ***Source:*** **Point SPA.ETOPS.100 'ETOPS';** **Point SPA.ETOPS.105 'ETOPS operational approval'**	X							
(02)		State that prior to conducting an ETOPS flight, an operator shall ensure that a suitable ETOPS en-route alternate is available, within either the approved diversion time or a diversion time based on the MEL-generated serviceability status of the aeroplane, whichever is shorter. ***Source:* Point SPA.ETOPS.110 'ETOPS en-route alternate**	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		aerodrome'								
(03)		State the requirements for take-off alternate. ***Source:* Point CAT.OP.MPA.180 'Selection of aerodromes — aeroplanes'**	X							
(04)		State the planning minima for ETOPS en-route alternate. ***Source:* Point SPA.ETOPS.115 'ETOPS en-route alternate aerodrome planning minima'**	X							
(05)		Navigation-planning procedures~~:~~. Describe the operator responsibilities concerning ETOPS routes. ***Source:*** **Point CAT.OP.MPA.135 'Routes and areas of operation — general';** **Point CAT.OP.MPA.145 'Establishment of minimum flight altitudes';** **Point CAT.OP.MPA.150 'Fuel policy'**	X							
(06)		Selection of a route~~:~~. Describe the limitations on extended-range operations with two-engined aeroplanes with and without ETOPS approval.	X							
(07)		Selection of alternate aerodrome~~:~~. State the maximum flight distance of a take-off alternate for: ~~two-engine aeroplane, ETOPS-approved aeroplane, three or four-engine aeroplane.~~	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— two-engined aeroplanes; — ETOPS-approved aeroplanes; — three- or four-engined aeroplanes. ***Source:* Point CAT.OP.MPA.180 ‘Selection of aerodromes — aeroplanes’**								
(08)		State the maximum distance from an adequate aerodrome for two-engined aeroplanes without an ETOPS approval. ***Source:* Point CAT.OP.MPA.140 ‘Maximum distance from an adequate aerodrome for two-engined aeroplanes without an ETOPS approval’**	X							
(09)		State the requirement for alternate ~~airport~~aerodrome accessibility check for ETOPS operations.	X							
071 02 00 00		**SPECIAL OPERATIONAL PROCEDURES AND HAZARDS — ~~(~~GENERAL ASPECTS~~)~~**								
071 02 01 00		**Operations ~~M~~manual** **(Points ORO.MLR.100, ORO.MLR.101 and related AMCs/GM)**								
071 02 01 01		***Operating procedures***								
(01)		~~State~~ Explain the general rules for the operations manual. ***Source:*** **Point ORO.MLR.100 ‘Operations manual — general’;** **AMC1 ORO.MLR.100**	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		~~State~~ Explain the structure and subject headings of the operations manual. ***Source:*** **Point ORO.MLR.101 'Operations manual — structure for commercial air transport';** **GM1 ORO.MLR.100(k) 'Operations manual — general'**	X	X	X	X	X			
(03)		~~State~~ Explain the requirements for a journey ~~logbook~~ log or equivalent. ***Source:* Point ORO.MLR.110 'Journey log';** **AMC1 ORO.MLR.110**	X	X	X	X	X			
(04)		Describe the requirements regarding the operational flight plan. ***Source:* Point ORO.MLR.115 'Record-keeping'**	X	X	X	X	X			
(05)		~~State~~ Explain the requirements for document-storage-periods. ***Source:*** **Point ORO.MLR.115 'Record-keeping';** **AMC1 ORO.MLR.115;** **GM1 ORO.MLR.115(c);(d)**	X	X	X	X	X			
(06)		~~State~~ Explain that all non-type-related operational policies, instructions and procedures ~~needed~~ required for a safe operation are included in Part A of the o~~O~~perations m~~M~~anual ***Source:***	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		Point ORO.MLR.101 'Operations manual — structure for commercial air transport; **AMC3 ORO.MLR.100 'Operations manual — general' (main topics in Part A, e.g. General/Basic, etc.)**								
(07)		State that the following items are included into Part A: ~~de-icing and anti-icing on the ground, adverse and potentially hazardous atmospheric conditions, wake turbulence, incapacitation of crew members, use of the minimum equipment and configuration deviation list(s), security, handling of accidents and occurrences.~~ — de-icing and anti-icing on the ground; — adverse and potentially hazardous atmospheric conditions; — wake turbulence; — incapacitation of crew members; — use of the minimum equipment list (MEL) and configuration deviation list(s) (CDL); — security; — handling of accidents and occurrences. ***Source:*** **Point ORO.MLR.101 'Operations manual — structure for commercial air transport';** **AMC3 ORO.MLR.100 'Operations manual — general'**	X	X	X	X	X			
(08)		State that the following items are included into Part A: altitude alerting system procedures, ground proximity	X	X						

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		warning system procedures, policy and procedures for the use of traffic alert and collision avoidance system (TCAS)/airborne collision avoidance system (ACAS). ***Source:*** **Point ORO.MLR.101 'Operations manual — structure for commercial air transport';** **AMC3 ORO.MLR.100 'Operations manual — general'**								
(09)		State that ~~the~~ rotor downwash ~~following items are~~ is included into Part A.~~: rotor downwash~~ ***Source:*** **Point ORO.MLR.101 'Operations manual — structure for commercial air transport';** **AMC3 ORO.MLR.100 'Operations manual — general'**			X	X	X			
~~LO (10)~~		~~Define the following terms: 'commencement of flight', 'inoperative', 'MEL', 'MMEL', rectification interval.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (11)~~		~~Define the 'limits of MEL applicability'.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (12)~~		~~Identify the responsibilities of the operator and the authority with regard to MEL and MMEL.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (13)~~		~~State the responsibilities of the crew members with regard to MEL.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (14)~~		~~State the responsibilities of the commander with regard to MEL.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
071 02 01 02		***Aeroplane/helicopter operating matters — type-related***								
(01)		State that all type-related instructions and procedures ~~needed~~ required for a safe operation are included in Part B of the o~~O~~perations m~~M~~anual. They ~~will~~ take account of any differences between types, variants or individual aircraft used by the operator. ***Source:* Point ORO.MLR.101 'Operations manual — structure for commercial air transport'**	X	X	X	X	X			
(02)		State that the following items are included into Part B: ~~abnormal and emergency procedures, configuration deviation list, minimum equipment list, emergency evacuation procedures.~~ — abnormal and emergency procedures; — configuration deviation list (CDL); — minimum equipment list (MEL); — emergency evacuation procedures. ***Source:*** **Point ORO.MLR.101 'Operations manual — structure for commercial air transport';** **AMC3 ORO.MLR.100 'Operations manual — general'**	X	X						
(03)		State that the following items are included into Part B: ~~emergency procedures, configuration deviation list, minimum equipment list, emergency evacuation procedures.~~ — emergency procedures;			X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— configuration deviation list (CDL); — minimum equipment list (MEL); — emergency evacuation procedures. ***Source:*** **Point ORO.MLR.101 'Operations manual — structure for commercial air transport';** **AMC3 ORO.MLR.100 'Operations manual — general'**								
071 02 01 03		***Minimum equipment list (MEL) and master minimum equipment list (MMEL)***								
(01)		~~Define~~ Describe the following terms: 'commencement of flight', 'inoperative', 'MEL', 'MMEL', 'rectification interval'. ***Source:*** **GM1 ORO.MLR.105(a) 'Minimum equipment list';** **CS-MMEL;** **GM2 ORO.MLR.105(d)(3)**	X	X	X	X	X			
(02)		~~State~~ Explain the relation between MMEL and MEL. ***Source:*** **Point ORO.MLR.100 'Operations manual — general';** **Point ORO.MLR.105 'Minimum equipment list';** **AMC1 ORO.MLR.105(j);(g)** **GM1 ORO.MLR.105(j)**								
(03)		Define the '~~limits of~~ extent of the MEL ~~applicability~~'. ***Source:*** **AMC2 ORO.MLR.105(d)(3) 'Minimum equipment list'**	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(04)		~~Identify~~Explain the responsibilities of the operator and the competent authority with regard to MEL and MMEL. ***Source:*** **Point ORO.MLR.100 'Operations manual — general'; Point ORO.MLR.105 'Minimum equipment list'; AMC1 ORO.MLR.105(c); GM1 ORO.MLR.105(d)(3)**	X	X	X	X	X			
(05)		~~State~~ Explain the responsibilities of the flight crew members with regard to MEL. ***Source:*** **Points CAT.IDE.A.105/CAT.IDE.H.105 'Minimum equipment for flight'**	X	X	X	X	X			
(06)		~~State~~ Explain the responsibilities of the commander with regard to MEL. ***Source:*** **Point CAT.OP.MPA.175 'Flight preparation'; Point CAT.IDE.A.105/CAT.IDE.H.105 'Minimum equipment for flight'**	X	X	X	X	X			
071 02 02 00		**Icing conditions**								
071 02 02 01		***On-ground de-icing/anti-icing procedures, types of de-icing/anti-icing fluids***								
(01)		Define the following terms: 'anti-icing', 'de-icing', 'one-step de-icing/anti-icing', 'two-step de-icing/anti-icing', 'holdover time'.~~(~~	X	X						

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations',Glossary~~).~~**								
~~LO (02)~~		~~Define the following weather conditions: 'drizzle', 'fog', 'freezing fog', 'freezing drizzle', 'freezing rain', 'frost', 'rain', 'rime', 'slush', 'snow', 'dry snow', 'wet snow'. (ICAO Doc 9640 Glossary)~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(03)		Describe 't~~T~~he clean aircraft concept' as presented in the relevant chapter of ICAO Doc 9640. ~~(~~ ***Source:*** **ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 2~~)~~**	X	X						
(04)		List the types of de-icing/anti-icing fluids available~~. (~~ ***Source:*** **ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 4, 4.1~~)~~**	X	X	X	X	X			
(05)		~~State~~ Explain the procedure to be followed when an aeroplane has exceeded the holdover time. ~~(~~ ***Source:*** **ICAO Doc 9640, 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 4~~),~~ 4.9**	X	X						
(06)		Interpret the fluid holdover time tables and list the factors which can reduce the fluid protection time. ~~(~~ ***Source:*** **ICAO Doc 9640, 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 5: 5.1, 5.2 and Attachment (5 tables)**	X	X						

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(07)		~~State that~~ Explain how the pre-take-off check, which is the responsibility of the pilot-in-command, ensures that the critical surfaces of the aircraft ~~aeroplane~~ are free of ice, snow, slush or frost just prior to take-off. This check shall be accomplished as close to the time of take-off as possible and is normally made from within the aeroplane by visually checking the wings. ~~(~~ ***Source*: ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 6, 6.4** ~~)~~	X	X						
(08)		~~State that~~ Explain why an aircraft has to be treated symmetrically~~. (~~ ***Source:* ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 11**~~)~~	X	X						
(09)		~~State that~~ Explain why an operator shall establish procedures to be followed when ground de-icing and anti-icing and related inspections of the ~~aeroplane(s)~~ aircraft are necessary. **Source: ICAO Doc 9640 Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 1: Introduction 1.1 to 1.6**	X	X	X	X	X			
(10)		~~State that~~ Explain why a commander shall not commence take-off unless the external surfaces are clear of any deposit which might adversely affect the performance ~~and/~~or controllability of the aircraft except as permitted in the	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		f~~F~~light m~~M~~anual. ***Source:*** **ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations';** **Point CAT.OP.MPA.250 'Ice and other contaminants — ground procedures'**								
(11)		~~State~~ Explain the requirements for operations in icing conditions. ***Source:*** **Point CAT.OP.MPA.250 'Ice and other contaminants — ground procedures';** **Point CAT.OP.MPA.255 'Ice and other contaminants — flight procedures';** **Point CAT.IDE.A.165 'Additional equipment for operations in icing conditions at night';** **Point CAT.IDE.H.165 'Additional equipment for operations in icing conditions at night'**	X	X	X	X	X			
(12)		Explain why safety must come before commercial pressures in relation to de-icing and anti-icing of aircraft. (Consider time and financial cost versus direct and indirect effects of an incident/accident). ***Source:*** **N/A**	X	X	X	X	X			
071 02 02 02		***Procedure to apply in case of performance deterioration, on ground/in flight***								
(01)		~~State that~~ Explain that the effects of icing are wide-ranging, unpredictable and dependent upon individual ~~aeroplane~~	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		aircraft design. The magnitude of these effects is dependent upon many variables, but the effects can be both significant and dangerous. ~~(~~ ***Source:*** **ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 1**~~)~~								
(02)		~~State that~~ Explain that in icing conditions, for a given speed and a given angle of attack, wing lift can be reduced by as much as 30 % and drag increased by up to 40 %. State that these changes in lift and drag will significantly increase stall speed, reduce controllability and alter flight characteristics. ~~(~~ ***Source:*** **ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 1**~~)~~	X	X	X	X	X			
(03)		~~State that~~ Explain that ice on critical surfaces and on the airframe may also break away during take-off and be ingested into engines, possibly damaging fan and compressor blades. ~~(~~ ***Source:*** **ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 1**~~)~~	X	X	X	X	X			
(04)		~~State that~~ Explain that ice forming on pitot tubes and static ports or on angle-of-attack vanes may give false altitude, airspeed, angle-of-attack and engine-power information for air-data systems. ***Source:*** **ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 1**~~)~~	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(05)		~~State that~~ Explain that ice, frost and snow formed on the critical surfaces on the ground can have a totally different effect on aircraft flight characteristics than ice, frost and snow formed in flight. **_Source:_ ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 1~~)~~**	X	X	X	X	X			
(06)		~~State that~~ Explain that flight in known icing conditions is subject to limitations that are contained ~~found~~ in Part B of the o~~O~~perations m~~M~~anual. **_Source:_ AMC4 ORO.MLR.100 'Operations manual — general'**	X	X	X	X	X			
(07)		~~State~~ Explain where procedures and performances regarding flight in expected or actual icing conditions can be found~~are located~~. **_Source:_ AMC4 ORO.MLR.100 'Operations manual — general'**	X	X	X	X	X			
071 02 03 00		**Bird-strike risk ~~and avoidance~~**								
_071 02 03 01_		**_Bird-strike risk and avoidance_**								
(01)		~~State that~~ Explain that the presence of birds that constitute~~ing~~ a potential hazard to aircraft operations is part of the pre-flight information. ~~(~~ **_Source:_ ICAO Annex 15, 8.1 Pre-flight information ~~Chapter 8).~~**	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		~~State that~~ Explain how information concerning the presence of birds observed by aircrews is made available to the a~~A~~eronautical i~~I~~nformation s~~S~~ervice (AIS) for ~~such~~ distribution as the circumstances dictate. ~~necessitate (~~ ***Source:*** **ICAO Annex 15, Chapter 8~~).~~**	X	X	X	X	X			
(03)		~~State that~~ Explain that the Aeronautical Information Publication (AIP) Section En-route (ENR) 5.6 contains information regarding bird migrations. ~~(~~ ***Source:*** **ICAO Annex 15, Appendix 1~~).~~**	X	X	X	X	X			
(04)		~~State~~ Explain significant data regarding bird strikes contained in ICAO Doc 9137 'Airport Services Manual'~~(~~ ***Source:*** **ICAO Doc 9137 'Airport Services Manual', Part 3, 1.1.6~~).~~**	X	X	X	X	X			
(05)		~~List incompatible land use around airports (ICAO Doc 9137, Part 3, 10.4).~~ Explain why birds constitute a hazard to aircraft (damage to probes, sensors, engines, windscreens, airframes, degradation in vision, etc.). ***Source:*** **N/A, though history in ICAO Doc 9137, Chapter 1.** **For more information, refer to the EGAST safety promotion leaflet 'Bird strike, a European risk with local specificities', available at:** **www.easa.europa.eu/system/files/dfu/EGAST_GA6-bird-strikes-final.pdf**	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(06)		Define the commander~~'s~~ responsibilities regarding the reporting of bird hazards and bird strikes. ***Source:* Point CAT.GEN.MPA.105 'Responsibilities of the commander'**	X	X	X	X	X			
(07)		State that birds tend to flock to areas where food is plentiful. Such areas include: rubbish (garbage) facilities; open sewage treatment works; recently ploughed land as well as their natural habitats. ***Source:* N/A**	X	X	X	X	X			
071 02 04 00		**Noise abatement**								
071 02 04 01		***Noise-abatement procedures***								
(01)		Define the operator responsibilities regarding the establishment of noise-abatement procedures. ***Source:*** **Point CAT.OP.MPA.130 'Noise abatement procedures — aeroplanes'** **Point CAT.OP.MPA.131 'Noise abatement procedures — helicopters'**	X	X	X	X	X			
(02)		State the main purpose of noise-abatement departure procedure (NADP) 1 and NADP 2. ~~(~~ ***Source:* ICAO Doc 8168 'Procedures for Air Navigation Services — Aircraft Operations' (PANS-OPS), Volume 1, Part I, Section 7, Appendix to Chapter 3, 1.1**	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)		State that the ~~pilot-in-command~~PIC/commender has the authority to decide not to execute an ~~noise-abatement departure procedure~~NADP if conditions preclude the safe execution of the procedure. ~~(~~ **Source: ICAO Doc 8168, Volume 1, Part I, Section 7, Chapter 3, 3.2.1 General** ~~V, 3.2.1.3).~~	X	X	X	X	X			
071 02 04 02		***Influence of the flight procedure (departure, cruise, approach)***								
(01)		List the main parameters for NADP 1 and NADP 2 (i.e. speeds, heights, and configuration ~~etc.)~~ ~~(~~ ***Source:*** **ICAO Doc 8168 'Procedures for Air Navigation Services — Aircraft Operations' (PANS-OPS), Volume 1, Part I, Section 7, Chapter 3, 3.3 & Appendix to Chapter 3**	X	X						
(02)		State that a runway lead-in lighting system should be provided where it is desired to provide visual guidance along a specific approach path for purposes of noise abatement. ~~(~~ ***Source:*** **ICAO Annex 14,~~—~~ Volume 1, 5.3.7.1/Volume 2, 5.3.4.1~~).~~**	X	X	X	X	X			
(03)		State that detailed information about noise-abatement procedures is to be found in Part 'Aerodromes' (AD) Sections 2 and 3 of the AIP. ~~(~~ *Source:* ICAO Annex 15, Appendix 1~~).~~	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
071 02 04 03		***Influence by the pilot (power setting, low drag)***								
(01)		List the adverse operating conditions under which noise-abatement procedures in the form of reduced-power take-off should not be required. ~~(~~ ***Source:*** **ICAO Doc 8168 'Procedures for Air Navigation Services — Aircraft Operations' (PANS-OPS), Volume 1, Part I, Section 3, Chapter 1, 1.2.3 Reduced power take-off** ~~Part V, 3.2.2).~~	X	X						
(02)		List the adverse operating conditions under which noise-abatement procedures during approach should not be required. ~~(~~ ***Source:*** **ICAO Doc 8168 'Procedures for Air Navigation Services — Aircraft Operations' (PANS-OPS), Volume 1, Part I, Section 7, Chapter 2, 2.1 Noise preferential runways** ~~Part V, 3.4.4).~~	X	X						
(03)		State the rule regarding the use of reverse thrust on landing. ~~(~~ **Source: ICAO Doc 8168, Volume 1, Part I, Section 7, Chapter 3, 3.5 Aeroplane operating procedures — landing** ~~Part V, 3.5).~~	X	X						
071 02 04 04		***Influence by the pilot (power setting, track of helicopter)***								
(01)		List the adverse operating conditions under which noise-abatement procedures in the form of reduced-power take-			X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		off should not be required. ~~(ICAO Doc 8168, Volume 1, Part V, 3.2.2)~~								
071 02 05 00		**Fire and smoke**								
071 02 05 01		***Carburettor fire***								
(01)		~~List the~~ Explain that the actions to be taken in the event of a carburettor fire may be type-specific and should be known by the pilot.	X	X	X	X	X			
071 02 05 02		***Engine fire***								
(01)		~~List the~~ Explain that the actions to be taken in the event of an engine fire may be type-specific and should be known by the pilot.	X	X	X	X	X			
071 02 05 03		***Fire in the cabin, in the ~~cockpit~~flight crew compartment, and in the cargo compartment***								
(01)		Identify the different types of extinguishants used in handheld fire extinguishers and the type of fire ~~on~~for which each one may be used.	X	X	X	X	X			
(02)		Describe the precautions to be considered ~~in the application of~~ when applying fire extinguishants.	X	X	X	X	X			
(03)		Identify the appropriate handheld extinguishers to be used in the ~~cockpit~~flight crew compartment, the passenger cabin and ~~toilets~~lavatories, and in the cargo compartments.	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
071 02 05 04		***Smoke in the ~~cockpit~~flight crew compartment and in the cabin***								
(01)		~~List the~~ ~~State~~ Explain which actions should ~~to~~ be taken in the event of smoke in the ~~cockpit~~flight crew compartment or in the cabin, why these actions may be type-specific, and why they should be known by the pilot.	X	X	X	X	X			
071 02 05 05		***Actions in case of overheated brakes***								
(01)		Describe the problems and safety precautions in the event that ~~following overheated~~ brakes overheat after a heavy-weight landing or a rejected take-off.	X	X						
(02)		Explain the difference in the way steel and carbon brakes react to energy absorption and the operational consequences.	X	X						
071 02 06 00		**Decompression of pressurised cabin**								
071 02 06 01		***Slow decompression***								
(01)		~~Indicate~~ Explain what can cause, and how to detect, a slow decompression or an automatic pressurisation system failure.	X	X						
(02)		Describe the actions required following a slow decompression.	X	X						
071 02 06 02		***Rapid and explosive decompression***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		~~Indicate~~ Explain what can cause, and how to detect, a rapid or an explosive decompression.	X	X						
071 02 06 03		***Dangers and action to be taken***								
(01)		Describe the actions required following a rapid or explosive decompression.	X	X						
(02)		Describe the effects on aircraft occupants of a slow decompression and of a rapid or explosive decompression.	X	X						
071 02 07 00		**Wind shear and microburst**								
071 02 07 01		***Effects and recognition during departure and approach***								
~~LO (01)~~		~~Define the meaning of the term 'low-level windshear'. (ICAO Circular 186, Chapter 1)~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~Define: vertical wind shear, horizontal wind shear, updraft and downdraft wind shear. (ICAO Circular 186, Chapter 2)~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~Identify the meteorological phenomena associated with wind shear. (ICAO Circular 186, Chapter 3)~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(04)		~~State recognition of~~ Explain how to identify low-level wind shear. ~~(~~ ***Source:*** **ICAO Circular 186 'Wind Shear'**~~, Chapter 4)~~	X	X	X	X	X			
071 02 07 02		***Actions to avoid and actions to take ~~during~~ when encountering wind shear***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Describe the effects of wind shear and the actions required when wind shear is encountered~~ing wind shear,~~ at take-off and approach. ***Source:*** **ICAO Circular 186 'Wind Shear'**~~, Chapter 4)~~	X	X	X	X	X			
(02)		Describe the precautions to be taken when wind shear is suspected~~,~~ at take-off and approach~~.~~ ***Source:*** **ICAO Circular 186 'Wind Shear'**~~, Chapter 4)~~	X	X	X	X	X			
(03)		Describe the effects of wind shear and the actions required following entry into a strong downdraft wind shear. ***Source:*** **ICAO Circular 186 'Wind Shear'**~~, Chapter 4)~~	X	X	X	X	X			
(04)		Describe a microburst and its effects. ***Source:*** **ICAO Circular 186 'Wind Shear'**~~, Chapter 4)~~	X	X	X	X	X			
071 02 08 00		**Wake turbulence**								
071 02 08 01		***Cause***								
(01)		~~Define~~ Describe the term 'wake turbulence'~~. (ICAO Doc 4444, 4.9)~~ ***Source:*** **ICAO Doc 9426 'Air Traffic Services Planning Manual', Part II**	X	X	X	X	X			
(02)		Describe tip vortex~~ices~~ circulation. ~~(~~ ***Source:*** **ICAO Doc 9426 'Air Traffic Services Planning Manual', Part II**~~)~~	X	X	X	X	X			
(03)		State when vortex generation begins and ends. ~~(~~	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **ICAO Doc 9426 'Air Traffic Services Planning Manual', Part II**~~)~~								
(04)		Describe vortex circulation on the ground with and without crosswind. ~~(~~ ***Source:*** **ICAO Doc 9426 'Air Traffic Services Planning Manual', Part II**~~)~~	X	X	X	X	X			
071 02 08 02		***List of relevant parameters***								
(01)		List the three main factors which, when combined, give the strongest vortices (heavy, clean, slow).~~(~~ ***Source:*** **ICAO Doc 9426 'Air Traffic Services Planning Manual', Part II**~~)~~	X	X	X	X	X			
(02)		Describe the wind conditions which are worst for wake turbulence near the ground. ~~(~~ ***Source:*** **ICAO Doc 9426 'Air Traffic Services Planning Manual', Part II**~~)~~	X	X	X	X	X			
071 02 08 03		***Actions to be taken when crossing traffic, during take-off and landing***								
(01)		Describe the actions to be taken to avoid wake turbulence, ~~specially~~ specifically separations. ~~(~~ ***Source*:** **ICAO Doc 4444 'Procedures for Air Navigation Services — Air Traffic Management' (PANS-ATM), 5.8 Time-based wake turbulence longitudinal separation**	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		minima ~~)~~								
071 02 09 00		**Security (unlawful events)**								
071 02 09 01		***ICAO Annex 17 and Regulation (EC) No 300/2008***								
(01)		~~Give~~ Define the following terms ~~definitions~~: 'aircraft security check', 'screening', 'security', 'security-restricted area', 'unidentified baggage'. ~~(~~ ***Source:*** **ICAO Annex 17, Chapter 1 Definitions ~~1)~~**	X	X	X	X	X			
(02)		~~Give~~ State the objectives of security. ~~(~~ ***Source:*** **ICAO Annex 17, 2.1 Objectives ~~2.1)~~**	X	X	X	X	X			
071 02 09 02		***Use of ~~s~~Secondary ~~s~~Surveillance ~~r~~Radar (SSR)***								
(01)		Describe the commander~~'s~~ responsibilities concerning notifying the appropriate ATS unit. ~~(~~ ***Source:*** **ICAO Annex 17, Attachment to Annex 17~~).~~**	X	X	X	X	X			
(02)		Describe the commander~~'s~~ responsibilities concerning operation of SSR. ~~(~~ ***Source:*** **ICAO Annex 17, Attachment to Annex 17~~).~~**	X	X	X	X	X			
(03)		Describe the commander's responsibilities concerning departing from assigned track ~~and/~~or cruising level. ~~(~~ ***Source:*** **ICAO Annex 17, Attachment to Annex 17~~).~~**	X	X	X	X	X			
(04)		Describe the commander's responsibilities concerning the action required or being requested by an ATS unit to	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		confirm SSR code and ATS interpretation response. ~~(~~ ***Source:*** **ICAO Annex 17, Attachment to Annex 17**~~).~~								
071 02 09 03		***Security (Regulation (EC) No 300/2008 and ICAO Annex 17)***								
(01)		Describe the relationship between Regulation (EC) No 300/2008 and ICAO Annex 17. ***Source:*** **Regulation (EC) No 300/2008, Articles 1 & 2**	X	X	X	X	X			
(02)		~~State~~ Explain the requirements regarding training programmes. ***Source:*** **Regulation (EC) No 300/2008, Annex: 10 'In-flight security measures' and 11 'Staff recruitment and training';** **ICAO Annex 17, 13.4 Training programmes**	X	X	X	X	X			
(03)		State the requirements regarding reporting acts of unlawful interference. ***Source:*** **ICAO Annex 17, 13.5 Reporting acts of unlawful interference**	X	X	X	X	X			
(04)		State the requirements regarding aircraft search procedures. ***Source:*** **ICAO Annex 17:** **4.3 Measures relating to aircraft;** **5.1 Prevention;** **13.3 Aeroplane search procedure checklist**	X	X	X	X	X			
071 02 10 00		**Emergency and precautionary landings, and ditching**								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
071 02 10 01		***~~Definition~~ Descriptions***								
(01)		~~Define~~ Describe the meaning of: ‘ditching’, ‘precautionary landing’, ‘emergency landing’.	X	X	X	X	X			
(02)		Describe a ditching procedure.	X	X	X	X	X			
(03)		Describe a precautionary landing.	X	X	X	X	X			
(04)		Describe an emergency landing procedure.	X	X	X	X	X			
(05)		Explain the factors to be considered when deciding to make a precautionary/emergency landing or ditching.	X	X	X	X	X			
		~~State Explain the operations limitations regarding ditching requirements.~~	X	X						
071 02 10 02		***Cause***								
(01)		List some ~~reasons~~ circumstances that may require a ditching, a precautionary landing or an emergency landing.	X	X	X	X	X			
071 02 10 03		***Passenger information***								
(01)		Describe the ~~passenger~~ briefing to be given to passengers before conducting a precautionary/emergency landing or ditching (including evacuation). ***Source:*** **AMC1 CAT.OP.MPA.170 ‘Passenger briefing’**	X	X	X	X	X			
071 02 10 04		***Action after landing***								
(01)		Describe the actions and responsibilities of crew members	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		after landing.								
071 02 10 05		***Evacuation***								
(01)		~~State that~~ Explain why the aircraft must be stopped and the engine(s) shut down before launching an emergency evacuation.	X	X	X	X	X			
~~LO (02)~~		~~State that evacuation procedures are to be found in Part B of the Operations Manual.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(03)		~~State~~ Explain the CS-25 requirements regarding evacuation procedures~~. (~~ ***Source:*** **CS 25.803 ~~+~~and Appendix** J~~)~~	X	X						
071 02 11 00		**Fuel jettisoning**								
071 02 11 01		***Safety aspects***								
(01)		~~State that~~ Explain why an aircraft may need to jettison fuel so as to reduce its landing mass in order to ~~effect~~ make a safe landing. ~~(~~ ***Source:*** **ICAO Doc 4444 'Procedures for Air Navigation Services — Air Traffic Management' (PANS-ATM), 15.5.3 Fuel dumping** ~~)~~	X	X						
(02)		~~State~~ Explain that when an aircraft that operate~~ing~~ within controlled airspace needs to jettison fuel, the flight crew shall coordinate with ATC the following: — route to be flown which, if possible, should be clear of	X	X						

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		cities and towns, preferably over water and away from areas where thunderstorms have been reported or are expected; — the flight level to be used, which should be not less than 1 800 m (6 000 ft); and — the duration of fuel jettisoning. ~~route to be flown which, if possible, should be clear of cities and towns, preferably over water and away from areas where thunderstorms have been reported or are expected; the level to be used, which should be not less than 1 800 m (6 000 ft); and the duration of fuel jettisoning. (~~ **Source: ICAO Doc 4444 'Procedures for Air Navigation Services — Air Traffic Management' (PANS-ATM), 15.5.3 Fuel dumping** ~~)~~								
(03)		~~State that~~ Explain how flaps and slats may adversely affect fuel jettisoning~~. (~~ ***Source:*** **CS 25.1001 Fuel jettisoning system** ~~)~~	X	X						
071 02 11 02		***Requirements***								
~~LO (01)~~		~~State that a fuel-jettisoning system must be installed on each aeroplane unless it is shown that the aeroplane meets some the CS-25 climb requirements. (CS 25.1001)~~	~~X~~	~~X~~						
(02)		~~State that~~ Explain why a fuel-jettisoning system must be capable of jettisoning enough fuel within 15 minutes. ~~(~~	X	X						

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		Source: **CS 25.1001 Fuel jettisoning system ~~)~~**								
071 02 12 00		**Transport of dangerous goods by air**								
071 02 12 01		***ICAO Annex 18 (4th Edition, July 2011)***								
(01)		Define ~~Give~~ the following terms~~definitions~~: 'dangerous goods', 'dangerous goods accident', 'dangerous goods incident', 'exemption', 'incompatible', 'packaging', 'UN number'. ~~(~~ **Source: ICAO Annex 18, Chapter 1 Definitions ~~).~~**	X	X	X	X	X			
(02)		~~State that~~ Explain that detailed provisions for the transport of dangerous goods by air ~~transportation~~ are contained in the Technical Instructions for the Safe Transport of Dangerous Goods by Air. ~~(~~ ***Source:*** **ICAO Doc 9284 'Technical Instructions For The Safe Transport of Dangerous Goods by Air';~~)(~~** **ICAO Annex 18, Chapter 2, 2.2.1~~).~~**	X	X	X	X	X			
(03)		State that in ~~case~~ the event of an in-flight emergency, the pilot-in-command must inform the ATC of the transport of dangerous goods by air ~~transportation~~. ~~(~~ **Source: ICAO Annex 18, Chapter 9, 9.5~~).~~**	X	X	X	X	X			
071 02 12 02		***Technical Instructions for the Safe Transport of Dangerous Goods by Air (ICAO Doc 9284)***								
(01)		Explain the principle of dangerous goods compatibility and	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		segregation. ~~(~~ *Source:* ICAO Doc 9284 **‘Technical Instructions For The Safe Transport of Dangerous Goods by Air’**~~).~~								
(02)		Explain the special requirements for the loading of radioactive materials. ~~(~~ *Source:* ICAO Doc 9284 **‘Technical Instructions For The Safe Transport of Dangerous Goods by Air’**~~).~~	X	X	X	X	X			
(03)		Explain the use of the dangerous goods list. ~~(~~ *Source:* ICAO Doc 9284 **‘Technical Instructions For The Safe Transport of Dangerous Goods by Air’**~~).~~	X	X	X	X	X			
(04)		Identify the labels. ~~(~~ *Source:* ICAO Doc 9284 **‘Technical Instructions For The Safe Transport of Dangerous Goods by Air’**~~).~~	X	X	X	X	X			
071 02 12 03		***~~Transport of dangerous goods by air~~ Regulation (EU) No 965/2012 — Annex IV (Part-CAT) and Annex V (Part-SPA)***								
(01)		~~State~~ Explain the terminology relevant to dangerous. ***Source:*** **Point SPA.DG.100 ‘Transport of dangerous goods’;** **Point SPA.DG.105 ‘Approval to transport dangerous goods’;** **Point SPA.DG.110 ‘Dangerous goods information and documentation’**	X	X	X	X	X			
(02)		~~State~~ Explain the scope of that~~the~~ ~~R~~regulation.	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		***Source:* Point CAT.GEN.MPA.200 'Transport of dangerous goods'**								
(03)		~~State~~ Explain ~~that~~ why transport of dangerous goods ~~transportation~~ by air is subject to operator approval. ***Source:*** **Point SPA.DG.100 'Transport of dangerous goods';** **AMC1 ARO.OPS.200 'Specific approval procedure'**	X	X	X	X	X			
(04)		~~State~~ Explain the limitations on the transport of dangerous goods by air. ***Source:*** **Point SPA.DG.100 'Transport of dangerous goods';** **Point SPA.DG.105 'Approval to transport dangerous goods';** **Point SPA.DG.110 'Dangerous goods information and documentation'**	X	X	X	X	X			
(05)		~~State~~ Explain the requirements for the acceptance of dangerous goods ***Source:*** **Point SPA.DG.110 'Dangerous goods information and documentation';** **AMC1 SPA.DG.110(b) 'Dangerous goods information and documentation'**	X	X	X	X	X			
(06)		~~State~~ Explain the requirements regarding inspection for damage, leakage or contamination. ***Source:*** **Point SPA.DG.105 'Approval to transport dangerous goods';**	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		AMC1 SPA.DG.110(b) 'Dangerous goods information and documentation': (a)(1)								
~~LO (07)~~		~~State the loading restrictions.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(08)		~~State~~ Explain the requirement for the provision of information to ~~the~~ flight crew. ***Source:*** **Point SPA.DG.110 'Dangerous goods information and documentation';** **AMC1 SPA.DG.110(a);(b) 'Dangerous goods information and documentation'**	X	X	X	X	X			
(09)		~~State~~ Explain the requirements for dangerous goods incident and accident reports. ***Source:* Point CAT.GEN.MPA.200 'Transport of dangerous goods'**	X	X	X	X	X			
(10)		~~Identify~~ State that some articles and substances, which would otherwise be classed as dangerous goods, can be exempted ~~that are excluded~~ can be exempted ~~from the provisions~~ if they are part of the aircraft equipment, or required for use during aeromedical flights. ***Source:*** **Point CAT.GEN.MPA.200 'Transport of dangerous goods';** **ICAO Doc 9284 'Technical Instructions For The Safe Transport of Dangerous Goods by Air', 2.2 Exceptions for dangerous goods of the operator**	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(11)		~~State that~~ Explain why some articles and substances may be forbidden for transport by air ~~transportation~~. *Source:* **Point CAT.GEN.MPA.200 'Transport of dangerous goods';** **ICAO Doc 9284 'Technical Instructions For The Safe Transport of Dangerous Goods by Air', 2.1 Dangerous goods forbidden for transport by air under any circumstance**	X	X	X	X	X			
(12)		~~State that~~ Explain why packing must comply with the specifications of the Technical Instructions ~~specifications~~. ***Source:* ICAO Doc 9284 'Technical Instructions For The Safe Transport of Dangerous Goods by Air', Introductory chapter, 2.4 (for packing purposes, etc.)**	X	X	X	X	X			
~~LO (13)~~		~~List the labelling and marking requirements.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (14)~~		~~List the Dangerous Goods Transport Document requirements.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
~~LO (15)~~		~~List the Acceptance of Dangerous Goods requirements.~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(16)		~~State~~ Explain the need for an inspection prior to loading dangerous goods on an aircraft. *Source:* **Point CAT.GEN.MPA.200 'Transport of dangerous goods';** **AMC1 SPA.DG.110(b) 'Dangerous goods information and documentation'**	X	X	X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(17)		~~State that~~ Explain why some dangerous goods are designated for carriage only on cargo aircraft. ***Source:*** **ICAO Annex 18, 8.9 Loading on cargo aircraft;** **ICAO Doc 9284 'Technical Instructions For The Safe Transport of Dangerous Goods by Air', GENERAL PRINCIPLES**	X	X	X	X	X			
~~LO (18)~~		~~State that accidents or incidents involving dangerous goods are to be reported~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			
(19)		~~State that~~ Explain how misdeclared or undeclared dangerous goods found in baggage are to be reported. ***Source:*** **Point CAT.GEN.MPA.200 and related AMCs/GM**	X	X	X	X	X			
071 02 13 00		**Contaminated runways**								
071 02 13 01		***~~Kinds of contamination~~ Intentionally left blank***								
~~LO (01)~~		~~Define a 'contaminated runway', a 'damp runway', a 'wet runway', and a 'dry runway'.~~	~~X~~	~~X~~						
~~LO (02)~~		~~List the different types of contamination: damp, wet or water patches, rime or frost-covered, dry snow, wet snow, slush, ice, compacted or rolled snow, frozen ruts or ridges. (ICAO Annex 15, Appendix 2)~~	~~X~~	~~X~~						
~~LO (03)~~		~~Give the definitions of the various types of snow. (ICAO Annex 15, Appendix 2)~~	~~X~~	~~X~~						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
071 02 13 02		***Estimated surface friction, friction coefficient***								
(01)		Identify the difference between friction coefficient and estimated surface friction. ~~(~~ ***Source:*** **ICAO Annex 15, Appendix 2**~~)~~	X	X						
(02)		State that when estimated surface friction ~~coefficient~~ is 4 or 5 ~~0.40 or higher~~, the expected braking action is good. ~~(~~ ***Source:*** **ICAO Annex 15, Appendix 2**~~)~~	X	X						
071 02 13 03		***Hydroplaning principles and effects***								
(01)		Define the different types of hydroplaning. ~~(~~ ***Source*:** **NASA TM-85652~~/~~ — Tire friction performance**~~/pp. 6 to 9)~~	X	X						
(02)		Compute the two dynamic hydroplaning speeds using the following formulas: — ~~S~~spin-down speed (rotating tire) (kt) = 9 square root (pressure in PSI) — ~~S~~spin-up speed (non-rotating tire) (kt) = 7.7 square root (pressure in PSI). ~~(~~ ***Source*:** **NASA TM-85652~~/~~ — Tire friction performance**~~ /p. 8)~~	X	X						
(03)		State that it is the spin-up speed rather than the spin-down speed which represents the actual tire situation for aircraft	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		touchdown on flooded runways. ~~(~~ ***Source*: NASA TM-85652~~/~~ — Tire friction performance~~ /p. 8)~~**								
071 02 13 04		***~~Procedures~~ Intentionally left blank***								
~~LO (01)~~		~~State that some wind limitations may apply in case of contaminated runways. Those limitations are to be found in Part B of the Operations Manual — Limitations.~~	~~X~~	~~X~~						
~~LO (02)~~		~~State that the procedures associated with take-off and landing on contaminated runways are to be found in Part B of the Operations Manual — Normal procedures.~~	~~X~~	~~X~~						
~~LO (03)~~		~~State that the performances associated with contaminated runways are to be found in Part B of the Operations Manual — Performance.~~	~~X~~	~~X~~						
071 02 13 05		***SNOWTAM and contamination on the aerodrome***								
(01)		Interpret from a SNOWTAM the contamination and braking action on a runway, taxiways and apron. ***Source:* ICAO Annex 15, Appendix 2**	X	X						
(02)		Explain which hazards can be identified from the SNOWTAM/METAR and how to mitigate them.	X	X	X	X	X			
071 02 14 00		**Rotor downwash**								
071 02 14 01		***Describe downwash***								
(01)		Describe the downwash.			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
071 02 14 02		***Effects***								
(01)		~~State~~ Explain ~~the~~ its effects~~s~~ ~~on~~: soil erosion, water dispersal and spray, recirculation, damage to property, loose articles.			X	X	X			
071 02 15 00		**Operation influence by meteorological conditions (~~H~~helicopter)**								
071 02 15 01		***White-out/sand/dust***								
(01)		Give the definition of 'white-out'.			X	X	X			
(02)		Describe loss of spatial orientation.			X	X	X			
(03)		Describe take-off and landing techniques.			X	X	X			
071 02 15 02		***Strong winds***								
(01)		Describe blade sailing.			X	X	X			
(02)		Describe wind operating envelopes.			X	X	X			
(03)		Describe vertical speed problems.			X	X	X			
071 02 15 03		***Mountain environment***								
(01)		Describe constraints associated with mountain environment.			X	X	X			
071 03 00 00		**EMERGENCY PROCEDURES (HELICOPTER)**								
071 03 01 00		**Influence of technical problems**								
071 03 01 01		***Engine failure***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Describe recovery techniques in the event of engine ~~for~~ failure ~~in~~during: hover, climb, cruise, approach.			X	X	X			
071 03 01 02		***Fire in the cabin~~/~~, in the flight crew compartment ~~cockpit/~~ and in the engine(s)***								
(01)		Describe the basic actions when encountering fire in the cabin, ~~cockpit~~flight deck or engine(s).			X	X	X			
071 03 01 03		***Tail~~/~~-rotor~~/~~directional control failure***								
(01)		Describe the basic actions following loss of tail rotor.			X	X	X			
(02)		Describe the basic actions following loss of directional control.			X	X	X			
071 03 01 04		***Ground resonance***								
(01)		Describe recovery actions.			X	X	X			
071 03 01 05		***Blade stall***								
(01)		Describe cause of and recovery actions when encountering retreating blade stall.			X	X	X			
071 03 01 06		***Settling with power (vortex ring)***								
(01)		Describe~~ prerequisite~~ potential conditions for this event and recovery actions.			X	X	X			
071 03 01 07		***Overpitch***								
(01)		Describe recovery actions.			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
071 03 01 08		***Overspeed: rotor/engine***								
(01)		Describe overspeed control.			X	X	X			
071 03 01 09		***Dynamic rollover***								
(01)		Describe potential conditions for this event and recovery action.			X	X	X			
071 03 01 10		***Mast bumping***								
(01)		Describe potential conditions of the 'conducive to' and 'avoidance of' effect.			X	X	X			
071 04 01 00		**SPECIALISED OPERATIONS** **(Regulation (EU) No 965/2012 on air operations as amended)**								
071 04 01 01		***Additional requirements for commercial specialised operations and CAT operations (Annex III (Part-ORO), Subpart FC, Section 3)***								
(01)		Explain the requirements related to flight crew recurrent training and checking and operator proficiency check. ***Source:*** **Point ORO.FC.330 'Recurrent training and checking — operator proficiency check'**	X	X	X	X	X			
071 04 01 02		***General requirements (Annex VIII (Part-SPO), Subpart A)***								
(01)		Explain the task specialist's responsibilities. ***Source:*** **Point SPO.GEN.106 'Task specialists**	X	X	X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		responsibilities’								
071 04 01 03		***Helicopter external sling load operations (HESLO) (Annex VIII (Part-SPO), Subpart E)***			X	X	X			
(01)		Explain the standard operating procedures, equipment requirements and transport of dangerous goods requirements. ***Source:*** **Point SPO.SPEC.HEC.100 ‘Standard operating procedures’ and related AMCs/GM;** **Point SPO.SPEC.HEC.105 ‘Specific HEC equipment’ and related AMCs/GM**			X	X				
071 04 01 04		***Human external cargo operations (HEC)) (Annex VIII (Part-SPO), Subpart E)***			X	X	X			
(01)		Explain the standard operating procedures and equipment requirements. ***Source:*** **Point SPO.SPEC.HEC.100 ‘Standard operating procedures’ and related AMCs/GM;** **Point SPO.SPEC.HEC.105 ‘Specific HEC equipment’ and related AMCs/GM**			X	X	X			

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Appendix to Annex I to ED Decision 2018/001/R

‘Acceptable Means of Compliance (AMCs) and Guidance Material (GM) to Part-FCL Amendment 4’

Appendix
‘SUBJECT 081 — PRINCIPLES OF FLIGHT — AEROPLANES’
to
AMC1 FCL.310; FCL.515(b); FCL.615(b)
‘Theoretical knowledge examinations’
of Annex I

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~~*SUBJECT 081 — PRINCIPLES OF FLIGHT (AEROPLANE)*~~

SUBJECT 081 — PRINCIPLES OF FLIGHT — AEROPLANES

~~(1)~~1. The following standard symbols and their corresponding meanings ~~conventions~~ are used for certain mathematical operations~~symbols~~:

*	multiplication
≥	greater than or equal to
≤	less than or equal to
SQRT(…)	square root of the function, symbol or number in round brackets

~~(2)~~2. Normally, it should be assumed that the effect of a variable under review is the only variation that needs to be addressed, unless specifically stated otherwise.

~~(3)~~3. Candidates are expected in simple calculations to be able to convert knots (kt) into metres/second (m/s), and know the appropriate conversion factors by heart.

~~(4)~~4. In the subsonic range, as covered under Subject 081 01, compressibility effects normally are not considered, unless specifically mentioned.

~~(5)~~5. For those questions related to propellers (Subject 081 07), as a simplification of the physical reality, the inflow speed into the propeller plane is taken as the aeroplane’s true airspeed (TAS).

6. In addition, when discussing propeller rotational direction, it will always be specified as seen from behind the propeller plane.

7. Note that the term ‘mass’ is used to describe a quantity of matter, and ‘weight’ when describing the force. However, the term ‘weight’ is normally used in aviation to colloquially describe ‘mass’. The professional pilot should always note the units to determine whether the term ‘weight’ is being used to describe a force (e.g. unit newton) or quantity of matter (e.g. unit kilogram).

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
080 00 00 00		**PRINCIPLES OF FLIGHT**								
081 00 00 00		**PRINCIPLES OF FLIGHT — AEROPLANES**								
081 01 00 00		**SUBSONIC AERODYNAMICS**								
081 01 01 00		**Basics, laws and definitions**								
081 01 01 01		***Laws and definitions***								
(01)		List the international system ~~(SI)~~ of units of measurement (SI) for mass, acceleration, weight, velocity, energy, density, temperature, pressure, force, wing loading and power.	X	X						
(02)	X	Define ‘mass’, ‘force’, ‘acceleration’ and ‘weight’.	X	X						
(03)		State and interpret Newton’s three laws of motion.	X	X						
~~LO (04)~~		~~State and interpret Newton’s first law.~~	~~X~~	~~X~~						
~~LO (05)~~		~~State and interpret Newton’s second law~~	~~X~~	~~X~~						
~~LO (06)~~		~~State and interpret Newton’s third law.~~	~~X~~	~~X~~						
(07)	X	Explain air density.	X	X						
(08)	X	List the atmospheric properties that effect air density.	X	X						
(09)		Explain how temperature and pressure changes affect air density.	X	X						
(10)	X	Define ‘static pressure’.	X	X						
(11)	X	Define ‘dynamic pressure’.	X	X						
(12)	X	State the formula for ‘dynamic pressure’.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(13)		Describe dynamic pressure in terms of an indication of the energy in the system, and how it is related to indicated airspeed (IAS) and air density for a given altitude and speed.	X	X						
(14)		State Bernoulli's equation for incompressible flow.	X	X						
(15)		Define 'total pressure' and explain that the total pressure differs in different systems.	X	X						
(16)		Apply Bernoulli's equation to flow through a venturi stream tube for incompressible flow.	X	X						
(17)		Describe how IAS is acquired from the pitot static system.	X	X						
(18)		Describe the relationship between density, temperature and pressure for air.	X	X						
(19)		Explain the equation of continuity and its application to the flow through a stream tube.	X	X						
(20)	X	Define 'IAS', 'CAS', 'EAS', and 'TAS'.	X	X						
081 01 01 02		***Basics ~~about~~ of airflow***								
(01)	X	Describe steady and unsteady airflow.	X	X						
(02)	X	Explain the concept of a streamline and a stream tube.	X	X						
(03)	X	Describe and explain airflow through a stream tube.	X	X						
(04)	X	Explain the difference between two- and three-dimensional airflow.	X	X						
081 01 01 03		***Aerodynamic forces ~~and moments~~ on aerofoils***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Describe the originating point and direction of the resultant force caused by ~~resulting from~~ the pressure distribution around an aerofoil.	X	X						
(02)	X	Resolve the resultant force into the components ‘lift’ and ‘drag’.	X	X						
(03)		Describe the direction of lift and drag.	X	X						
(04)	X	Define the ‘aerodynamic moment’.	X	X						
(05)	X	List the factors that affect the aerodynamic moment.	X	X						
(06)		Describe the aerodynamic moment for a symmetrical aerofoil.	X	X						
(07)		Describe the aerodynamic moment for a positively and negatively cambered aerofoil.	X	X						
~~LO (08)~~		~~Forces and equilibrium of forces (refer to 081 08 00 00).~~	~~X~~	~~X~~						
(09)	X	Define ‘angle of attack’ (α).	X	X						
081 01 01 04		***Shape of an aerofoil section***								
		~~Describe the following parameter of an aerofoil section:~~								
(01)	X	Describe the following parameter of an aerofoil section: leading edge.	X	X						
(02)	X	Describe the following parameter of an aerofoil section: trailing edge.	X	X						
(03)		Describe the following parameter of an aerofoil section: chord line.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		Describe the following parameter of an aerofoil section: thickness-to-chord ratio or relative thickness.	X	X						
(05)		Describe the following parameter of an aerofoil section: location of maximum thickness.	X	X						
(06)		Describe the following parameter of an aerofoil section: camber line.	X	X						
(07)		Describe the following parameter of an aerofoil section: camber.	X	X						
(08)	X	Describe the following parameter of an aerofoil section: nose radius.	X	X						
(09)	X	Describe a symmetrical and an asymmetrical aerofoil section.	X	X						
081 01 01 05		***Wing shape***								
		~~Describe the following parameters of a wing:~~								
(01)	X	Describe the following parameter of a wing: span.	X	X						
(02)	X	Describe the following parameter of a wing: tip and root chord.	X	X						
(03)		Describe the following parameter of a wing: taper ratio.	X	X						
(04)	X	Describe the following parameter of a wing: wing area.	X	X						
(05)		Describe the following parameter of a wing: wing planform.	X	X						
(06)	X	Describe the following parameter of a wing: mean geometric chord.	X	X						
(07)		Describe the following parameter of a wing: mean aerodynamic	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		chord (MAC).								
(08)		Describe the following parameter of a wing: aspect ratio.	X	X						
(09)	X	Describe the following parameter of a wing: dihedral angle.	X	X						
(10)	X	Describe the following parameter of a wing: sweep angle.	X	X						
(11)	X	Describe the following parameter of a wing: wing twist~~;~~ , geometric and aerodynamic .	X	X						
(12)		Describe the following parameter of a wing: angle of incidence. *Remark: In certain textbooks, angle of incidence is used as angle of attack (α). For Part-FCL theoretical knowledge examination purposes this use is discontinued, and the angle of incidence is defined as the angle between the aeroplane longitudinal axis and the wing-root chord line.*	X	X						
081 01 02 00		**Two-dimensional airflow around an aerofoil**								
081 01 02 01		***Streamline pattern***								
(01)	X	Describe the streamline pattern around an aerofoil.	X	X						
(02)		Describe converging and diverging streamlines, and their effect on static pressure and velocity.	X	X						
(03)	X	Describe upwash and downwash.	X	X						
081 01 02 02		***Stagnation point***								
(01)		Describe the stagnation point.	X	X						
(02)		Describe the movement of the stagnation point as the α changes.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
~~LO (03)~~		~~Explain local-pressure changes.~~	~~X~~	~~X~~						
081 01 02 03		***Pressure distribution***								
(01)		Describe pressure distribution and local speeds around an aerofoil including effects of camber and ~~angle of attack~~ α.	X	X						
(02)		Describe where the minimum local static pressure is typically situated on an aerofoil.	X	X						
081 01 02 04		***Centre of pressure (CP) and aerodynamic centre (AC)***								
(01)		Explain ~~centre of pressure~~CP and ~~aerodynamic centre~~AC.	X	X						
081 01 02 05		***~~Lift and downwash~~ Intentionally left blank***								
~~LO (01)~~		~~Explain the association between lift and downwash.~~	~~X~~	~~X~~						
081 01 02 06		***Drag and wake***								
(01)	X	List two physical phenomena that cause drag.	X	X						
(02)		Describe skin friction drag.	X	X						
(03)		Describe form (pressure) drag.	X	X						
(04)	X	Explain why drag and wake cause loss of energy (momentum).	X	X						
081 01 02 07		***Influence of angle of attack (α)***								
(01)		Explain the influence of ~~angle of attack~~α on lift.	X	X						
081 01 02 08		***~~Flow separation at high angles of attack~~ Intentionally left blank***								
~~LO (01)~~		~~Refer to 081 01 08 01.~~	~~X~~	~~X~~						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
081 01 02 09		***The lift coefficient (C_L) ~~lift~~ — angle of attack (α) graph***								
(01)		Describe the C_L ~~lift and the angle of attack~~ (α) graph.	X	X						
(02)		Explain the significant points: — point where the curve crosses the horizontal axis (zero lift); — point where the curve crosses the vertical axis (α = 0); — point where the curve reaches its maximum (C_{LMAX}).	X	X						
~~LO (03)~~		~~Describe the coefficient of lift against α graph for a symmetrical aerofoil.~~	~~X~~	~~X~~						
081 01 03 00		***Coefficients***								
081 01 03 01		***General use of coefficients***								
(01)	X	Explain why coefficients are used in general.	X	X						
081 01 03 ~~01~~02		***The lift coefficient (C_L)***								
(01)		Explain ~~Describe~~ the lift formula, the factors that affect lift, and perform simple calculations.	X	X						
(02)		Describe the effect of camber on the C_L–α graph (symmetrical and positively/ negatively cambered aerofoils).	X	X						
(03)		Describe the typical difference in the C_L–α graph for fast and slow aerofoil design.	X	X						
(04)	X	Define 'C_{LMAX}' (maximum lift coefficient) and 'α_{CRIT}' (stalling α) on the graph.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(05)		Describe C_L and explain the variables that affect it in low subsonic flight.	X	X						
081 01 03 ~~02~~03		***~~The~~ Drag ~~coefficient C_{dp}~~***								
(01)		Describe the two-dimensional drag formula and perform simple calculations.	X	X						
(02)		Discuss the effect of the shape of a body, cross-sectional area and surface roughness on the drag coefficient.	X	X						
~~LO (03)~~		~~Describe the Coefficient of lift – Coefficient of drag graph (aerofoil polar).~~	~~X~~	~~X~~						
~~LO (04)~~		~~Indicate minimum drag on the graph.~~	~~X~~	~~X~~						
~~LO (05)~~		~~Explain why the C_l–C_d ratio is important as a measure of performance.~~	~~X~~	~~X~~						
~~LO (06)~~	~~X~~	~~State the normal values of C_l–C_d.~~	~~X~~	~~X~~						
081 01 04 00		**Three-dimensional airflow ~~about~~ around an aeroplane**								
081 01 04 01		***Angle of attack (α)***								
(01)	X	Define ‘angle of attack’ (α). *Remark: For theoretical knowledge examination purposes, the angle-of-attack definition requires a reference line. This reference line for 3D has been chosen to be the longitudinal axis and for 2D the chord line.*	X	X						
(02)		Explain the difference between the (α) and the attitude of an aeroplane.	X	X						

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Syllabus reference	**BK**	**Syllabus details and associated Learning Objectives**	**Aeroplane**		**Helicopter**			**IR**	**CB-IR(A) and EIR**	**Remarks**
			ATPL	**CPL**	**ATPL /IR**	**ATPL**	**CPL**			
081 01 04 ~~01~~02		***Streamline pattern***								
(01)		Describe the general streamline pattern around the wing, tail section and fuselage.	X	X						
(02)		Explain and describe the causes of spanwise flow over top and bottom surfaces.	X	X						
(03)		Describe wing tip vortices and the contribution to downwash behind the wing.	X	X						
(04)		Explain why wing tip vortices vary with (α).	X	X						
~~LO (05)~~		~~Explain upwash and downwash due to tip vortices.~~	~~X~~	~~X~~						
(06)		Describe spanwise lift distribution including the effect of wing planform.	X	X						
(07)		Describe the causes, distribution and duration of the wake turbulence behind an aeroplane.	X	X						
(08)		Describe the influence of flap deflection on the wing tip vortex.	X	X						
(09)		Describe the parameters that influence wake turbulence.	X	X						
081 01 04 ~~02~~03		***Induced drag***								
(01)		Explain the factors that ~~what~~ cause ~~the~~ induced drag.	X	X						
(02)		Describe the approximate formula for the induced drag coefficient (including variables but excluding constants).	X	X						
~~LO (03)~~		~~State the factors that affect induced drag.~~	~~X~~	~~X~~						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(04)		Describe the relationship between induced drag and total drag in straight and level flight with variable speed.	X	X						
(05)		Describe the effect of mass on induced drag at a given IAS.	X	X						
(06)		Describe the means to reduce induced drag: — aspect ratio; — winglets; — tip tanks; — wing twist; — camber change.	X	X						
(07)		Describe the influence of lift distribution on induced drag.	X	X						
(08)		Describe the influence of downwash on the effective airflow.	X	X						
(09)		Explain induced and effective local α.	X	X						
(10)		Explain the influence of the induced α on the direction of the lift vector.	X	X						
(11)		Explain the relationship between induced drag and: — speed; — aspect ratio; — wing planform; — bank angle in a horizontal coordinated turn.	X	X						
~~LO (12)~~		~~Explain the induced drag coefficient.~~	~~X~~	~~X~~						
(13)		Explain the induced drag coefficient and its relationship with the lift coefficient and aspect ratio.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(14)		Explain the influence of induced drag on: — the C_L–α graph, and show the effect on the graph when comparing high- and low-aspect ratio wings; — the C_L–C_D (aeroplane polar), and show the effect on the graph when comparing high- and low-aspect ratio wings; — the parabolic aeroplane polar in a graph and as a formula [$C_D = C_{PD} + kC_L^2$], where C_D = coefficient of drag and C_{PD} = coefficient of parasite drag.	X	X						
(15)		Describe the C_L–C_D graph (polar).	X	X						
(16)		Indicate minimum drag on the graph.	X	X						
(17)		Explain why the **C_L–C_D** ratio is important as a measure of performance.	X	X						
(18)	X	State the normal values of **C_L–C_D**.	X	X						
081 01 05 00		**Total drag**								
_081 01 05 01_		**_Total drag in relation to parasite drag and induced drag_**								
(01)	X	State that total drag consists of parasite drag and induced drag.	X	X						
_081 01 05 ~~01~~02_		**_Parasite drag_**								
(01)		Describe ~~List~~ the types of drag that are included in parasite drag.	X	X						
(02)		Describe form (pressure) drag and the factors which affect its magnitude.	X	X						
(03)		Describe interference drag and the factors which affect its magnitude.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		Describe friction drag and the factors which affect its magnitude.	X	X						
081 01 05 ~~02~~03		***Parasite drag and speed***								
(01)		Describe the relationship between parasite drag and speed.	X	X						
081 01 05 ~~03~~04		***Induced drag and speed*** *(Refer to 081 01 04 ~~02~~03)*								
~~081 01 05 04~~		***~~Intentionally left blank~~***								
081 01 05 05		***Total drag ~~and speed~~***								
(01)		Explain the total drag–speed graph and the constituent drag components.	X	X						
(02)		Indicate the speed for minimum drag.	X	X						
081 01 05 06		***Intentionally left blank***								
081 01 05 07		***Variables affecting t~~T~~he total drag–speed graph***								
(01)		Describe the effect of aeroplane gross mass on the graph.	X	X						
(02)		Describe the effect of pressure altitude on: — drag–IAS graph; — drag–TAS graph.	X	X						
(03)		Describe speed stability from the graph.	X	X						
(04)		Describe non-stable, neutral and stable IAS regions.	X	X						
(05)		Explain what happens to the IAS and drag in the non-stable region if speed suddenly decreases and why this could occur.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
081 01 06 00		**Ground effect**								
081 01 06 01		***Influence of ground effect*** ~~***Effect on C_{Di}***~~								
(01)		Explain the influence of ground effect on ~~what happens to the~~ wing tip vortices, downwash, airflow pattern, lift, and drag ~~in ground effect~~.	X	X						
(~~01~~02)		Describe the influence of ground effect on ~~C_{Di} and~~ induced α ~~angle of attack~~ and the coefficient of induced drag (C_{Di}).	X	X						
(~~02~~03)		Explain the effects of~~n~~ entering and leaving ground effect.	X	X						
081 01 06 02		***Effect on stalling angle of attack*** **(α_{CRIT})**								
(01)		Describe the influence of ground effect on α_{CRIT} ~~α_{stall}~~.	X	X						
081 01 06 03		***Effect on lift coefficient (C_L)***								
(01)		Describe the influence of ground effect on the effective α and C_L.	X	X						
081 01 06 04		***Effect on take-off and landing characteristics of an aeroplane***								
(01)		Describe the influence of ground effect on take-off and landing characteristics and performance of an aeroplane.	X	X						
(02)		Describe the difference in take-off and landing characteristics of high- and low-wing aeroplanes.~~between:~~ — ~~high and low wing characteristics;~~ — ~~high and low tail characteristics.~~	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (03)~~		~~Explain the effects on static pressure measurements at the static ports when entering and leaving ground effect.~~	~~X~~	~~X~~						
081 01 07 00		**The relationship between lift coefficient and speed in steady, straight and level flight**								
081 01 07 01		***Represented by an equation***								
(01)		Explain the effect on C_L during speed increase/decrease in steady, straight and level flight, and perform simple calculations.	X	X						
081 01 07 02		***Represented by a graph***								
(01)		Explain, by using a graph, the effect on speed of C_L changes at a given weight.	X	X						
081 01 08 00		**~~The stall~~ Intentionally left blank**								
~~081 01 08 01~~		***~~Flow separation at increasing angles of attack~~***								
~~LO (01)~~		~~Define the 'boundary layer'.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Describe the thickness of a typical laminar and turbulent boundary layer.~~	~~X~~	~~X~~						
~~LO (03)~~		~~List the factors that affect thickness.~~	~~X~~	~~X~~						
~~LO (04)~~		~~Describe the properties, advantages and disadvantages of the laminar boundary layer.~~	~~X~~	~~X~~						
~~LO (05)~~		~~Describe the properties, advantages and disadvantages of the turbulent layer.~~	~~X~~	~~X~~						
~~LO (06)~~		~~Define the 'transition point'.~~	~~X~~	~~X~~						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
~~LO (07)~~		~~List the differences between laminar and turbulent boundary layers.~~	~~X~~	~~X~~						
~~LO (08)~~		~~Explain why the laminar boundary layer separates easier than the turbulent one.~~	~~X~~	~~X~~						
~~LO (09)~~		~~Describe why List the factors that slow down the airflow over the aft part of an wing aerofoil slows down , as the angle of attack increases.~~	~~X~~	~~X~~						
~~LO (10)~~		~~Define the 'separation point' and describe its location as a function of angle of attack.~~	~~X~~	~~X~~						
~~LO (11)~~		~~Define the 'critical stall angle of attack'.~~	~~X~~	~~X~~						
~~LO (12)~~		~~Describe in straight and level flight the influence of increasing the angle of attack on:~~ — ~~the forward stagnation point;~~ — ~~the pressure distribution;~~ — ~~the location of the centre of pressure (straight and swept back wing);~~ — ~~CL and L;~~ — ~~CD and D;~~ — ~~the pitching moment (straight and swept back wing);~~ — ~~the downwash at the horizon stabiliser.~~	~~X~~	~~X~~						
~~LO (13)~~		~~Explain what causes the possible natural buffet on the controls in a pre-stall condition.~~	~~X~~	~~X~~						
~~LO (14)~~		~~Describe the effectiveness of the flight controls in a pre-stall~~	~~X~~	~~X~~						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~condition.~~								
~~LO (15)~~		~~Describe and explain the normal post-stall behaviour of a straight wing/ aeroplane;~~	~~X~~	~~X~~						
~~LO (16)~~		~~Describe the effect and dangers of using the controls close to the stall.~~	~~X~~	~~X~~						
~~***081 01 08 02***~~		~~***The stall speed***~~								
~~LO (01)~~		~~Explain V_{S0}, V_{S1}, V_{SR}, V_{S1g}.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Solve the 1gG stall speed from the lift formula, given varying:~~ — ~~airspeed;~~ — ~~coefficient of lift.~~	~~X~~	~~X~~						
~~LO (03)~~		~~Describe and explain the influence of the following parameters on stall speed:~~ — ~~centre of gravity;~~ — ~~thrust component;~~ — ~~slipstream;~~ — ~~wing loading;~~ — ~~mass;~~ — ~~wing contamination;~~ — ~~angle of sweep;~~ — ~~altitude (for compressibility effects, see 081 02 03 02).~~	~~X~~	~~X~~						
~~LO (04)~~		~~Define the 'load factor n'.~~	~~X~~	~~X~~						
~~LO (05)~~		~~Explain why the load factor increases in a turn.~~	~~X~~	~~X~~						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (06)~~		~~Explain why the load factor increases in a pull-up and decreases in a push-over manoeuvre.~~	~~X~~	~~X~~						
~~LO (07)~~		~~Describe and explain the influence of the 'load factor n' on stall speed.~~	~~X~~	~~X~~						
~~LO (08)~~		~~Explain the expression 'accelerated stall'.~~ ~~*Remark: Sometimes accelerated stall is also erroneously referred to as high-speed stall. This latter expression will not be used for subject 081.*~~	~~X~~	~~X~~						
~~LO (09)~~		~~Calculate the change of stall speed as a function of the load factor.~~	~~X~~	~~X~~						
~~LO (10)~~		~~Calculate the increase of stall speed in a horizontal coordinated turn as a function of bank angle.~~	~~X~~	~~X~~						
~~LO (11)~~		~~Calculate the change of stall speed as a function of the gross mass.~~	~~X~~	~~X~~						
~~***081 01 08 03***~~		~~***The initial stall in span-wise direction***~~								
~~LO (01)~~		~~Explain the initial stall sequence on the following planforms:~~ — ~~elliptical;~~ — ~~rectangular;~~ — ~~moderate and high taper;~~ — ~~sweepback or delta.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Explain the influence of geometric twist (wash out.) and aerodynamic twist.~~	~~X~~	~~X~~						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
~~LO (03)~~		~~Explain the influence of deflected ailerons.~~	~~X~~	~~X~~						
~~LO (04)~~		~~Explain the influence of fences, vortilons, saw teeth, vortex generators (on engine nacelles).~~	~~X~~	~~X~~						
~~081 01 08 04~~		***~~Stall warning~~***								
~~LO (01)~~		~~Explain why stall warning is necessary.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Explain when aerodynamic and artificial stall warnings are used.~~	~~X~~	~~X~~						
~~LO (03)~~		~~Explain why CS-23 and CS-25 require a margin to stall speed~~	~~X~~	~~X~~						
~~LO (04)~~		~~Describe:~~ — ~~buffet;~~ — ~~stall strip;~~ — ~~flapper switch (leading-edge stall-warning vane);~~ — ~~angle-of-attack vane;~~ — ~~angle-of-attack probe;~~ — ~~stick shaker.~~	~~X~~	~~X~~						
~~LO (05)~~		~~Describe the recovery after:~~ — ~~stall warning;~~ — ~~stall;~~ — ~~stick-pusher actuation.~~	~~X~~	~~X~~						
~~081 01 08 05~~		***~~Special phenomena of stall~~***								
~~LO (01)~~		~~Describe the basic stall requirements for transport category aeroplanes.~~	~~X~~	~~X~~						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
~~LO (02)~~		~~Explain the difference between power-off and power-on stalls and recovery.~~	~~X~~	~~X~~						
~~LO (03)~~		~~Describe stall and recovery in a climbing and descending turn.~~	~~X~~	~~X~~						
~~LO (04)~~		~~Describe the effect on stall and recovery characteristics of:~~ — ~~wing sweep (consider both forward and backward sweep);~~ — ~~T-tailed aeroplane;~~ — ~~canards.~~	~~X~~	~~X~~						
~~LO (05)~~		~~Describe super-stall or deep-stall.~~	~~X~~	~~X~~						
~~LO (06)~~		~~Describe the philosophy behind the stick-pusher system.~~	~~X~~	~~X~~						
~~LO (07)~~		~~Explain the effect of ice, frost or snow on the :~~ — ~~stagnation point.~~	~~X~~	~~X~~						
~~LO (08)~~		— ~~danger and reason for the absence of stall warning.~~	~~X~~	~~X~~						
~~LO (09)~~		— ~~abnormal behaviour of the stall.~~	~~X~~	~~X~~						
~~LO (10)~~		~~Describe and explain the cause and effects of the stabiliser stall caused by ice (negative tail stall).~~	~~X~~	~~X~~						
~~LO (11)~~		~~Describe when to expect in-flight icing.~~	~~X~~	~~X~~						
~~LO (12)~~		~~Explain how the effect is changed when retracting/ extending lift augmentation devices.~~	~~X~~	~~X~~						
~~LO (13)~~		~~Describe how to recover from a stall after a configuration change caused by in-flight icing.~~	~~X~~	~~X~~						
~~LO (14)~~		~~Explain the effect of a contaminated wing on the stall speed~~	~~X~~	~~X~~						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~and critical angle of attack.~~								
~~LO (15)~~		~~Explain what 'on-ground' icing is.~~	~~X~~	~~X~~						
~~LO (16)~~		~~Describe the aerodynamic effects and hazards of de-icing/anti-ice fluid after the holdover time has been reached.~~	~~X~~	~~X~~						
~~LO (17)~~		~~Describe the aerodynamic effects of heavy tropical rain on stall speed and drag, and appropriate mitigation in such conditions.~~	~~X~~	~~X~~						
~~LO (18)~~		~~Explain how to avoid spins.~~	~~X~~	~~X~~						
~~LO (19)~~		~~List the factors that cause a spin to develop.~~	~~X~~	~~X~~						
~~LO (20)~~		~~Describe spin development, recognition and recovery.~~	~~X~~	~~X~~						
~~LO (21)~~		~~Describe the differences in spin attitude with forward and aft centre of gravity. Recovery techniques for aeroplanes that have different mass distributions between the wings and the fuselage.~~	~~X~~	~~X~~						
081 01 09 00		**C_{LMAX} augmentation**								
081 01 09 01		***Trailing-edge flaps and the reasons for their use in take-off and landing***								
~~LO (01)~~		~~Describe trailing-edge flaps and the reasons for their use during take-off and landing.~~	~~X~~	~~X~~						
(02)		From the given relevant diagrams describe or ~~i~~Identify the following types of trailing-edge flaps ~~given a relevant diagram~~: — split flaps; — plain flaps;	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		— slotted flaps; — Fowler flaps.								
~~LO (03)~~		~~Describe their effect on wing geometry.~~	~~X~~	~~X~~						
(04)		Describe how the wing's effective camber increases the C_L and C_D, and the reasons why this can be beneficial.	X	X						
~~LO (05)~~		~~Describe how the effective chord line differs from the normal chord line.~~	X	X						
(06)		Describe their effect on: — the location of CP~~centre of pressure~~; — pitching moments (due to wing CP movement); — stall speed.	X	X						
(07)		Compare their influence on the C_L–α graph: — indicate the variation in C_L at any given α~~angle of attack~~; — ~~indicate the variation in C_D at any given~~ α~~angle of attack;~~ — indicate their effect on C_{LMAX}; — indicate their effect on ~~the stall or~~ critical α~~angle of attack~~; — indicate their effect on the α~~angle of attack~~ at a given C_L.	X	X						
(08)		Compare their influence on the C_L–C_D graph: — indicate how the $(C_L/C_D)_{MAX}$ differs from that of a clean wing.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(09)		Explain the influence of trailing-edge flap deflection on the glide angle.	X	X						
(10)		Describe flap asymmetry: — explain the effect on aeroplane controllability.	X	X						
(11)		Describe trailing-edge flap effect on take-off and landing: — explain the advantages of lower-nose attitudes; — explain why take-off and landing speeds/distances are reduced.	X	X						
(12)		Explain the effects of flap-setting errors, such as mis-selection and premature/late extension or retraction of flaps, on: — take-off and landing distance and speeds; — climb and descent performance; — stall buffet margins.	X	X						
081 01 09 02		***Leading-edge devices and the reasons for their use in take-off and landing***								
~~LO (01)~~		~~Describe leading-edge high-lift devices.~~	~~X~~	~~X~~						
(02)		From the given relevant diagrams, describe or ~~i~~Identify the different types of leading-edge high-lift devices ~~given a relevant diagram~~: — Krueger flaps; — variable camber flaps; — slats.	X	X						
~~LO (03)~~		~~State their effect on wing geometry.~~	~~X~~	~~X~~						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		Describe the function of the slot.	X	X						
(05)		Describe how the wing's effective camber increases with a leading-edge flap.	X	X						
~~LO (06)~~		~~Describe how the effective chord line differs from the normal chord line.~~	~~X~~	~~X~~						
(07)		Explain ~~State~~ the~~ir~~ effect of leading-edge flaps on the stall speed, also in comparison with trailing-edge flaps.	X	X						
(08)		Compare their influence on the C_L–α graph, compared with trailing-edge flaps and a clean wing: — indicate the effect of leading-edge devices on C_{LMAX}; — explain how the C_L curve differs from that of a clean wing; — indicate the effect of leading-edge devices on the stall or critical α_{CRIT} ~~angle of attack~~.	X	X						
(09)		Compare their influence on the C_L–C_D graph.	X	X						
(10)		Describe slat asymmetry: — describe the effect on aeroplane controllability.	X	X						
(11)		Explain the reasons for using leading-edge high-lift devices on take-off and landing: — explain the disadvantage of increased nose-up attitudes; — explain why take-off and landing speeds/distances are reduced.	X	X						
081 01 09 03		***Vortex generators***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Explain the purpose of vortex generators.	X	X						
(02)		Describe the basic operating principle of vortex generators.	X	X						
(03)		State their advantages and disadvantages.	X	X						
081 01 10 00		**Means to reduce the C_L–C_D ratio**								
081 01 10 01		***Spoilers and the reasons for their use in the different phases of flight***								
(01)		Describe the aerodynamic functioning of spoilers: — roll spoilers; — flight spoilers (speed brakes); — ground spoilers (lift dumpers).	X	X						
(02)		Describe the effect of spoilers on the C_L–α graph and stall speed.	X	X						
(03)		Describe the influence of spoilers on the C_L–C_D graph and lift–drag ratio.	X	X						
081 01 10 02		***Speed brakes and the reasons for their us~~e~~ing them in the different phases of flight***								
(01)		Describe speed brakes and the reasons for use in the different phases of flight.	X	X						
(02)		State their influence on the C_L–C_D graph and lift–drag ratio.	X	X						
(03)		Explain how speed brakes increase parasite drag.	X	X						
(04)		Describe how speed brakes affect the minimum drag speed.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(05)		Describe their effect on rate and angle of descent.	X	X						
081 01 11 00		**~~The boundary layer~~ *Intentionally left blank***								
~~081 01 11 01~~		***~~Different types~~***								
~~(01)~~		~~Refer to 081 01 08 01.~~	~~X~~	~~X~~						
~~081 01 11 02~~		***~~Their advantages and disadvantages on pressure drag and friction drag~~***								
081 01 12 00		**Aerodynamic degradation**								
081 01 12 01		***Ice and other contaminants***								
(01)		Describe the locations on an aeroplane where ice build-up will occur during flight.	X	X						
(02)		Explain the aerodynamic effects of ice and other contaminants on: — lift (maximum C_L ~~lift coefficient~~); — drag; — stall speed; — α_{CRIT} ~~stalling~~ — stability and controllability.	X	X						
(03)		Explain the aerodynamic effects of icing ~~on the various phases~~ during take-off.	X	X						
081 01 12 02		***Deformation and modification of airframe, ageing aeroplanes***								
(01)		Describe the effect of airframe deformation and modification of an ageing aeroplane on aeroplane performance.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		Explain the effect on boundary layer condition of an ageing aeroplane.	X	X						
081 02 00 00		**HIGH-SPEED AERODYNAMICS**								
081 02 01 00		**Speeds**								
081 02 01 01		***Speed of sound***								
(01)	X	Define 'speed of sound'.	X							
(02)		Explain the variation of the speed of sound with altitude.	X							
(03)		Explain ~~Describe~~ the influence of temperature on the speed of sound.	X							
081 02 01 02		***Mach number***								
(01)		Define 'Mach number' as a function of TAS and speed of sound~~'~~.	X							
081 02 01 03		***Influence of temperature and altitude on Mach number***								
(01)		Explain the absence of change of Mach number with varying temperature at constant flight level and calibrated airspeed.	X							
(02)		~~Referring to 081 08 01 02 and 081 08 01 03,~~ Explain the relationship ~~of~~ between Mach number, TAS and IAS during climb and descent at constant Mach number and IAS, and explain variation of lift coefficient, ~~angle of attack~~α, pitch and flight-path angle.	X							
(03)		~~Referring to 081 06 01 04 and 081 06 01 05, explain that V_{MO} could be exceeded during a descent at constant Mach number, and that M_{MO} could be exceeded during a climb at constant IAS,~~	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~if climb or descent not managed~~. Explain: — risk of exceeding the maximum operation speed (V_{MO}) when descending at constant Mach number; — risk of exceeding the maximum operating Mach number (M_{MO}) when climbing at constant IAS; — risk of a low-speed stall at high altitude when climbing at a too low Mach number.								
081 02 01 04		***Compressibility***								
(01)		State that compressibility means that density can change along a streamline, and that this occurs in the high subsonic, transonic and supersonic flow~~above~~.	X							
(02)	X	~~Describe how the streamline pattern changes due to compressibility~~ State that compressibility negatively affects the pressure gradient, leading to an overall reduction of the C_L.	X							
(03)	X	State that Mach number is a measure of compressibility.	X							
(04)		Describe that compressibility increases low speed stall speed and decreases α_{CRIT} ~~the critical angle of attack~~	X							
081 02 01 05		***Subdivision of aerodynamic flow***								
(01)	X	List the subdivision of aerodynamic flow: — subsonic flow; — transonic flow; — supersonic flow.	X							
(02)		Describe the characteristics of the flow regimes listed above.	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(03)		Explain why ~~State that~~ some transport aeroplanes normally cruise at Mach numbers above the critical Mach number (M_{CRIT}), but below the divergence Mach number ($M_{DRAG\ DIVERGENCE}$).	X							
081 02 02 00		**Shock waves**								
081 02 02 01		***Definition of shock wave***								
(01)	X	Define a 'shock wave'.	X							
081 02 02 ~~01~~02		***Normal shock waves***								
(01)		Describe a normal shock wave with respect to changes in: — static temperature; — static and total pressure; — velocity; — local speed of sound; — Mach number; — density.	X							
(02)		Describe a normal shock wave with respect to orientation relative to the wing surface.	X							
(03)		Explain the influence of increasing Mach number on a normal shock wave, at positive lift, with respect to: — strength; — length; — position relative to the wing;	X							

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		— second shock wave at the lower surface.								
(04)		Explain the influence of ~~angle of attack~~ α on shock-wave intensity and shock-wave location at constant Mach number.	X							
~~LO (05)~~		~~Discuss the bow wave.~~	~~X~~							
~~***081 02 02 02***~~		~~***Oblique shock waves***~~								
~~LO (01)~~		~~Describe an oblique shock wave with respect to changes in:~~ — ~~static temperature;~~ — ~~static and total pressure;~~ — ~~velocity;~~ — ~~local speed of sound;~~ — ~~Mach number;~~ — ~~density.~~	~~X~~							
~~LO (02)~~		~~Compare the characteristics of normal and oblique shock waves.~~	~~X~~							
~~***081 02 02 03***~~		~~***Mach cone***~~								
~~LO (01)~~		~~Define 'Mach angle μ' with a formula and perform simple calculations.~~	~~X~~							
~~LO (02)~~		~~Identify the Mach-cone zone of influence of a pressure disturbance due to the presence of the aeroplane.~~	~~X~~							
~~LO (03)~~		~~Explain 'sonic boom'.~~	~~X~~							
081 02 03 00		**Effects of exceeding the critical Mach number (M_{CRIT})**								
081 02 03 01		***Critical Mach number (M_{CRIT})***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(01)		Define ‘M_{CRIT}’.	X							
(02)		Explain how a change in α~~angle of attack~~, aeroplane weight, manoeuvres and centre-of-gravity (CG) position influences M_{CRIT}.	X							
081 02 03 02		***Effect on lift***								
(01)		Describe the behaviour of ~~lift coefficient~~ C_L versus Mach number at constant α~~angle of attack~~.	X							
~~LO (02)~~		~~Explain shock-induced separation, shock stall, and describe its relationship with Mach buffet.~~	~~X~~							
~~LO (03)~~	~~X~~	~~Define ‘shock stall’.~~ ~~*Remark: For theoretical-knowledge examination purposes, the following description is used for shock stall: Shock stall occurs when the lift coefficient, as a function of Mach number, reaches its maximum value (for a given angle of attack).*~~	~~X~~							
(04)		Explain ~~Describe~~ the consequences of exceeding M_{CRIT} with respect to C_L and C_{LMAX}. — ~~gradient of the C_L–α graph;~~ — ~~C_{LMAX} (stall speed).~~	X							
(05)		Explain the change in stall indicated airspeed (IAS) with altitude.	X							
(06)		Discuss the effect on α_{CRIT} ~~critical or stalling angle of attac~~	X							
(07)		Explain the advantages of slightly exceeding M_{CRIT} in aeroplanes with supercritical aerofoils with respect to:								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— speed versus drag ratio; — specific range; — optimum altitude.								
081 02 03 03		***Effect on drag***								
(01)		Describe wave drag.	X							
(02)		Describe the behaviour of ~~drag coefficient~~ C_D versus Mach number at constant α~~angle of attack~~.	X							
(03)		Explain the effect of Mach number on the C_L–C_D graph.	X							
(04)		Describe the effects and hazards of exceeding $M_{DRAG\ DIVERGENCE}$~~the Define 'drag divergence Mach number' (M_{DD}) and explain the relation with M_{CRIT}~~, namely: — drag rise; — instability; — Mach tuck; — shock stall.	X							
(05)		State the relation between M_{CRIT} and $M_{DRAG\ DIVERGENCE}$.	X							
081 02 03 04		***Effect on pitching moment***								
(01)		Discuss the effect of Mach number on the CP location of ~~centre of pressure and aerodynamic centre~~.	X							
(02)		Describe ~~Explain~~ the overall change in pitching moment from M_{CRIT} to $M_{DRAG\ DIVERGENCE}$ and explain the 'tuck under' or 'Mach tuck' effect.	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)	X	State ~~List~~ the requirement for a Mach trim system ~~methods of compensating~~ to compensate for the effect of the CP movement and 'tuck under' effect.	X							
(04)	X	Discuss the aerodynamic functioning of the Mach trim system.	X							
(05)		Discuss the corrective measures if the Mach trim fails.	X							
081 02 03 05		***Effect on control effectiveness***								
(01)		Discuss the effects on the functioning of control surfaces.	X							
081 02 04 00		***~~Buffet onset~~ Intentionally left blank***								
~~LO (01)~~		~~Explain the concept of buffet margin and describe the influence of the following parameters:~~ — ~~angle of attack;~~ — ~~Mach number;~~ — ~~pressure altitude;~~ — ~~mass;~~ — ~~load factor;~~ — ~~angle of bank;~~ — ~~CG location.~~	~~X~~							
~~LO (02)~~		~~Explain how the buffet onset boundary chart can be used to determine manoeuvre capability.~~	~~X~~							
~~LO (03)~~		~~Describe the effect of exceeding the speed for buffet onset.~~	~~X~~							
~~LO (04)~~		~~Explain aerodynamic ceiling and 'coffin corner'.~~	~~X~~							
~~LO (05)~~		~~Explain the concept of the '1.3G' altitude.~~	~~X~~							

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LO (06)		~~Find (using an example graph):~~ — ~~buffet free range;~~ — ~~aerodynamic ceiling at a given mass;~~ — ~~load factor and bank angle at which buffet occurs at a given mass, Mach number and pressure altitude.~~	~~X~~							
081 02 05 00		**Means to influence critical Mach number (M_{CRIT})**								
081 02 05 01		***Wing sweep***								
(01)		Explain the influence of the angle of sweep on: — M_{CRIT}; — effective thickness/chord change or velocity component perpendicular to the quarter chord line.	X							
(02)		Describe the influence of the angle of sweepback at subsonic speed on: — C_{LMAX}; — efficiency of and requirement for high-lift devices; — pitch-up stall behaviour.	X							
(03)		Discuss the effect of wing sweepback on drag.	X							
081 02 05 02		***Aerofoil shape***								
(01)		Explain the use of thin aerofoils with reduced camber.	X							
(02)		Explain the main purpose of supercritical aerofoils.	X							
(03)	X	Identify the shape characteristics of a supercritical aerofoil shape.	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(04)		Explain the advantages and disadvantages of supercritical aerofoils for wing design.	X							
081 02 05 03		***Vortex generators***								
(01)		Explain the use of vortex generators as a means to avoid or restrict flow separation caused by the presence of a normal shock wave.	X							
~~***081 02 05 04***~~		~~***Area ruling***~~								
~~LO (01)~~		~~Explain area ruling in aeroplane design.~~	~~X~~							
081 03 00 00		**Stall, shock stall, and upset prevention and recovery**								
081 03 01 00		**The stall**								
081 03 01 01		***Flow separation at increasing ~~angles of attack~~ α***								
(01)	X	Define the ‘boundary layer’.	X	X						
(02)	X	Describe the thickness of a typical laminar and turbulent boundary layer.	X	X						
~~LO (03)~~		~~List the factors that affect thickness.~~	~~X~~	~~X~~						
(04)		Describe the properties, advantages and disadvantages of the laminar boundary layer.	X	X						
(05)		Describe the properties, advantages and disadvantages of the turbulent layer.	X	X						
(06)		Define the ‘transition point’.	X	X						
~~LO (07)~~		~~List the differences between laminar and turbulent boundary~~	~~X~~	~~X~~						

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		~~layers.~~								
(08)		Explain why the laminar boundary layer separates easier than the turbulent ~~one~~ layer does.	X	X						
(09)		Describe why ~~List the factors that slow down~~ the airflow over the aft part of a wing ~~aerofoil~~ slows down ~~,~~ as the ~~angle of attack~~α increases.	X	X						
(10)		Define the 'separation point' and describe its location as a function of ~~angle of attack~~α.	X	X						
(11)	X	Define α_{CRIT} ~~the 'critical stall angle of attack'~~.	X	X						
(12)		Describe in straight and level flight the influence of increasing the ~~angle of attack~~α on: — the forward stagnation point; — the pressure distribution; — the CP location ~~of the~~ ~~centre of pressure~~ (straight and swept back wing); — C_L ~~and L~~; — C_D and D (drag);~~.~~ — the pitching moment (straight and swept back wing); — ~~the downwash at the horizon stabiliser.~~	X	X						
(13)		Explain what causes the possible natural buffet on the controls and on the aeroplane in a pre-stall condition.	X	X						
(14)		Describe the effectiveness of the flight controls in a pre-stall condition.	X	X						

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(15)		Describe and explain the normal post-stall behaviour of a straight-wing~~/~~ aeroplane.	X	X						
(16)		Describe the effect and dangers of using the controls close to the stall.	X	X						
081 03 01 02		***The stall speed***								
(01)		Explain V_{S0}, V_{S1}, V_{SR}, and V_{S1G}.	X	X						
(02)		Solve V_{S1G} ~~the 1G stall speed~~ from the lift formula~~,~~ given varying~~:~~ — C_L.	X	X						
(03)		Describe and explain the influence of the following parameters on stall speed: — CG~~centre of gravity~~; — thrust component; — slipstream; — wing loading; — mass; — wing contamination; — angle of sweep; — altitude (for compressibility effects, see 081 02 03 02).	X	X						
(04)	X	Define the 'load factor n'.	X	X						
(05)		Explain why the load factor increases in a turn.	X	X						
(06)		Explain why the load factor increases in a pull-up and decreases	X	X						

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		in a push-over manoeuvre.								
(07)		Describe and explain the influence of the 'load factor n' on stall speed.	X	X						
(08)	X	Explain the expression 'accelerated stall'. *Remark: Sometimes accelerated stall is also erroneously referred to as high-speed stall. This latter expression will not be used for ~~S~~subject 081.*	X	X						
(09)		Calculate the change of stall speed as a function of the load factor.	X	X						
(10)		Calculate the increase of stall speed in a horizontal coordinated turn as a function of bank angle.	X	X						
(11)		Calculate the change of stall speed as a function of the gross mass.	X	X						
081 03 01 03		***The initial stall in ~~spanwise~~ spanwise direction***								
(01)		Explain the initial stall sequence on the following planforms~~plan forms~~: — elliptical; — rectangular; — moderate and high taper; — sweepback or delta.	X	X						
(02)		Explain the purpose of ~~influence~~ of ~~geometric twist (~~washout~~.)~~ ~~and aerodynamic twist.~~	X	X						
(03)		Explain the effect ~~influence~~ of ~~deflected~~ ailerons~~ ~~ deflection.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(04)		Explain the influence of fences, vortilons, saw teeth, vortex generators, and strakes on engine nacelles.	X	X						
081 03 01 04		***Stall warning***								
(01)	X	Explain why stall warning is necessary.	X	X						
(02)	X	Explain when aerodynamic and artificial stall warnings are used.	X	X						
(03)		Explain why CS-23 and CS-25 require a margin to stall speed for take-off and landing speeds.	X	X						
(04)	X	Describe: — buffet; — stall strip; — flapper switch (leading-edge stall-warning vane); — angle-of-attack vane; — angle-of-attack probe; — stick shaker.	X	X						
(05)		Describe the recovery after: — stall warning; — stall; — stick-pusher actuation.	X	X						
081 03 01 05		***Special phenomena of stall***								
(01)	X	Describe the basic stall requirements for commercial air transport (CAT) ~~category~~ aeroplanes.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(02)		Explain the difference between power-off and power-on stalls and recovery.	X	X						
(03)		Describe stall and recovery in a climbing and descending turn.	X	X						
(04)		Describe the effect on stall and recovery characteristics of: — wing sweep (~~consider both forward and~~ backward sweep); — T-tailed aeroplane~~;~~. ~~— canards.~~	X	X						
(05)		Describe super stall or deep stall.	X	X						
(06)		Describe the philosophy behind the stick-pusher system.	X	X						
~~(07)~~		~~Explain the effect of ice, frost or snow on the stagnation point.~~	~~X~~	~~X~~						
(08)		Describe the factors that can lead to the a~~A~~bsence of stall warning and explain the associated risks.	X	X						
~~(09)~~		~~Abnormal behaviour of the stall.~~	~~X~~	~~X~~						
(10)		Describe the indications and explain the ~~cause and effects~~ consequences of ~~the~~ premature stabiliser stall due to ice contamination (negative tail stall).	X	X						
(11)		Describe when to expect in-flight icing.	X	X						
(12)		Explain how the effect is changed when retracting/extending lift augmentation devices.	X	X						
(13)		Describe how to recover from a stall after a configuration change caused by in-flight icing.	X	X						
(14)		Explain the effect of a contaminated wing on the stall speed	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		and α_{CRIT}								
(15)		Explain ~~what 'on-ground' icing is~~ airframe contamination and the aerodynamic effects when parked and during ground operations in winter conditions.	X	X						
(16)		~~Describe the aerodynamic effects of de-icing/anti-ice fluid after the holdover time has been reached.~~ Explain de-icing/anti-icing holdover time and the likely hazards after it has expired.	X	X						
(17)		Describe the aerodynamic effects of heavy tropical rain on stall speed and drag, and the appropriate mitigation in such conditions.	X	X						
081 03 01 06		***The spin***								
(01)		Explain how to avoid spins.	X	X						
(02)		List the factors that cause a spin to develop.	X	X						
(03)		Describe an 'incipient', 'developing' and 'developed' spin, recognition and recovery.	X	X						
(04)		Describe the differences in spin attitude with forward and aft CG. ~~Recovery techniques for aeroplanes that have different mass distributions between the wings and the fuselage.~~	X	X						
081 03 02 00		**Shock sStall**								
081 03 02 01		***Definition and relationship with Mach buffet***								
(01)		Explain shock-induced separation, shock stall, and describe its relationship with Mach buffet.	X							

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)	X	Define 'shock stall'. *Remark: For theoretical knowledge examination purposes, the following description is used for shock stall: Shock stall occurs when the lift coefficient, as a function of Mach number, reaches its maximum value (for a given ~~angle of attack~~α).*	X							
081 03 02 ~~01~~02		***Buffet onset***								
(01)		Explain the concept of buffet margin and describe the influence of the following parameters: — α~~Angle of attack~~; — Mach number; — pressure altitude; — mass; — load factor; — angle of bank; — CG location.	X							
(02)		Explain how the buffet onset boundary chart can be used to determine: — manoeuvrability; — buffet margin. — ~~manoeuvre capability~~.	X							
(03)		Describe the effect of exceeding the speed ~~for~~on buffet onset.	X							
(04)		Explain 'aerodynamic ceiling' and 'coffin corner'.	X							
(05)		Explain the concept of the '1.3g~~G~~' buffet margin altitude.	X							

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(06)		Find (using an example graph): — buffet free range; — aerodynamic ceiling at a given mass; — load factor and bank angle at which buffet occurs at a given mass, Mach number and pressure altitude.	X							
(07)		Explain why descent increases the buffet free range.	X							
081 03 03 00		**Situations in which buffet or stall could occur**								
081 03 03 01		***Explain why buffet or stall occurs***								
(01)		Explain why buffet or stall could occur in the following pilot-induced situations, and the methods to mitigate them: — inappropriate take-off configuration, detailing the consequences of errors associated with leading edge devices; — steep turns; — go-around using take-off/go-around (TOGA) setting (underslung engines).	X	X						
(02)		Explain why buffet or stall could occur in the following environmental conditions at low altitude, and how to mitigate them: — thunderstorms; — wind shear and microburst; — turbulence; — wake turbulence;	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— icing conditions.								
(03)		Explain why buffet or stall could occur in the following environmental conditions at high altitude, and how to mitigate them: — thunderstorms in the intertropical convergence zone (ITCZ); — jet streams; — clear air turbulence.	X							
(04)		Explain why buffet or stall could occur in the following situations, and how to mitigate them: — inappropriate autopilot climb mode; — loss of, or unreliable, airspeed indication.	X	X						
081 03 04 00		**Recognition of stalled condition**								
081 03 04 01		***Recognition and explanation of stalled condition***								
(01)		Explain why a stalled condition can occur at any airspeed, or attitude or altitude.	X	X						
(02)		Explain that a stall may be recognised by continuous stall-warning activation accompanied by at least one of the following: — buffet, that can be heavy; — lack of pitch authority; — uncommanded pitch down and uncommanded roll; — inability to arrest the descent rate.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(03)		Explain that 'stall warning' means a natural or synthetic indication provided when approaching the stall that may include one or more of the following indications: — aerodynamic buffeting; — reduced roll stability and aileron effectiveness; — visual or aural clues and warnings; — reduced elevator (pitch) authority; — inability to maintain altitude or arrest a rate of descent; — stick-shaker activation.	X	X						
081 04 00 00		**STABILITY**								
081 04 01 00		**Static and dynamic stability**								
081 04 01 01		***Basics and definitions***								
(01)		Define 'static stability': — describe/identify a statically stable, neutral and unstable condition (positive, neutral and negative static stability).	X	X						
(02)		Explain manoeuvrability.	X	X						
(03)		Explain why static stability is the opposite of manoeuvrability, and why CAT aeroplanes are designed to be statically stable.	X	X						
(04)		Define 'dynamic stability': — describe/identify a dynamically stable, neutral and unstable motion (positive, neutral and negative dynamic stability); — describe/identify periodic and aperiodic motion.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(05)		Explain what combinations of static and dynamic stability will return an aeroplane to the equilibrium state after a disturbance.	X	X						
081 04 01 02		***Precondition for static stability***								
(01)	X	Explain an equilibrium of forces and moments as the initial condition for the concept of static stability.	X	X						
081 04 01 03		***Sum of forces***								
(01)	X	Identify the forces considered in the equilibrium of forces.	X	X						
081 04 01 04		***Sum of moments***								
(01)		Identify the moments about all three axes considered in the equilibrium of moments.	X	X						
(02)		Discuss the effect of sum of moments not being zero.	X	X						
081 04 02 00		**Intentionally left blank**								
081 04 03 00		**Static and dynamic longitudinal stability**								
081 04 03 01		***Methods for achieving balance***								
(01)	X	Explain the stabiliser ~~and the canard~~ as the means to satisfy the condition of nullifying the total sum of the moments about the lateral axis.	X	X						
(02)		Explain the influence of the location of the wing CP ~~centre of pressure~~ relative to the CG~~centre of gravity~~ on the magnitude and direction of the balancing force on the stabiliser ~~and canard~~.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(03)		Explain the influence of the indicated airspeed on the magnitude and direction of the balancing force on the stabiliser ~~and canard~~.	X	X						
~~LO (04)~~		~~Explain the influence of the balancing force on the magnitude of the wing/fuselage lift.~~	~~X~~	~~X~~						
(05)		Explain the use of the elevator deflection or stabiliser angle for the generation of the balancing force and its direction.	X	X						
(06)		Explain the elevator deflection required to balance thrust changes.	X	X						
081 04 03 02		***Static longitudinal stability***								
~~LO (01)~~		~~Explain the changes in aerodynamic forces when varying angle of attack for a static longitudinally stable aeroplane.~~	~~X~~	~~X~~						
(02)		Discuss the effect of the CG location on pitch manoeuvrability and longitudinal stability.	X	X						
081 04 03 03		***Neutral point***								
(01)	X	Define 'neutral point'.	X	X						
(02)	X	Explain why the location of the neutral point is only dependent on the aerodynamic design of the aeroplane.	X	X						
081 04 03 04		***Factors affecting neutral point***								
(01)		Describe ~~Indicate~~ the location of the neutral point relative to the locations of the aerodynamic centre of the wing and tail~~/canard~~.	~~X~~	~~X~~						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
~~LO (02)~~		~~Explain the influence of the downwash variations with angle-of-attack variation on the location of the neutral point.~~	~~X~~	~~X~~						
~~LO (03)~~		~~Explain the contribution of engine nacelles.~~	~~X~~	~~X~~						
081 04 03 05		***Location of centre of gravity (CG)***								
(01)		Explain the influence of the CG location on the static longitudinal stability of the aeroplane.	X	X						
(02)		Explain the CG forward and aft limits with respect to: — longitudinal control forces; — elevator effectiveness; — stability.	X	X						
(03)	~~X~~	Define 'static margin'.	X	X						
081 04 03 06		***The C_m–α graph***								
~~LO (01)~~		~~Define the 'aerodynamic pitching moment coefficient (C_m)'.~~	~~X~~	~~X~~						
(02)	X	Describe the C_m–α graph with respect to the ~~:~~ — ~~positive and negative sign;~~ — ~~linear relationship;~~ — ~~angle of attack for equilibrium state;~~ — relationship between the slope of the graph and static stability.	X	X						
081 04 03 07		***Factors affecting the C_m–α graph***								
(01)		Explain: — the effect on the C_m–α graph of a shift of CG in the forward	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		and aft direction; — the effect on the C_m–α graph when the elevator is moved up or down; — the effect on the C_m–α graph when the trim is moved; — the effect of the wing contribution and how it is affected by the CG location; — the effect of the fuselage contribution and how it is affected by the CG location; — the tail contribution; — the effect of aerofoil camber change.								
081 04 03 08		***~~The elevator position versus speed graph (IAS)~~ Intentionally left blank***								
~~LO (01)~~		~~Describe the elevator position speed graph.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Explain:~~ — ~~the gradient of the elevator position speed graph;~~ — ~~the influence of the airspeed on the stick position stability.~~	~~X~~	~~X~~						
081 04 03 09		***~~Factors affecting the elevator position–speed graph~~*** ***Intentionally left blank***								
~~LO (01)~~		~~Explain the contribution on the elevator position–speed graph of:~~ — ~~the location of centre of gravity;~~ — ~~the trim (trim tab and stabiliser trim);~~ — ~~high-lift devices.~~	~~X~~	~~X~~						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
081 04 03 10		***The stick force versus speed graph (IAS~~)~~***								
~~LO (01)~~		~~Define the 'stick force speed graph'.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Describe the minimum gradient for stick force versus speed that is required for certification according to CS-23 and CS-25.~~	~~X~~	~~X~~						
~~LO (03)~~		~~Explain the importance of the stick force gradient for good flying qualities of an aeroplane. Trim speed and CG~~	~~X~~	~~X~~						
~~LO (04)~~		~~Identify the trim speed in the stick force speed graph.~~	~~X~~	~~X~~						
(01)		Explain how a pilot perceives stable static longitudinal stick force stability regarding changes in: — speed; — altitude; — mass.	X	X						
081 04 03 11		***~~Factors affecting the stick force versus speed graph~~*** ***Intentionally left blank***								
~~LO (01)~~		~~Explain the contribution of:~~ — ~~the location of the centre of gravity;~~ — ~~the trim (trim tab and stabiliser trim);~~ — ~~down spring;~~ — ~~bob weight;~~ — ~~friction.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Explain the contribution of Mach number — Ref. 081 02 03 04.~~	~~X~~							
081 04 03 12		***The manoeuvring stability/stick force per g~~G~~***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)	X	Define the ‘stick force per ~~‘~~g~~G~~’, and describe that the stick force increases linearly with increase in g.	X	X						
(02)		Explain why: — the stick force per g~~G~~ has a prescribed minimum and maximum value; — the stick force per g~~G~~ decreases with pressure altitude at the same indicated airspeed.	X	X						
081 04 03 13		***Intentionally left blank***								
081 04 03 14		***Factors affecting the manoeuvring stability/stick force per g~~G~~*** ~~***Intentionally left blank***~~								
(01)		Explain the influence on stick force per g~~G~~ of: — CG location; — trim setting~~;~~ — ~~a down spring in the control system;~~ — ~~a bob weight in the control system~~.	X	X						
081 04 03 15		~~***Stick force per G and the limit-load factor***~~ ***Intentionally left blank***								
~~LO (01)~~		~~Explain why the prescribed minimum and maximum values of the stick force per G are dependent on the limit-load factor.~~	~~X~~	~~X~~						
~~LO (02)~~		~~Calculate the stick force to achieve a certain load factor at a given manoeuvre stability.~~	~~X~~	~~X~~						
081 04 03 16		***Dynamic longitudinal stability***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Describe the phugoid and short-period motion in terms of period, damping, variations (if applicable) in speed, altitude, and ~~angle of attack~~α.	X	X						
(02)		Explain why the short-period motion is more hazardous ~~important for flying qualities~~ than the phugoid.	X	X						
(03)		~~Define and d~~Describe 'pilot-induced oscillations'.	X	X						
(04)		Explain the effect of high altitude on dynamic stability.	X	X						
(05)		Describe the influence of the CG location on the dynamic longitudinal stability of the aeroplane.	X	X						
081 04 04 00		**Static directional stability**								
081 04 04 01		***Definition and effects of static directional stability***								
(01)	X	Define 'static directional stability'.	X	X						
(02)		Explain the effects of static directional stability being too weak or too strong.	X	X						
081 04 04 ~~01~~02		***Sideslip angle ~~β~~***								
(01)		Define 'sideslip angle'.	X	X						
(02)		Identify β as the symbol used for the sideslip angle.	X	X						
081 04 04 ~~02~~03		***Yaw-moment coefficient C_n***								
(01)	X	Define the 'yawing-moment coefficient C_n'.	X	X						
(02)	X	Define the relationship between C_n and β for an aeroplane with static directional stability.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
081 04 04 ~~03~~04		***C_n–β graph***								
(01)	X	Explain why: — C_n depends on the ~~angle of sideslip~~β; — C_n equals zero for that ~~angle of sideslip~~β that provides static equilibrium about the aeroplane's normal axis; — if no asymmetric engine thrust, flight control or loading condition prevails, the equilibrium ~~angle of sideslip~~β equals zero.	X	X						
(02)	X	Identify how the slope of the C_n–β graph is a measure for static directional stability.	X	X						
(03)	X	Identify how the slope of the C_n–β graph is affected by altitude.	X	X						
081 04 04 ~~04~~05		***Factors affecting static directional stability***								
(01)		Describe how the following aeroplane components contribute to static directional stability: — wing; — fin; — dorsal fin; — ventral fin; — angle of sweep of the wing; — angle of sweep of the fin; — fuselage at high ~~angles of attack~~α; — strakes.	X	X						
(02)		Explain why both the fuselage and the fin contribution reduce	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		static directional stability when the CG moves aft.								
081 04 05 00		**Static lateral stability**								
081 04 05 01		***Definition and effects of static lateral stability***								
(01)	X	Define ‘static lateral stability’.	X	X						
(02)		Explain the effects of static lateral stability being too weak or too strong.	X	X						
081 04 05 ~~01~~02		***Bank angle Ø***								
(01)	X	Define ‘bank angle Ø’.	X	X						
081 04 05 ~~02~~03		***The roll-moment coefficient C_l***								
(01)	X	Define the ‘roll-moment coefficient C_l’.	~~X~~	~~X~~						
081 04 05 ~~03~~04		***Contribution of sideslip angle (β)***								
(01)		Explain how without coordination the bank angle (Ø) creates sideslip angle.	X	X						
081 04 05 ~~04~~05		***The C_l–β graph***								
(01)	X	Describe the C_l–β graph.	X	X						
(02)	X	Identify the slope of the C_l–β graph as a measure for static lateral stability.	X	X						
(03)	X	Identify how the slope of the C_l–β graph is affected by altitude.	X	X						
081 04 05 ~~05~~06		***~~Intentionally left blank~~Factors affecting static lateral stability***								
(01)		Explain the contribution to the static lateral stability of:	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— dihedral, anhedral; — high wing, low wing; — sweep angle of the wing; — ventral fin; — vertical tail.								
~~(02)~~	~~X~~	~~Define 'dihedral effect'.~~	~~X~~	~~X~~						
081 04 06 00		**Dynamic lateral/directional stability**								
081 04 06 01		***~~Effects of asymmetric propeller slipstream~~ Intentionally left blank***								
081 04 06 02		***Tendency to spiral dive***								
(01)		Explain how lateral and directional stability are coupled.	X	X						
(02)		Explain how high-static directional stability and ~~a~~ low-static lateral stability may cause spiral divergence (unstable spiral dive), and under which conditions the spiral dive mode is neutral or stable.	X	X						
(03)		Describe an unstable spiral dive mode with respect to deviations in speed, bank angle, nose low-pitch attitude, and decreasing altitude.	X	X						
081 04 06 03		***Dutch roll***								
(01)		Describe Dutch roll.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(02)		Explain: — why Dutch roll occurs when the static lateral stability is large compared to~~with~~ static directional stability; — the condition for a stable, neutral or unstable Dutch roll motion; — the function of the yaw damper; — the actions to be taken ~~in case of non-availability of~~ when the yaw damper is not available.	X	X						
(03)		State the effect of Mach number on Dutch roll.	X							
081 04 06 04		***Effects of altitude on dynamic stability***								
(01)		Explain that increased pressure altitude reduces dynamic lateral/directional stability.	X	X						
081 05 00 00		**CONTROL**								
081 05 01 00		**General**								
081 05 01 01		***Basics~~,~~ — T~~t~~he three planes and three axes***								
(01)	X	Define: — lateral axis; — longitudinal axis; — normal axis.	X	X						
(02)	X	Define: — pitch angle; — bank angle (Ø);	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— yaw angle.								
(03)		Describe the motion about the three axes.	X	X						
(04)		Name and describe the devices that control these motions.	X	X						
081 05 01 02		***Camber change***								
(01)		State that ~~Explain how~~ camber is changed by movement of a control surface and explain the effect.	X	X						
081 05 01 03		***Angle-of-attack (α) change***								
(01)	X	Explain the influence of local ~~angle-of-attack~~α change by movement of a control surface.	X	X						
081 05 02 00		**Pitch (longitudinal) control**								
081 05 02 01		***Elevator/all-flying tails***								
(01)		Explain the working principle of the elevator/all-flying tail and describe its function.	X	X						
~~081 05 02 01 02~~		~~Describe the loads on the tailplane over the whole speed range.~~	~~X~~	~~X~~						
081 05 02 02		***Downwash effects***								
(01)		Explain the effect of downwash on the tailplane ~~angle of attack~~α.	X	X						
(02)		Explain in this context the use of a T-tail or stabiliser trim.	X	X						
081 05 02 03		***~~Ice on tail~~ Intentionally left blank***								
~~LO (01)~~		~~Explain how ice can change the aerodynamic characteristics of~~	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~the tailplane.~~								
~~LO (02)~~		~~Explain how this can affect the tail's proper function.~~	X	X						
081 05 02 04		***Location of centre of gravity (CG)***								
(01)		Explain the relationship between elevator deflection and CG location to produce a given aeroplane response.	X	X						
(02)		Explain the effect of forward CG limit on pitch control.	X	X						
081 05 02 05		***Moments due to engine thrust***								
(01)		Describe the effect of engine thrust on pitching moments for different engine locations.	X	X						
081 05 03 00		**Yaw (directional) control**								
081 05 03 01		***The rudder***								
(01)		Explain the working principle of the rudder and describe its function. State the relationship between rudder deflection and the moment about the normal axis~~;~~. Describe the effect of sideslip on the moment about the normal axis.	X	X						
081 05 03 ~~01~~02		***Rudder limiting***								
(01)		Explain why and how rudder deflection is limited on CAT~~transport~~ aeroplanes.	X							
081 05 04 00		**Roll (lateral) control**								
081 05 04 01		***Ailerons***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Explain the functioning of ailerons.	X	X						
(02)		Describe the adverse effects of ailerons deflection. *(Refer to Subjects 081 05 04 04 and 081 06 01 02)*	X	X						
(03)		Explain why some aeroplanes have ~~in this context the use of~~ inboard and outboard ailerons.	X	X						
(04)		~~Explain~~ State that the outboard aileron~~'~~s are locked out ~~the general conditions under which this feature is used~~. beyond a given speed to prevent: — over-control; — exceeding structural limitations; — aeroelastic phenomena (flutter, divergence and aileron reversal).	X	X						
(05)		Describe the use of aileron deflection in normal flight, flight with sideslip, crosswind landings, horizontal turns, flight with one-engine-inoperative ~~out~~.	X	X						
(06)	X	Define 'roll rate'.	X	X						
(07)	X	List the factors that affect roll rate.	X	X						
(08)		Describe f~~F~~laperons~~,~~ and aileron droop.	X	X						
081 05 04 02		***Intentionally left blank***								
081 05 04 03		***Spoilers***								
(01)		Explain how spoilers can be used to control the rolling movement in combination with or instead of the ailerons.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
081 05 04 04		***Adverse yaw***								
(01)		Explain why ~~how~~ the use of ailerons induces adverse yaw.	X	X						
081 05 04 05		***Means to avoid adverse yaw***								
(01)		Explain how the following reduce adverse yaw: — Frise ailerons; — differential aileron deflection; — rudder aileron cross-coupling; — roll spoilers.	X	X						
081 05 05 00		**Roll/yaw interaction**								
081 05 05 01		***Explain roll/yaw interaction***								
(01)		Explain the secondary effect of roll.	X	X						
(02)		Explain the secondary effect of yaw.	X	X						
081 05 06 00		**Means to reduce control forces**								
081 05 06 01		***Aerodynamic balance***								
(01)		Describe the purpose of aerodynamic balance.	X	X						
(02)		Describe the working principle of the ~~nose and~~ horn balance.	X	X						
(03)		Describe the working principle of the internal balance.	X	X						
(04)		Describe the working principle and ~~the~~ application of: — balance tab; — anti-balance tab;	X	X						

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		— spring tab; — servo tab.								
081 05 06 02		***Artificial means***								
(01)		~~Describe~~ State the differences between fully powered controls and power-assisted controls.	X	X						
(02)		Describe power-assisted controls.	X	X						
(03)		Describe the advantages of ~~Explain why~~ artificial feel in fully powered control ~~is required~~.	X	X						
~~LO (04)~~		~~Explain the inputs to an artificial feel system.~~	~~X~~	~~X~~						
~~081 05 07 00~~		**~~Mass balance~~ Intentionally left blank**								
~~LO (01)~~		~~Refer to 081 06 01 01 for mass balance.~~ ~~Refer to 081 04 03 11 and 081 04 03 14 for bob weight.~~	~~X~~	~~X~~						
081 05 08 00		**Trimming**								
081 05 08 01		***Reasons to trim***								
(01)		State the reasons for using trimming devices.	X	X						
(02)		Explain the difference between a trim tab and the various balance tabs.	X	X						
081 05 08 02		***Trim tabs***								
(01)		Describe the working principle of a trim tab including cockpit indications.	X	X						
081 05 08 03		***Stabiliser trim***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(01)		Explain the advantages and disadvantages of a stabiliser trim compared to~~with~~ a trim tab.	X	X						
(02)		Explain elevator deflection when the aeroplane is trimmed in the case of fully powered and power-assisted pitch controls.	X	X						
(03)		Explain the relationship between CG position, take-off trim setting ~~factors influencing~~ and stabiliser trim position ~~setting~~.	X	X						
(04)		Explain the effect of errors in ~~influence of~~ the take-off stabiliser trim setting on the rotation characteristics and stick force during take-off rotation ~~at extremes of CG position~~.	X	X						
(05)		Discuss the effects of jammed and runaway stabiliser.	X	X						
(06)		Explain ~~the landing considerations with a~~ the consequences of a jammed stabiliser during take-off, landing, and go-around.	X	X						
081 06 00 00		**LIMITATIONS**								
081 06 01 00		**Operating limitations**								
081 06 01 01		***Flutter***								
(01)		Describe the phenomenon of flutter and how IAS and mass distribution affects the likelihood of flutter occurrence. ~~list the factors:~~ — ~~elasticity;~~ — ~~backlash;~~ — ~~aeroelastic coupling;~~ — ~~mass distribution;~~	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— ~~structural properties~~ — ~~IAS.~~								
~~LO (02)~~		~~List the flutter modes of an aeroplane:~~ — ~~wing.~~ — ~~tailplane.~~ — ~~fin.~~ — ~~control surfaces including tabs.~~	~~X~~	~~X~~						
(03)		Describe the use of mass balance to alleviate the flutter problem by adjusting the mass distribution: — wing-mounted engines on pylons; — control surface mass balance.	X	X						
(04)		State how to avoid flutter, and possible actions if flutter occurred. ~~List the possible actions in the case of flutter in flight.~~	X	X						
081 06 01 02		***Aileron reversal***								
(01)		Describe the phenomenon of aileron reversal: — at low speeds; — at high speeds. Describe the aileron reversal speed in relationship to V_{NE} and V_{NO}.	X	X						
081 06 01 03		***Landing gear/flap operating***								
(01)		Describe the reason for flap/landing gear limitations. — D~~d~~efine 'V_{LO}.'~~;~~	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		— D~~d~~efine ‘V_{LE}’.								
(02)		Explain why there is a difference between V_{LO} and V_{LE} in the case of some aeroplane types.	X	X						
(03)		Define ‘V_{FE}’ and describe flap-limiting speeds.	X	X						
(04)		Describe flap design features, procedures and warnings to prevent overload.	X	X						
081 06 01 04		***V_{MO}, V_{NO}, and V_{NE}***								
(01)	X	Define ‘V_{MO}’, ‘V_{NO}’, and ‘V_{NE}’.	X	X						
(02)		Describe ~~the differences between~~ V_{MO}, V_{NO} and V_{NE}, the relevance of the airspeed on which they are based, and the differences between the airspeeds.	X	X						
(03)		Explain the hazards ~~dangers~~ of flying at speeds close to V_{NE} and V_{MO}.	X	X						
081 06 01 05		***M_{MO}***								
(01)		Define ‘M_{MO}’ and state its limiting factors.	X							
081 06 02 00		**Manoeuvring envelope**								
081 06 02 01		***Manoeuvring-load diagram***								
(01)		Describe the manoeuvring-load diagram.	X	X						
(02)		Define limit and ultimate load factor, and explain what can happen if these values are exceeded.	X	X						
(03)		Define ‘V_A’, ‘V_C’, and ‘V_D’.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(04)		Identify and explain the varying features on the V_N diagram: — load factor 'n'; — speed scale, equivalent airspeed~~, EAS~~; — equivalent airspeed envelope ~~boundary~~; — C_{LMAX} boundary; — 1g stall speed; — accelerated stall boundary ~~speed~~ (refer to ~~081 01 08 02~~ 081 03 01 02).	X	X						
(05)		Describe the relationship between V_{MO} or V_{NE} and V_C.	X	X						
(06)		State all the manoeuvring ~~limit~~ load-factors limits applicable to CS-23 and CS-25 aeroplanes.	X	X						
(07)		Explain the relationship between V_A and V_S in a formula, and calculate the values.	X	X						
(08)		Explain the significance of V_A and the adverse consequences of applying full, abrupt nose-up elevator deflection when exceeding V_A.	X	X						
081 06 02 02		***Factors affecting the manoeuvring-load diagram***								
(01)		State the relationship of mass to: — load-factor limits; — accelerated stall speed boundary limit; — V_A ~~and V_C.~~ and explain why if a single value for V_A is given, it will be at the aeroplane's maximum structural take-off mass and at low altitude.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
(02)		~~Explain the relationship between V_A, aeroplane mass and altitude.~~ Calculate the change of V_A with changing mass.	X	X						
~~LO (03)~~		~~Describe the effect of altitude on Mach number, with respect to limitations.~~	~~X~~							
(04)		Explain why V_A loses significance at higher altitude where compressibility effects occur.	X							
(05)	X	Define 'M_C' and 'M_D' and their relation with 'V_C' and 'V_D'.	X							
081 06 03 00		**Gust envelope**								
081 06 03 01		***Gust-load diagram***								
(01)		Recognise a typical gust-load diagram, and state the minimum gust speeds in ft/s, m/s and kt that the aeroplane must be designed to withstand at V_B to V_C and V_D.	X	X						
~~LO (02)~~		~~Identify and describe the various features shown on the diagram:~~ — ~~gust-load factor 'n';~~ — ~~speed scale, equivalent airspeed and EAS;~~ — ~~C_{LMAX} boundary;~~ — ~~vertical gust velocities;~~ — ~~relationship of V_B to V_C and V_D.~~ — ~~gust limit load factor.~~	~~X~~	~~X~~						
~~LO (03)~~		~~Define 'V_{RA}', 'V_B'.~~	~~X~~	~~X~~						
(04)		Discuss considerations for the selection of V_{RA} ~~this speed~~.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(05)		Explain the adverse effects on the aeroplane when flying in turbulence.	X	X						
081 06 03 02		***Factors affecting the gust-load diagram***								
(01)		Describe and e~~E~~xplain the relationship between the gust-load factor and the following: lift-curve slope, aspect ratio, angle of sweep, altitude~~density ratio~~, wing loading, weight, wing area, equivalent airspeed (EAS), and speed of vertical gust.~~and equivalent vertical sharp-edged gust velocity and perform relevant calculations.~~	X	X						
081 07 00 00		**PROPELLERS**								
081 07 01 00		**Conversion of engine torque to thrust**								
081 07 01 01		**Explain conversion of aerodynamic force on a propeller blade**								
(01)		Explain the resolution of aerodynamic force on a propeller blade element into lift and drag or into thrust and torque.	X	X						
(02)		Describe how propeller thrust and aerodynamic torque vary ~~and their variation~~ with IAS.	X	X						
081 07 01 ~~01~~02		***Relevant propeller parameters***								
(01)		Describe the geometry of a typical propeller blade element at the reference section: — blade chord line; — propeller rotational velocity vector; — true airspeed vector; — blade angle of attack;	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— pitch or blade angle; — advance or helix angle; D~~d~~efine 'geometric pitch', 'effective pitch' and 'propeller slip'. *Remark: For theoretical knowledge examination purposes, the following definition is used for geometric pitch: the theoretical distance a propeller would advance in one revolution at zero blade angle of attack.*								
(02)		Describe how the terms ~~Define~~ 'fine pitch' and 'coarse pitch' can be used to express blade angle.	X	X						
081 07 01 ~~02~~03		***Blade twist***								
(01)	X	Define 'blade twist'.	X	X						
(02)		Explain why blade twist is necessary.	X	X						
081 07 01 ~~03~~04		***Fixed pitch and variable pitch/constant speed***								
(01)	X	List the different types of propellers: — fixed pitch; — adjustable pitch or variable pitch (non-governing); — variable pitch (governing)/constant speed.	X	X						
(02)		Discuss the advantages and disadvantages of fixed-pitch and constant-speed propellers.	X	X						
(03)		Discuss climb and cruise propellers.	X	X						
(04)		Explain the relationship between blade angle, blade angle of	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		attack and airspeed for fixed and variable pitch propellers.								
(05)		Describe ~~Given a diagram,~~ and explain the forces that act~~ing~~ on a rotating blade element in normal, feathered, windmilling and reverse operation.	X	X						
(06)		Explain the effects of changing propeller pitch at constant IAS.	X	X						
081 07 01 ~~04~~05		***Propeller efficiency versus speed***								
(01)		Define 'propeller efficiency'.	X	X						
(02)		Explain and describe the relationship between propeller efficiency and speed (TAS) for different types of propellers.	X	X						
~~LO (03)~~		~~Plot propeller efficiency against speed for the types of propellers listed in 081 07 01 03 above.~~	X	X						
(04)		Explain the relationship between blade angle and thrust.	X	X						
081 07 01 ~~05~~06		***Effects of ice on propeller***								
(01)		Describe the effects and hazards of ice on a propeller.	X	X						
081 07 02 00		**Engine failure**								
081 07 02 01		***Windmilling drag***								
(01)		Describe ~~List~~ the effects of an inoperative engine on the performance and controllability of an aeroplane: — thrust loss/drag increase; — influence on yaw moment during asymmetric power.	X	X						
081 07 02 02		***Feathering***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Explain the reasons for feathering a propeller including the effect on the yaw moment, performance and controllability.	X	X						
~~LO (02)~~		~~Influence on yaw moment during asymmetric power.~~	~~X~~	~~X~~						
081 07 03 00		**Design features for power absorption**								
(01)	X	Name ~~Describe~~ the ~~factors of~~ propeller design characteristics that increase power absorption.	X	X						
081 07 03 01		***~~Aspect ratio of blade~~ Propeller design characteristics that increase power absorption***								
~~LO (01)~~		~~Define 'blade-aspect ratio'.~~	~~X~~	~~X~~						
(01)	X	Name ~~Describe~~ the ~~factors of~~ propeller design characteristics that increase power absorption.	X	X						
081 07 03 02		***Diameter of propeller***								
(01)		Explain the reasons for restricting propeller diameter.	X	X						
081 07 03 03		***Number of blades***								
(01)	X	Define 'solidity'.	X	X						
(02)		Describe the advantages and disadvantages of increasing the number of blades.	X	X						
081 07 03 04		***Propeller noise***								
(01)	X	Describe ~~Explain~~ how propeller noise can be minimised.	X	X						
081 07 04 00		**Secondary effects of propellers**								
081 07 04 01		***Torque reaction***								

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Describe the effects of engine/propeller torque.	X	X						
(02)		Describe the following methods for counteracting engine/propeller torque: — counter-rotating propellers; — contra-rotating propellers.	X	X						
081 07 04 02		***Gyroscopic precession***								
(01)	X	Describe what causes gyroscopic precession.	X	X						
(02)	X	Describe the effect on the aeroplane due to the gyroscopic effect.	X	X						
081 07 04 03		***~~Asymmetric s~~Slipstream effect***								
(01)		Describe the possible ~~asymmetric~~ effects of the rotating propeller slipstream.	X	X						
081 07 04 04		***Asymmetric blade effect***								
(01)		Explain the asymmetric blade effect (also called P factor).	X	X						
(02)		Explain the influence of direction of rotation on the critical engine on twin-engine aeroplanes.	X	X						
081 07 04 05		***Hazards and management of propeller effects***								
(01)		Describe, given direction of propeller rotation, the propeller effects during take-off run, rotation and initial climb, and their consequence on controllability.	X	X						
(02)		Describe, given the direction of propeller rotation, the propeller effects during a go-around and their consequence on	X	X						

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		controllability.								
(03)		Explain how the hazards associated with propeller effects during go-around can be aggravated by: — high engine performance conditions and their effect on the VMC speeds; — loss of the critical engine; — cross wind; — high flap setting; — engine failure at the moment of the go-around.	X	X						
081 08 00 00		**FLIGHT MECHANICS**								
081 08 01 00		**Forces acting on an aeroplane**								
081 08 01 01		***Straight, horizontal, steady flight***								
(01)	X	Describe the forces that acti~~ng~~ on an aeroplane in straight, horizontal, and steady flight.	X	X						
(02)	X	List the four forces and state where they act on.	X	X						
(03)		Explain how the four forces are balanced including the function of the tailplane.	X	X						
~~LO (04)~~		~~Describe the function of the tailplane.~~	~~X~~	~~X~~						
081 08 01 02		***Straight, steady climb***								
(01)	X	Define ‘~~γ~~ flight-path angle’ (γ).	X	X						
(02)		Describe the relationship between pitch attitude, ~~flight-path angle~~ γ and ~~angle of attack~~ α for ~~the~~ zero-wind and zero-bank	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~and sideslip~~ conditions.								
(03)	X	Describe the forces that act~~ing~~ on an aeroplane in a straight, steady climb.	X	X						
(04)		Name the forces parallel and perpendicular to the direction of flight. — Apply the formula relating to the parallel forces ($T = D + W \sin \gamma$). — Apply the formula relating to the perpendicular forces ($L = W \cos \gamma$).	X	X						
(05)		Explain why thrust is greater than drag.	X	X						
(06)		Explain why lift is less than weight.	X	X						
(07)		Explain the formula (for small angles) that give~~ing~~ the relationship between γ~~flight-path angle~~, thrust, weight, and lift–drag ratio, and use this formula for simple calculations.	X	X						
(08)		Explain how IAS, ~~angle of attack~~ α, and γ~~flight-path angle~~ change in a climb performed with constant ~~pitch attitude and normal thrust decay with altitude~~ vertical speed and constant thrust setting.	X	X						
081 08 01 03		***Straight, steady descent***								
(01)	X	Describe the forces that act~~ing~~ on an aeroplane in a straight, steady descent.	X	X						
(02)		Name the forces parallel and perpendicular to the direction of flight.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		— Apply the formula for forces parallel to the direction of flight (T = D – W sin γ). — Apply the formula relating to the perpendicular forces (L = W cos γ).								
(03)		Explain why lift is less than weight.	X	X						
(04)		Explain why thrust is less than drag.	X	X						
081 08 01 04		***Straight, steady glide***								
(01)	X	Describe the forces acting on an aeroplane in a straight, steady glide.	X	X						
(02)		Name the forces parallel and perpendicular to the direction of flight. — Apply the formula for forces parallel to the direction of flight (D = W sin γ)~~;~~. — Apply the formula for forces perpendicular to the direction of flight (L = W cos γ).	X	X						
(03)		Describe the relationship between the glide gradient ~~angle~~ and the lift–drag ratio~~,~~ and calculate glide range given: — initial height; — L/D ratio; — glide speed and wind speed.	X	X						
(04)		Explain ~~Describe~~ the relationship between angle of attack, V_{MD} and the best lift–drag ratio.	X	X						
(05)		Explain the effect of wind component on glide angle, duration	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		and distance.								
(06)		Explain the effect of mass change on glide angle, duration and distance, given that the aeroplane remains at either the same airspeed or at V_{MD}.	X	X						
(07)		Explain the effect of configuration change on glide angle, duration	X	X						
(08)		Describe the relation between TAS, gradient of descent and rate of descent ~~sink rate~~.	X	X						
(09)		Describe that minimum rate of descent in the glide will be at V_{MP}, and explain the relationship of this speed to the optimum speed for minimum glide angle.	X	X						
(10)		Discuss when a pilot could elect to fly for minimum glide rate of descent or minimum glide angle, and why speed stability or headwinds/tailwinds may favour a speed that is faster or slower than the optimum airspeed in still air.	X	X						
081 08 01 05		***Steady, coordinated turn***								
(01)		Describe the forces acting on an aeroplane in a steady, coordinated turn.	X	X						
(02)		Resolve the forces acting horizontally and vertically during a coordinated turn ($\tan\phi = \frac{V^2}{gR}$).	X	X						
(03)		Describe the difference between a coordinated and an uncoordinated turn, and ~~explain~~ describe how to correct an	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL /IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		uncoordinated turn using turn and slip indicator or turn coordinator.								
(04)		Explain why the angle of bank is independent of mass and that it only depends on TAS and radius of turn.	X	X						
(05)		Resolve the forces to show that for a given angle of bank the radius of turn is determined solely by airspeed ($\tan\phi = \frac{V^2}{gR}$).	X	X						
(06)		Calculate the turn radius of a steady turn given TAS and angle of bank ~~load factor and the time for a complete turn for relevant parameters given for a steady turn~~.	X	X						
(07)		Explain ~~Discuss~~ the effects of bank angle on: — load factor (LF = $1/\cos\phi$); — ~~angle of attack~~ α; — thrust; — drag.	X	X						
(08)	X	Define 'angular velocity'.	X	X						
(09)	X	Define 'rate of turn' and 'rate-one turn'.	X	X						
(10)		Explain the influence of TAS on rate of turn at a given bank angle.	X	X						
(11)		Calculate the load factor and stall speed in a turn given angle of bank and 1g stall speed.	X	X						
(12)		Explain situations in which turn radius is relevant for safety, such as maximum speed limits on departure or arrival plates, or	X	X						

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		outbound speed categories on approach plates, and the implications/hazards of exceeding given speeds.								
(13)		Describe the hazards of excessive use of rudder to tighten a turn in a swept-wing aeroplane.	X	X						
081 08 02 00		**Asymmetric thrust**								
081 08 02 01		***Jet-engined and propeller-driven aeroplanes***								
(01)		Describe the effects on the aeroplane of asymmetric thrust during flight, ~~with asymmetric thrust~~ including both jet-engined and propeller-driven aeroplanes.	X	X						
(02)		Explain ~~Discuss~~ critical engine, include effect of crosswind when on the ground, and for a propeller-driven aeroplane the direction of propeller rotation.	X	X						
(03)	X	Explain the effect of steady, asymmetric flight on a conventional (ball) slip indicator/turn indicator.	X	X						
081 08 02 ~~01~~02		***Balanced mMoments about the normal axis***								
~~LO (01)~~		~~Describe the moments about the normal axis.~~	~~X~~	~~X~~						
(02)		Explain the yaw~~ing~~ moments about the CG.	X	X						
(03)		Explain ~~Describe~~ the change to the yaw~~ing~~ moment caused by the effect of air density ~~power~~ on thrust.	X	X						
(04)		Describe the changes to the yaw~~ing~~ moment caused by engine distance from CG.	X	X						
(05)		Describe the methods to achieve directional balance after	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		engine loss.								
~~081 08 02 02~~		***~~Intentionally left blank~~***								
081 08 02 03		***Forces parallel to the lateral axis***								
(01)		Explain: — the force on the vertical fin; — the fuselage side force due to sideslip (using wing-level method); — the use of bank angle to tilt the lift vector (in wing-down method).	X	X						
~~(02)~~		~~Explain how bank angle and sideslip are related in a steady asymmetric flight.~~	~~X~~	~~X~~						
(03)		Explain why the required small bank angle~~, must be limited.~~ is limited by: — increased overall lift required and increase in drag in banked attitude; — fin stalling angle.	X	X						
(04)		Explain the effect on fin angle of attack due to sideslip.	X	X						
081 08 02 04		***Influence of aeroplane mass***								
(01)		Explain why controllability with one engine inoperative is a typical problem arising from the low speeds associated with ~~encountered at~~ low aeroplane mass.	X	X						
081 08 02 05		***Intentionally left blank***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
081 08 02 06		***~~Secondary propeller effects~~ Intentionally left blank***								
~~LO (01)~~		~~Describe propeller effects:~~ — ~~slip stream;~~ — ~~torque reaction;~~ — ~~asymmetric blade effect.~~	~~X~~	~~X~~						
081 08 02 07		***Intentionally left blank***								
081 08 02 08		***Minimum control speed (V_{MC})***								
(01)		Define 'V_{MC}'.	X	X						
(02)		Describe how V_{MC} is determined.	X	X						
(03)		Explain the influence of the CG location.	X	X						
081 08 02 09		***Minimum control speed during approach and landing (V_{MCL})***								
(01)		Define 'V_{MCL}'.	X	X						
(02)		Describe how V_{MCL} is determined.	X	X						
(03)		Explain the influence of the CG location.	X	X						
081 08 02 10		***Minimum control speed on the ground (V_{MCG})***								
(01)		Define 'V_{MCG}'.	X	X						
(02)		Describe how V_{MCG} is determined.	X	X						
(03)		Explain the influence of the CG location.	X	X						
081 08 02 11		***Influence of density***								
(01)		Describe the influence of density.	X	X						

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		Explain why $V_{MC\cancel{A}}$, V_{MCL} and V_{MCG} reduce with an increase in altitude and temperature.	X	X						
081 08 03 00		**~~Particular~~Significant points on a polar curve**								
081 08 03 01		***Identify and explain***								
(01)		Identify and explain t~~T~~he significant ~~particular~~ points on a polar curve ~~and explain their significance, assuming a parabolic approximation~~.	X	X						

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Appendix to Annex I to ED Decision 2018/001/R

'Acceptable Means of Compliance (AMCs) and Guidance Material (GM) to Part-FCL Amendment 4'

Appendix
'SUBJECT 082 — PRINCIPLES OF FLIGHT — HELICOPTERS'
to
AMC1 FCL.310; FCL.515(b); FCL.615(b)
'Theoretical knowledge examinations'
of Annex I

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~~SUBJECT 082 — PRINCIPLES OF FLIGHT (HELICOPTER)~~

SUBJECT 082 — PRINCIPLES OF FLIGHT — HELICOPTERS

(1) VOCABULARY OF MECHANICS

Speed is a scalar quantity; it has only magnitude.

Velocity is a vector quantity ~~having~~ with magnitude and direction.

The velocity ~~(speed)~~ of a point on a rotor blade when rotating ~~of the aerofoil in the rotation~~ around ~~its~~ an axis is the 'linear' or 'tangential' velocity, ~~(speed). The rotational velocity (speed) of a body around an axis is an angular velocity (speed)~~ which can be expressed in revolutions per minute (rpm) ~~(RPM), or degrees per second (deg/s), or radians per second (rad/s)~~.

Density is the mass of the fluid per unit volume: (kg/m^3) in the international system ~~SI~~ of units of measurement (SI) (*Système International*).

(2) AERONAUTICAL DEFINITIONS

~~The blade is the aerofoil between a root radius and the tip radius (R) attached to the hub with hinges or flexible elements.~~

A rotor blade is a high-aspect ratio aerofoil attached by its root to the rotor hub with hinges or flexible elements.

~~The cross section of a blade perpendicular to the feathering axis, the blade section at a distance (radius) from the hub centre shows the shape of the aerofoil.~~

~~Such section is characterised by a contour, a leading and trailing edge, a chord line, a chord, a camber line, the maximum thickness or depth, the thickness-to-chord ratio.~~

~~The blade element is a spanwise piece of the blade. It is assumed that its radial extension is small such that the aerodynamic forces don't vary with radial distance. The aerodynamic forces on the blade element produce lift, drag and a pitching moment.~~

A blade element is a spanwise slice of the blade, so thin that the aerodynamic forces involved may be assumed not to vary. The forces produce lift (L), drag (D) and a pitching moment. Such a cross section has a contour, a leading and trailing edge, a chord line, a mean camber line, a maximum thickness or depth, and a thickness-to-chord ratio.

The centre of pressure (CP) is defined as the point on the chord line where the resultant of all aerodynamic forces acts~~, such that the pitching moment about this point is zero~~.

The planform ~~of the blade~~ is the shape of a blade as seen from above.

The pitch angle ~~of a section~~ (of a blade or an element) is the angle between the chord line and the plane of rotation. ~~a reference plane. (The reference planes will be defined later in this text.)~~

The blade is ~~without twist~~ not twisted when the pitch angle is constant from root to tip.

~~The blade is twisted when the pitch angle of the sections varies as a function of the radial distance (the chord lines are not parallel). If the pitch angle decreases towards the tip, this is called washout.~~

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A blade is twisted when the pitch angle of its elements' sections varies with their distance from the root (in other words, the chord lines of the elements involved are not parallel). Washout exists when the pitch angle decreases towards the blade tip.

The vector sum of the undisturbed upstream velocity ~~and the thrust-induced velocity is the relative velocity.~~ (i.e. that found in the plane of rotation of the blades) and the induced velocity is the relative airflow.

~~In the helicopter theory we use the following definitions for 'angle of attack', 'lift' and 'drag':~~

- ~~The angle between the relative velocity and the chord line is the angle of attack α or AoA, called effective angle of attack. The geometric angle of attack is the angle between the undisturbed upstream velocity and the chord line.~~
- ~~Lift is the component of the aerodynamic force on a blade element perpendicular to the relative velocity.~~
- ~~Profile drag is the component of the aerodynamic force on a blade element parallel to the relative velocity.~~

~~Profile drag is produced by the pressure forces and by skin-friction forces that act on the surface of the blade element.~~

~~The component of the drag force due to the pressure forces is the pressure or form drag.~~

~~The component of the drag due to the shear forces over the aerofoil is termed skin-friction drag.~~

~~The sum of the pressure drag and the skin-friction drag is the profile drag.~~

The angle between the relative airflow and the chord line of a blade element is the angle of attack (α).

Lift is the component of the aerodynamic force on a blade element that is perpendicular to the relative airflow.

Profile drag is the component of the aerodynamic force on a blade element that is parallel to the plane of rotation. Induced drag is the component of the aerodynamic force on a blade element that is parallel to the relative airflow.

Profile drag consists of pressure forces and skin friction acting on the surface of the blade element. The component of profile drag that arises from pressure forces (between the leading and trailing edges) is pressure or form drag. The component of profile drag due to shear forces over the surface is skin friction.

The total rotor thrust is the vertical upwards force from the rotor disc as a whole, as the sum of all the blade thrusts. This term has been reinstated because there is already the term 'rotor thrust' that is used to denote the thrust along the axis of rotation that acts directly opposite the weight of the helicopter in a blade element.

(3) HELICOPTER CHARACTERISTICS

Disc loading is ~~by definition~~ the mass (M) ~~or weight (W)~~ of the helicopter divided by the area of the disc.

~~(The disc area is πR^2, R being the tip radius).~~

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~~The disc loading is $M/(\pi R^2)$ or $W/(\pi R^2)$.~~

Blade loading is ~~by definition~~ the mass ~~(weight)~~ divided by the total planform area of the blades.

The area of a rectangular blade is given by the chord ~~times~~ multiplied by the blade tip radius. For tapered blades, the mean geometric chord is taken as an approximately equivalent chord.

~~Blade loading is defined as the mass or weight of the helicopter divided by the total area of all blades.~~

Rotor solidity is the ratio of the total blade area to the disc area.

(4) PLANES, AXES AND REFERENCE SYSTEMS OF THE ROTOR

— Shaft axis: The physical axis of the rotor shaft (mast).

— Hub plane: A plane perpendicular to the shaft axis through the centre of the hub.

— Tip p~~P~~ath p~~P~~lane: The plane traced out by the blade tips. ~~This plane is also the no-flapping plane.~~

— Virtual rotation axis: The axis through the centre of the hub and perpendicular to the t~~T~~ip p~~P~~ath p~~P~~lane. ~~Another name for this axis is no-flapping axis.~~

— ~~Rotor-disc plane: another name for the tip-path plane.~~

— Rotor disc: The disc traced out by the blade tips in the t~~T~~ip p~~P~~ath p~~P~~lane.

— Plane of rotation: T~~t~~he plane parallel to the t~~T~~ip p~~P~~ath p~~P~~lane that acts through the hub centre.

— ~~No-feathering plane: is also called the control plane. This is the reference plane relative to which the pitch of the rotating blade has no variation during a full rotation. The control plane is parallel to the swash plate in the simple feathering mechanism (no flap-feathering coupling).~~

— ~~Control axis or axis of no-feathering. Axis through the hub centre and perpendicular to the no-feathering or control plane.~~

— ~~The azimuthal angle of a blade is the angle in the rotor-disc plane counted in the rotation sense from the direction opposite to the helicopter velocity.~~

~~(5) REFERENCE SYSTEMS (sometimes called frames of reference)~~

~~There are three different reference systems in which the movement of the blades can be studied or observed:~~

— ~~The tip-path plane with the virtual rotation axis: the observer in this system observes no flapping, only cyclic feathering.~~

— ~~The no-feathering plane (or control plane) with the control axis: the observer in this system observes no feathering, only cyclic flapping.~~

— ~~The hub plane and shaft axis: the observer in this system observes both cyclic flapping and cyclic feathering.~~

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(~~6~~5) ANGLES OF THE BLADES, INDUCED VELOCITY

— Pitch angle of a blade ~~section~~ element: The angle between the chord line of the ~~section~~ element and ~~the hub plane (the reference plane),~~ its plane of rotation, sometimes ~~also~~ called 'local pitch angle'.

— ~~Pitch angle of the blade: the pitch angle at 75 % of the tip radius~~

— Blade pitch angle: Taken to be equivalent to the pitch angle of the blade element found at 75 % of the blade radius.

— Flapping angle: The angle between the longitudinal axis of the blade and the hub plane.

— Coning angle: The angle between the longitudinal axis of the blade and the t~~T~~ip p~~P~~ath p~~P~~lane.

— ~~Advance angle: The azimuthal angle between the flapping axis and the point where the pitch link is connected to the swash plate (not to be confused with the phase lag from pitch input to flapping response).~~

~~The induced velocity is the velocity induced by the rotor thrust in the plane of the rotor disc (about 10 m/s for a light helicopter in hover). The slipstream velocity continues to increase downstream of the rotor. In the hover out-of-ground-effect (HOGE), the velocity in the ultimate wake is equal to two times the induced velocity.~~

Induced velocity is that induced by the engine power perpendicular to the plane of rotation.

Aerodynamic forces on the blades~~BLADES~~ and the rotor~~ROTOR~~

~~The airflow around the blade element produces an aerodynamic force resolvable in two components: lift and drag. Lift is perpendicular to the relative air velocity, and drag is parallel to the relative air velocity.~~

~~The aerodynamic force may also be resolved into thrust perpendicular to the tip-path plane (or plane of rotation) and drag parallel to the tip-path plane. This drag is the sum of the profile drag and the induced drag.~~

~~Because the angle between the lift vector and the thrust vector is very small, the magnitudes of these two vectors may be taken as equal.~~

The thrust from a blade (blade thrust) is the sum of the thrusts ~~of all blade elements along the blade radius~~ from each blade element.

The sum of the thrusts from all blades is the (total) rotor thrust acting perpendicular to the t~~T~~ip p~~P~~ath p~~P~~lane in the direction of the virtual rotation axis.

The result of the induced drag forces on all the blade elements of all blades is a torque on the shaft which, ~~—~~multiplied by the angular velocity of the ~~rotor~~ blade, ~~—~~gives the required induced power.

The result of ~~all~~ the profile drag~~s~~ forces is a torque on the shaft which, ~~—~~multiplied by the angular velocity of the blade, ~~rotor —~~ gives the required profile power.

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(~~7~~6) TYPES OF ROTOR HUBS

There are basically four types of rotor hubs in use:

1. Teetering rotor or seesaw rotor: The two blades are connected together; the ‘hinge’ is on the shaft axis, and the head is underslung. A variation is the gimballed hub; the blades and the hub are attached to the rotor shaft by means of a gimbal or universal joint (Bell 47). It is sometimes called semi-rigid because there is no movement of the blade in a drag-wise sense.
2. Fully articulated rotor: ~~The rotor has more than two blades.~~ There are more than two rotor blades and each has a flapping hinge, a lead-lag (drag) hinge, and a feathering hinge or bearing.
3. Hingeless rotor: There are no flapping or ~~and lead-lag~~ dragging hinges. They are replaced by flexible elements (virtual hinges) at ~~the root~~ some part of the blade~~s~~ radius which allow ~~flapping and lead-lag~~ such movements. A ~~The~~ feathering bearing allows feathering of the blade.
4. Bearingless rotor: There are no hinges or rotating bearings. Flapping and ~~lead or lag~~ dragging movements are obtained ~~by~~ with flexible elements called elastomeric hinges~~ and~~. ~~F~~feathering is obtained by twisting the element.

When refering to their equipment, Airbus call this a semi-articulated head (ref.: their training material).

Two remarks:

1. Hinge offset and equivalent hinge offset

   The hinge offset is the distance between the shaft axis and the axis of the hinge. ~~In the h~~Hingeless and bearingless rotors have~~, we define~~ an equivalent hinge offset.

2. Elastomeric hinges

   This bearing consists of alternate layers of elastomer and metal. The ~~elasticity in~~ flexibility of the elastomer allows ~~the movements of~~ flapping, ~~lead-lag~~ dragging and feathering.

(~~8~~7) DRAG AND POWERS

~~The induced power is the power resulting from the induced velocity in the rotor disc for the generation of lift. For any given thrust, the induced power is minimum when the induced velocity is uniform over the rotor disc. Such velocity distribution can be approximated by using some blade twist (a truly uniform velocity cannot be obtained).~~

~~The rotor profile drag results from the component opposite to the blade velocities of all the profile drags of the blade elements of all the blades.~~

~~The resulting power is the rotor profile power or the profile-drag power (sum of the powers to overcome the torque).~~

~~The parasite drag is the drag on the helicopter fuselage including the drag of the rotor hub and all external equipment such as wheels, winch, etc. The tail-rotor drag is also included in the parasite drag. The power to overcome this drag is the parasite power.~~

~~In the level flight at constant speed, the main-rotor-induced power, the rotor profile power and the parasite power are summed to give the total power required to drive the main rotor.~~

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~~The tail-rotor-induced power and the tail-rotor profile power are summed to give the power required to drive the tail rotor~~.

~~The power required to drive the auxiliary services, such as oil pumps and electrical generators, is the accessory or ancillary power. The power to overcome the mechanical friction in the transmissions is included in the accessory power.~~

~~The total power required in level flight at constant speed is the sum of the total power for the main rotor, the power for the tail rotor and the accessory power.~~

~~In the low-speed region, the required power in straight and level flight decreases as speed increases. The phenomenon is called translational lift.~~

Induced power is that required to generate the induced velocity in the rotor disc for the production of lift. For any given thrust, induced power is minimum when the induced velocity is uniform over the rotor disc. This can be approximated by using washout and ensuring that the blades are in track (a truly uniform velocity cannot be obtained).

Rotor profile drag results from those components acting in the opposite direction to the blade velocities (i.e. the sum of all the profile drags from each blade element). The power required to overcome it is rotor profile power (the sum of the powers required to overcome the torque).

Parasite drag is the drag from the helicopter fuselage including that from the rotor hub and all external equipment such as wheels, the winch, external loads, etc. (any drag from the tail rotor is included, but not from the rotor blades, which produce profile drag). The power to overcome this drag is parasite power.

In level flight at constant speed, induced power, rotor profile power and parasite power are summed to give the total power required to drive the main rotor.

Induced power and profile power for the tail rotor are summed to give the power required to drive the tail rotor.

The power required to drive auxiliary services, such as oil pumps and electrical generators, is called accessory or ancillary power. It includes the power required to overcome mechanical friction in transmissions.

The total power required in level flight at constant speed is the sum of all the above.

When transitioning from the hover, the power required decreases as speed increases. This is called translational lift.

The term limited power means that the total power required to hover out of ground effect (HOGE) is greater than the available power.

(~~9~~8) PHASE ANGLE IN FLAPPING MOVEMENT OF THE BLADE

~~The cyclic movement tilts the rotor disc in the direction of the intended helicopter velocity.~~

~~The flapping response is approximately 90° later than the applied cyclic pitch (somewhat less than 90° for hingeless rotors).~~

The movement of the cyclic control tilts the rotor disc in the direction of the intended movement of the helicopter.

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For teetering heads, the flapping response is 90° later than the applied cyclic control movement (less than 90° for rotors with offset hinges).

The pitch mechanism consists of the swash plate, and for each blade the pitch mechanism consists of a pitch link attached to the swash plate and a pitch horn attached to the blade.

(~~10~~9) AXES THROUGH THE CENTRE OF THE HELICOPTER

Longitudinal axis or roll axis: A straight line through the centre of gravity (CG) of the helicopter from the nose to the tail about which the helicopter can roll left or right.

Lateral axis, transverse axis or pitch axis: A straight line through the CG~~centre of gravity~~ of the helicopter about which the helicopter can pitch its nose up or down~~. T~~(this axis is also perpendicular to the reference plane of the aircraft, which is the plane either side of which the components that constitute the major part of the aircraft are symmetrically disposed in the port and starboard sense).

Normal axis or yaw axis: A straight line perpendicular to the plane defined by the longitudinal and lateral axes and about which the helicopter can yaw.

~~Aircraft reference plane: The plane with respect to which a subset of the components that constitutes the major part of the aircraft is symmetrically disposed in the port and starboard sense.~~

Note that the term ‘mass’ is used to describe a quantity of matter, and ‘weight’ when describing the force. However, the term ‘weight’ is normally used in aviation to colloquially describe mass. The professional pilot should always note the units to determine whether the term ‘weight’ is being used to describe a force (e.g. unit newton) or quantity of matter (e.g. unit kilogram).

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
080 00 00 00		**PRINCIPLES OF FLIGHT**								
082 00 00 00		**PRINCIPLES OF FLIGHT — HELICOPTERS**								
082 01 00 00		**SUBSONIC AERODYNAMICS**								
082 01 01 00		**Basic concepts, laws and definitions**								
082 01 01 01		***International system ~~SI~~ of units of measurement (SI) and conversion of SI units***								
(01)	X	List the fundamental quantities and units in ~~the~~ SI ~~system:~~, such as mass (kg), length (m), time (s).			X	X	X			
(02)	X	~~Show and apply tables of conversion of units of~~ Be able to convert ~~English~~imperial units to SI units and vice versa.			X	X	X			
~~LO (03)~~		~~The units of the physical quantities should be mentioned when they are introduced.~~			~~X~~	~~X~~	~~X~~			
082 01 01 02		***Definitions and basic concepts ~~about~~ of air***								
(01)	X	Describe air temperature and pressure as functions of height.			X	X	X			
(02)	X	Define the ~~Use the table of the~~ International Standard Atmosphere (ISA).			X	X	X			
(03)	X	Define air density~~;~~, and explain the relationship between air density, pressure and temperature.			X	X	X			
(04)	X	Explain the influence of moisture content on air density.			X	X	X			
(05)	X	Define pressure altitude and air density altitude.			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
082 01 01 03		***Newton's laws***								
(01)	X	~~Describe~~ State and interpret Newton's ~~second law: force equals product of mass and acceleration.~~ three laws of motion.			X	X	X			
(02)	X	Distinguish between mass and weight, and their units.			X	X	X			
~~LO (03)~~		~~Describe the other form of the second law, applicable to thrust.~~			~~X~~	~~X~~	~~X~~			
~~LO (04)~~		~~Describe Newton's third law: action and reaction, force and torque.~~			~~X~~	~~X~~	~~X~~			
082 01 01 04		***Basic concepts of airflow***								
(01)	X	Describe steady and unsteady airflow.			X	X	X			
(02)	X	Define 'streamline' and 'stream tube'.			X	X	X			
(03)	X	Explain the principle of the continuity equation or ~~mass conservation~~ the conservation of mass. ~~Equation of continuity or mass conservation.~~			X	X	X			
(04)	X	Describe the m~~M~~ass flow rate through a stream tube section.			X	X	X			
~~LO (05)~~		~~Describe the relationship between the external force on a stream tube and the variation in momentum of the airflow.~~			~~X~~	~~X~~	~~X~~			
(06)		~~State the Bernoulli's equation in a non-viscous airflow, use this equation to explain and define static pressure, dynamic pressure and total pressure.~~ State Bernoulli's equation and use it to explain and define the relationship between static, dynamic and total pressure.			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(07)		Define the stagnation point in ~~a~~ the flow around an aerofoil and explain the pressure obtained ~~in~~ at the stagnation point.			X	X	X			
(08)		Use the pitot system to ~~Describe the pitot system and~~ explain the measurement of airspeed (no compressibility effects).			X	X	X			
(09)		Define 'TAS', 'IAS', and 'CAS'.			X	X	X			
(10)	X	~~Define a two-dimensional airflow and an aerofoil of infinite span. Explain the difference between a two- and a three-dimensional airflow.~~ Define two-dimensional airflow and its relationship to an aerofoil of infinite span (i.e. no blade tip vortices and, therefore, no induced drag). Explain the difference between two- and three-dimensional airflows.			X	X	X			
(11)	X	Explain that viscosity is a feature of any fluid (gas or liquid).			X	X	X			
(12)		~~Describe the airflow over a flat surface and e~~Explain the tangential friction between air and the surface of an aerofoil, and the development of a boundary layer.			X	X	X			
(13)		~~Define a~~ Describe laminar and turbulent boundary layers~~, a turbulent boundary layer~~ and the transition from laminar to turbulent. Show the influence of the roughness of the surface on the position of the transition point.			X	X	X			
082 01 02 00		**Two-dimensional airflow**								
082 01 02 01		***Aerofoil section geometry***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)	X	Define the terms ‘aerofoil section’, ‘aerofoil element’, ‘chord line’, ‘chord’, ‘thickness’, ‘thickness-to-chord ratio~~ of section~~’, ‘camber line’, ‘camber’, and ‘leading-edge radius’.			X	X	X			
(02)		Describe ~~different aerofoil sections,~~ symmetrical and asymmetrical aerofoil sections.			X	X	X			
082 01 02 02		***Aerodynamic forces on aerofoil elements***								
(01)		Define the angle of attack (α).			X	X	X			
~~LO (02)~~		~~Describe the pressure distribution on the upper and lower surfaces of an aerofoil.~~			X	X	X			
~~LO (03)~~		~~Describe the boundary layers on the upper and lower surfaces for small angles of attack (below the onset of stall).~~			X	X	X			
(04)		Describe: — the resultant force ~~due to~~ from the pressure distribution and the friction at the element;~~,~~ — the resultant force from the boundary layers and the velocities in the wake; and~~,~~ — the loss of momentum due to friction forces.			X	X	X			
(05)		Resolve the aerodynamic force into the components of lift (L) and drag (D).			X	X	X			
(06)		Define the lift coefficient (C_L) and the drag coefficient (C_D)~~, with equations~~.			X	X	X			
(07)		Show that the C_L~~lift coefficient~~ is a function of the α~~angle of attack.~~			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR	CB-IR(A) and EIR	Remarks
		~~draw the graph~~.								
(08)		Explain how drag is caused by pressure forces on the surfaces of an aerofoil and by friction in the boundary layers. Define the term 'profile drag'.			X	X	X			
(09)		~~Draw the graph of lift (or lift coefficient) as a function of drag or of the drag coefficient and define~~ Define the ~~lift–drag~~ LD ratio.			X	X	X			
(10)		Use the lift and drag equations to show the influence of speed and density on lift and drag for a given α~~angle of attack and to calculate lift and drag~~.			X	X	X			
(11)		Define the action line of the aerodynamic force~~,~~ and the CP~~centre of pressure, the pitching moment~~.			X	X	X			
~~LO (12)~~		~~Know that the pitching moment about the centre of pressure is zero by definition.~~			~~X~~	~~X~~	~~X~~			
(13)		Know that symmetrical aerofoils have ~~the~~ a ~~centre of pressure~~ CP that is approximately a quarter chord behind the leading edge ~~independently of the angle of attack, as long as the angle of attack remains smaller than the angle of stall~~.			X	X	X			
~~LO (14)~~		~~Taking an asymmetrical aerofoil section with different cambers, know the position of the centre of pressure, the influence of the angle of attack on the centre of pressure and the pitching moment about a line which is a quarter chord behind the leading edge.~~			~~X~~	~~X~~	~~X~~			
082 01 02 03		***Stall***								
(01)		Explain the boundary layer separation when α~~the angle of attack~~			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		increases beyond the onset of stall and the decrease of lift and the increase of drag. Define the 'separation point ~~and line~~'.								
~~LO (02)~~		~~Draw a graph of lift and drag coefficients as a function of the angle of attack before and beyond the stall onset.~~			~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~Describe how the stall phenomenon displaces the centre of pressure and how pitching moments appear about the line at quarter chord behind the leading edge.~~			~~X~~	~~X~~	~~X~~			
082 01 02 04		***Disturbances due to profile contamination***								
(01)		Explain ice contamination, the modification of the section profile and ~~the~~ surfaces due to ice and snow, the influence on ~~lift~~ (L) and ~~drag~~ (D) and the L–D ratio, the influence on α~~the angle of attack~~ (at stall onset), and the effect of the ~~weight~~ increase in weight.			X	X	X			
(02)		Explain the ~~erosion~~ effect of erosion by ~~of~~ heavy rain on the blade ~~wing~~ and subsequent increase ~~of~~ in profile drag.			X	X	X			
082 01 03 00		**Three-dimensional airflow around a blade ~~(wing) and a fuselage~~**								
082 01 03 01		***The blade***								
(01)		Describe the various ~~different~~ blade planforms~~of blades, and describe untwisted and twisted blades.~~			X	X	X			
(02)		Define ~~the root chord and the tip chord, the mean chord, the~~ aspect ratio and ~~the~~ blade twist.			X	X	X			
082 01 03 02		***Airflow pattern and influence on lift (L)***								
(01)		Explain the spanwise flow ~~in the case of~~ around a blade and the			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		appearance of ~~the~~ blade tip vortices which are a loss of energy.								
(02)		Show that the strength of the vortices increases as α~~the angle of attack~~ and ~~the lift~~ (L) increase.			X	X	X			
(03)		Show that downwash causes vortices.			X	X	X			
(04)		Define the ~~effective air velocity~~ relative airflow as the resultant of the undisturbed air velocity and ~~the~~ induced velocity, and define α ~~the effective angle of attack~~.			X	X	X			
(05)		Explain the spanwise ~~lift~~ (L) distribution and ~~how~~ the way in which it can be modified by twist (washout).			X	X	X			
082 01 03 03		***Induced drag***								
(01)		Explain ~~the thrust~~ induced drag~~,~~ and the influence of α~~the angle of attack~~ and ~~of the~~ aspect ratio.			X	X	X			
082 01 03 04		***The airflow around ~~a~~ the fuselage***								
(01)		Describe the ~~aircraft~~ fuselage and the external components ~~which~~ that cause (parasite) drag, the airflow around the fuselage, and the influence of the pitch angle of the fuselage. Describe fuselage shapes that minimise drag.			X	X	X			
(02)		Define ~~parasite~~ profile drag as the sum of pressure (form) drag and skin friction drag.			X	X	X			
(03)		Define 'interference drag'.			X	X	X			
~~LO (04)~~		~~Describe fuselage shapes that minimise drag.~~			X	X	X			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
(05)		Know the drag formula ~~of the parasite drag~~ ~~and explain the influence of the speed~~.			X	X	X			
082 02 00 00		**TRANSONIC AERODYNAMICS AND COMPRESSIBILITY EFFECTS**								
082 02 01 00		**Airflow speeds and velocities**								
082 02 01 01		***Speeds and Mach number***								
(01)		Define the speed of sound in air.			X	X	X			
(02)		State that the speed of sound is proportional to the square root of the absolute temperature (~~unit~~ in Kelvins).			X	X	X			
(03)		Explain the variation ~~of~~ in the speed of sound with altitude.			X	X	X			
(04)		Define Mach number.			X	X	X			
(05)		Explain the meaning of incompressibility and compressibility of air; relate this to the value of the Mach number.			X	X	X			
(06)		Define ~~subsonic,~~ high subsonic, transonic and supersonic flows in relation to the value of the Mach number.			X	X	X			
082 02 01 02		***Shock waves***								
(01)		Describe ~~a~~ shock waves in a supersonic flow and the changes in pressure and speed ~~changes by the shock~~.			X	X	X			
(02)		Describe the appearance of local supersonic flows ~~at~~ on the ~~upper~~ surfaces of a blade ~~section and the compression by a shock when the section is in an upstream high subsonic flow~~.			X	X	X			
~~LO (03)~~		~~Describe the effect of the shock on lift, drag, the pitching moment~~			~~X~~	~~X~~	~~X~~			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~and the C_L–C_D ratio, drag divergence Mach number.~~								
082 02 01 03		***Influence of aerofoil section and blade planform***								
(01)		Explain the different shapes ~~which~~ that allow higher ~~upstream~~ Mach numbers without generating a shock wave on the upper surface, such as: — reducing the section thickness-to-chord ratio; — ~~special aerofoil sections as supercritical shapes;~~ — a planform with a sweep angle~~, positive and negative~~.			X	X	X			
082 03 00 00		**ROTORCRAFT TYPES**								
082 03 01 00		**Rotorcraft**								
082 03 01 01		***Rotorcraft types***								
(01)		~~Define the 'autogyro' and the 'helicopter'.~~ Explain the difference between an autogyro and a helicopter.			X	X	X			
~~LO (02)~~		~~Explain the rolling moment on an autogyro with fixed blades, the necessity for using flapping hinges and the ensuing reduction of the moment arm, the flapback of the blades.~~			~~X~~	~~X~~	~~X~~			
082 03 02 00		**Helicopters**								
082 03 02 01		***Helicopter configurations***								
(01)		Describe (briefly) the single-main-rotor helicopter and other configurations: tandem, coaxial, side by side, synchrocopter (with intermeshing blades), the compound helicopter~~, tilt-wing~~ and tilt-			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		rotor.								
082 03 02 02		***The helicopter, characteristics and associated terminology***								
~~LO (01)~~		~~Describe the general layout of a single main rotor helicopter, fuselage, engine or engines, main gearbox, main rotor shaft and rotor hub.~~			~~X~~	~~X~~	~~X~~			
(02)		Mention the tail rotor~~ at the aft of the fuselage~~, the ~~f~~Fenestron and the no tail rotor~~NOTOR~~ (NOTAR)~~ (No Tail Rotor)~~.			X	X	X			
(03)		Define the rotor disc area and the blade area~~, the blades turning in the hubplane~~.			X	X	X			
(04)		Describe the teetering rotor with ~~the~~ its hinge axis on the shaft axis and ~~the~~ rotors with more than two blades with offset hinge axes.			X	X	X			
(05)		Define the fuselage centre line and the three axes: roll, pitch and normal (yaw).			X	X	X			
(06)		Define gross weight and ~~the~~ gross mass (and the units involved), ~~the~~ disc and blade loading.			X	X	X			
082 04 00 00		**MAIN-ROTOR AERODYNAMICS**								
082 04 01 00		**Hover flight o~~O~~utside g~~G~~round e~~E~~ffect**								
082 04 01 01		**Airflow through the rotor disc and around the blades**								
~~LO (01)~~		~~Define the circumferential (tangential) velocity of the blade sections, which equals the angular velocity of the rotor multiplied by the radius of the section.~~			~~X~~	~~X~~	~~X~~			

FOR INFORMATION ONLY

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (02)~~		~~Keep the blade fixed and define the undisturbed upstream air velocity relative to the blade.~~			~~X~~	~~X~~	~~X~~			
(03)	X	Based on Newton's second law (momentum), explain that the upward vertical force ~~on~~ from the disc, i.e. the rotor thrust, ~~produces~~ is the result of vertical downward velocities ~~in~~ inside the rotor disc. ~~The values of these thrust-induced velocities increase as the thrust increases and decrease with increasing rotor diameter. Know that the velocities some distance downstream are twice the value of the induced speed in the disc plane.~~			X	X	X			
(04)		Explain why the production of the induced flow requires ~~a~~ power ~~on~~ applied to the shaft, i.e. ~~the~~ induced power. ~~The~~ ~~I~~Induced power is ~~smaller~~ least if the induced velocities have the same value ~~over~~ on the whole disc (i.e. there is ~~flow~~ uniformity of flow over the disc).			X	X	X			
~~LO (05)~~		~~Describe uniform and typical non-uniform velocities through the rotor disc.~~			~~X~~	~~X~~	~~X~~			
(06)		Explain why vertical rotor thrust must be ~~somewhat~~ higher than the weight of the helicopter because of the vertical drag on the fuselage.			X	X	X			
~~LO (07)~~		~~Describe the vertical air velocities relative to the rotor disc as the sum of the upstream air velocities and the induced velocities.~~			~~X~~	~~X~~	~~X~~			
(08)		Define the pitch angle and the α~~angle of attack~~ of a blade element.			X	X	X			
(09)		Explain ~~lift~~ L and ~~the profile~~ ~~drag~~ D ~~of~~ relating to a blade element			X	X	X			

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		(including induced and profile drag).								
~~LO (10)~~		~~Explain the resulting lift and the thrust on the blade, define the resulting rotor thrust.~~			~~X~~	~~X~~	~~X~~			
(11)		Explain the necessity ~~of~~ for collective pitch angle changes, the influence on the ~~angles of attack~~ α and ~~on the~~ rotor thrust, and the ~~necessity of~~ need for blade feathering.			X	X	X			
~~LO (12)~~		~~Explain the blade twist necessary to obtain a more even induced airspeed over the disc.~~			~~X~~	~~X~~	~~X~~			
(13)		Describe the different blade shapes (as viewed from above).			X	X	X			
(14)		Explain how profile drag on the blade elements generates a torque on the main shaft, and define the resulting rotor profile power.			X	X	X			
(15)		Explain the influence of air density on the required powers.			X	X	X			
~~LO (16)~~		~~Show the effect on the airflow over the blade tips.~~			~~X~~	~~X~~	~~X~~			
082 04 01 02		***Anti-torque force and tail rotor***								
(01)		~~Based on~~ Using Newton's third law (motion), explain the need ~~of a~~ for tail-rotor thrust, the required value being proportional to ~~the~~ main-rotor torque. Show that ~~the~~ tail-rotor power is proportional to ~~the~~ tail-rotor thrust.			X	X	X			
(02)		Explain the necessity ~~of blade feathering~~ for feathering of the tail-rotor blades and ~~the~~ their control by the yaw pedals, and the maximum and minimum values of the pitch angles of the blades.			X	X	X			
082 04 01 03		***Total power required and h~~H~~over o~~O~~utside g~~G~~round e~~E~~ffect***								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		(HOGE)								
(01)		Define ~~the~~ ancillary equipment and its power requirement.			X	X	X			
(02)		Define the total power required.			X	X	X			
(03)	X	Describe the influence of ambient pressure, temperature and moisture on the required power.			X	X	X			
082 04 02 00		**Vertical climb**								
082 04 02 01		***Relative airflow and angles of attack (α)***								
(01)	X	Describe the dependence of the vertical climb speed ~~and~~ on the opposite vertical air velocity relative to the rotor disk.			X	X	X			
~~LO (02)~~		~~Explain the relative air velocities and angles of attack of the blade elements.~~			X	X	X			
(03)		Explain how α~~the angle of attack~~ is controlled by the collective pitch angle control.			X	X	X			
082 04 02 02		***Power and vertical speed***								
(01)		Define ~~the~~ total main-rotor power as the sum of ~~the~~ parasite power, ~~the~~ induced power, ~~the~~ climb power and ~~the~~ rotor profile power.			X	X	X			
(02)		Explain why the total main-rotor power required increases when the rate of climb increases.			X	X	X			
~~LO (03)~~		~~Define the total required power in vertical flight.~~			X	X	X			
082 04 03 00		**Forward flight**								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
082 04 03 01		***Airflow and forces in uniform inflow distribution***								
(01)		Explain the assumption of a uniform inflow distribution on the rotor disc.			X	X	X			
~~LO (02)~~		~~Define the azimuth angle of a blade, the advancing blade angular range centred at 90°, and the retreating blade range centred at 270°.~~			~~X~~	~~X~~	~~X~~			
(03)		Show the upstream air velocities relative to the blade elements and the different effects on the advancing and retreating blades. Define the area of reverse flow. Explain the influence of forward speed on the ~~tip~~ circumferential speed of the blade tip.			X	X	X			
(04)		Assuming constant pitch angles and rigid blade attachments, explain the ~~huge~~ roll moment from ~~by~~ the asymmetric ~~lift~~ distribution of L.			X	X	X			
(05)		Show that through cyclic feathering this imbalance could be eliminated by a low α~~angle of attack~~ (accomplished by a low pitch angle) on the advancing blade and a high α~~angle of attack~~ (accomplished by a high pitch angle) on the retreating blade.			X	X	X			
(06)		Describe the high air velocity at the advancing blade tip and the compressibility effects which limit ~~the~~ maximum speed ~~of the helicopter~~.			X	X	X			
(07)		Describe the low air velocity~~ies~~ on the retreating blade tip resulting from the difference between the circumferential speed and ~~the~~ forward speed, the ~~necessity of~~ need for high ~~angle of~~			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~attack~~ α and the onset of stall.								
(08)		Define the blade tip speed ratio ~~and show the limits~~.			X	X	X			
(09)		Explain the total r~~R~~otor t~~T~~hrust that is perpendicular to the rotor disc and the ~~necessity to~~ need for tilting the thrust vector forward. ~~(Realisation will be explained in 082 05 00 00)~~			X	X	X			
(10)		Explain the conditions of equilibrium ~~conditions~~ in steady straight and level flight.			X	X	X			
082 04 03 02		***The flare (powered flight)***								
(01)		Explain the flare in powered flight, the rearward tilt of the rotor disc and ~~of~~ the thrust vector. Show the horizontal thrust component that is in the opposite direction to ~~the speed~~ forward velocity.			X	X	X			
(02)		State the increase ~~of the~~ in thrust due to the upward inflow, and show the modifications ~~of~~ in the ~~angles of attack~~ α.			X	X	X			
(03)		Explain the increase ~~of~~ in rotor ~~RPM~~rpm ~~in the case of~~ for a non-governed rotor.			X	X	X			
~~LO (04)~~		~~Explain the actions to be taken by the pilot.~~			~~X~~	~~X~~	~~X~~			
082 04 03 03		***Non-uniform inflow distribution in relation to inflow roll***								
(01)		~~Explain why the uniform inflow distribution is an assumption to simplify the theory and describe the real.~~ Describe the inflow distribution which modifies α~~the angle of attack~~ and ~~the~~ L ~~lift~~ especially on the ~~forward~~ advancing and ~~backward~~ retreating			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		blades.								
082 04 03 04		***Power and maximum speed***								
(01)		Explain that the induced velocities and ~~induced~~ power values decrease as the speed of the helicopter ~~speed~~ increases.			X	X	X			
(02)		Define ~~the~~ profile drag and ~~the~~ profile power, and the~~ir~~ increase in their values with the speed of the helicopter ~~speed~~.			X	X	X			
(03)		Define ~~the fuselage~~ parasite drag and ~~the~~ parasite power, and the increase in their values with the speed of the helicopter ~~speed~~.			X	X	X			
(04)		Define ~~the~~ total drag and ~~the~~ its increase with the speed of the ~~helicopter~~ speed.			X	X	X			
(05)		Describe the ~~tail-rotor~~ power required for the tail rotor and the power required by ~~the~~ ancillary equipment.			X	X	X			
(06)		Define the total power requirement as a sum of the above partial powers, and explain how ~~this total power~~ it varies with the speed of the helicopter ~~speed~~.			X	X	X			
(07)		Explain the influence of ~~the~~ helicopter mass, ~~the~~ air density and additional external equipment on the partial powers and the total power required.			X	X	X			
(08)		Describe ~~the~~ translational lift and show the decrease ~~of~~ in required total power as the helicopter increases its speed ~~in the low-speed region~~ from the hover.			X	X	X			
082 04 04 00		**Hover and forward flight i~~I~~n g~~G~~round e~~E~~ffect ~~(IGE)~~**								

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
082 04 04 01		***Airflow in ground effect, downwash***								
(01)		Explain how the vicinity of the ground changes the downward flow pattern and the consequences on lift (thrust) at constant rotor power. Show that ~~the~~ ground effect depends on the height of the rotor above the ground and the rotor diameter. Show the required rotor power at constant all-up mass (AUM) as a function of height above the ground. Describe the influence of ~~the~~ forward speed.			X	X	X			
082 04 05 00		**Vertical descent**								
082 04 05 01		***Vertical descent, power on***								
(01)		Describe the airflow ~~to~~ around the rotor disc in a trouble-free vertical descent, power on, the airflow ~~opposite to~~ opposing the helicopter's velocity, the relative airflow ~~air velocity~~ and α~~the angle of attack~~.			X	X	X			
(02)		Explain the vortex-ring state, ~~the~~ also known as settling with power. State the approximate ~~values of~~ vertical descent speeds ~~for~~ that allow the formation of vortex ring, related to the values of the induced velocities.			X	X	X			
(03)		Describe the airflow relative to the blades, the root stall, the loss of lift ~~on~~ at the blade tip, and the turbulence. Show the effect of raising the lever and ~~discuss~~ describe the effects on the controls.			X	X	X			
082 04 05 02		***Autorotation***								
(01)		State the need for early recognition ~~of malfunctions~~ and for a quick initiation of recovery. Describe the recovery actions.			X	X	X			

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
(02)		Explain that the collective lever ~~position~~ must be lowered ~~sufficient~~ quickly enough to avoid a rapid decay of rotor ~~RPM~~rpm due to drag on the blades, and explain the influence of ~~the~~ rotational inertia of the rotor on the rate of decay.			X	X	X			
(03)		Show the induced flow through the rotor disc, the rotational velocity and ~~the~~ relative airflow, the inflow and inflow angles.			X	X	X			
(04)		Show how the aerodynamic forces on the blade elements vary from root to tip and distinguish three zones: the inner ~~stalled ring~~ ~~(~~stalled region~~)~~, the middle ~~autorotation ring (~~driving region~~)~~, and the ~~outer anti-autorotation ring (~~driven region~~)~~. ~~Explain the RPM stability of the RPM at a given collective pitch.~~			X	X	X			
(05)		Explain the control of the rotor ~~RPM~~rpm with collective pitch.			X	X	X			
(06)		Show the need ~~of~~ for negative tail-rotor thrust ~~for~~ with yaw control.			X	X	X			
(07)		Explain the final increase in rotor thrust caused by ~~pulling~~ raising the collective pitch to decrease the vertical descent speed and the decay in rotor ~~RPM~~rpm.			X	X	X			
082 04 06 00		**Forward flight — ~~a~~Autorotation**								
082 04 06 01		***Airflow at the rotor disc***								
(01)		Explain the factors that affect~~ing~~ inflow angle and α~~angle of attack~~, the autorotative power distribution and the ~~assymetry~~ dissymmetry over the rotor disc in forward flight.			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
082 04 06 02		***Flight and landing***								
(01)		Show the effect of forward speed on the vertical descent speed.			X	X	X			
(02)		Explain the effects of gross weight, rotor ~~RPM~~rpm and altitude (density) on endurance and range.			X	X	X			
(03)		Explain the ~~manoeuvers~~manoeuvres of turning and touchdown.			X	X	X			
(04)		Explain the height–velocity ~~avoidance graph or dead man's~~ curves.			X	X	X			
082 05 00 00		**MAIN-ROTOR MECHANICS**								
082 05 01 00		**Flapping of the blade in hover**								
082 05 01 01		***~~Forces and stresses on the blade~~ Intentionally left blank***								
~~LO (01)~~		~~Show how the centrifugal forces depend on rotor RPM and blade mass and how they pull on the blade's attachment to the hub. Apply the formula to an example. Justify the upper limit of the rotor RPM.~~			~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~Assume a rigid attachment and show how thrust may cause huge oscillating bending moments which stress the attachment.~~			~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~Explain why flapping hinges do not transfer such moments. Show the small flapping hinge offset on fully articulated rotors and zero offset in the case of teetering rotors.~~			~~X~~	~~X~~	~~X~~			
~~LO (04)~~		~~Describe the working principle of the flexible element in the hingeless rotor and describe the equivalent flapping hinge offset compared to that of the articulated rotor.~~			~~X~~	~~X~~	~~X~~			

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
082 05 01 02		***Centrifugal turning moment (CTM)***								
(01)		Describe the centrifugal forces on the mass elements of a blade with pitch applied and the components of ~~these~~ those forces. Show how ~~these~~ the forces generate a moment ~~which~~ that tries to reduce the blade pitch angle.			X	X	X			
(02)		Explain the methods of counteracting CTM ~~by~~ with hydraulics, bias springs and balance masses.			X	X	X			
082 05 01 03		***Coning angle in the hover***								
(01)		Define the tip path plane and the coning angle.			X	X	X			
(02)		Show how the equilibrium of the moments about the flapping hinge of lift (thrust) and of the centrifugal force determine the coning angle of the blade (the blade ~~weight~~ mass being negligible).			X	X	X			
(03)		~~Explain the influence of rotor RPM and lift on the coning angle, j~~Justify the lower limit of ~~the~~ rotor rpm~~RPM, relate the lift on one blade to the gross weight~~.			X	X	X			
(04)		Explain the effect of the mass of ~~the~~ a blade on the tip path and the tracking.			X	X	X			
082 05 02 00		**Flapping angles of the blade in forward flight**								
082 05 02 01		***Forces on the blade in forward flight without cyclic feathering***								
(01)		Assume rigid attachments of the blade to the hub and show the periodic lift, moment and stresses on the attachment, the ensuing metal fatigue, the roll moment on the helicopter, and justify the			X	X	X			

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		necessity for a flapping hinge.								
(02)		Assume no cyclic pitch and describe the lift on the advancing and the retreating blades.			X	X	X			
(03)		State the azimuthal phase lag (90° or less) between the input (applied pitch) and the output (flapping angle). Explain ~~the rotor~~ flapback (the rearward tilting of the tip path plane and ~~the rotor thrust~~ total rotor thrust).			X	X	X			
082 05 02 02		***Cyclic pitch (feathering) in ~~helicopter mode,~~ forward flight***								
(01)		Show that in order to assume and maintain forward flight, the ~~rotor thrust~~ total rotor thrust vector must ~~get~~ obtain a forward component by tilting the tip path plane.			X	X	X			
(02)		Show how the applied cyclic pitch modifies the lift on the advancing and retreating blades and produces the required forward tilting of the tip path plane and the total rotor thrust.			X	X	X			
(03)		Show the cone described by the blades and define the virtual axis of rotation ~~(or the no flapping axis)~~. Define the plane of rotation.			X	X	X			
(04)		Define the reference system in which ~~we define~~ the movements are defined: the shaft axis and the hub plane.			X	X	X			
(05)		Describe the swash plates, the pitch links and ~~the pitch~~ horns. Explain how the collective lever moves the non-rotating swash plate up or down ~~alongside~~ the shaft axis.			X	X	X			
(06)		Describe the mechanism by which the desired cyclic blade pitch can be produced by tilting the swash plate with the cyclic stick.			X	X	X			

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (07)~~		~~Define the no-feathering or control plane (control orbit) and the no-feathering axis or control axis.~~			X	X	X			
(08)		Explain the translational lift effect when the speed increases.			X	X	X			
(09)	X	Justify the increase of the tilt angle of the thrust vector and of the ~~Tip Path Plane~~ disc in order to increase the speed.			X	X	X			
082 05 03 00		**Blade-lag motion in forward flight**								
082 05 03 01		***Forces on the blade in the disc plane (tip path plane) in forward flight***								
(01)		Explain the Coriolis force due to flapping, the resulting periodic moments in the hub plane, and the resulting periodic stresses which make lead-lag hinges necessary to avoid material fatigue.			X	X	X			
(02)		Describe the profile drag forces on the blade elements and the periodic variation of these forces.			X	X	X			
082 05 03 02		***~~The drag or lag hinge~~ Intentionally left blank***								
~~LO (01)~~		~~Describe the drag hinge of the fully articulated rotor and the lag flexure in the hingeless rotor.~~			~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~Explain the necessity for drag dampers.~~			~~X~~	~~X~~	~~X~~			
082 05 03 03		***Ground resonance***								
(01)		Explain the movement of the CG ~~centre of gravity~~ of the blades due to ~~the~~ lead-lag movements in the multibladed rotor.			X	X	X			
(02)		Show the effect on the fuselage and the danger of resonance			X	X	X			

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Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL /IR	ATPL	CPL			
		between this force, ~~and~~ the fuselage and undercarriage when the gear touches the ground. ~~State the conditions likely to lead to ground resonance.~~								
082 05 04 00		**Rotor systems**								
082 05 04 01		***See-saw or teetering rotor***								
(01)		Explain that a teetering rotor is prone to mast bumping in low-g~~G~~ situations, ~~because of having no flapping hinge offset~~ and that it is difficult to counteract because there is no lift force to provide sideways movement.			X	X	X			
082 05 04 02		***~~Fully articulated rotor~~ Intentionally left blank***								
~~LO (01)~~		~~Describe the fully articulated rotor with hinges and feathering bearings.~~			~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~Describe ball and roller bearings and elastomeric bearings, their advantages and disadvantages.~~			~~X~~	~~X~~	~~X~~			
082 05 04 03		***Hingeless rotor, bearingless rotor***								
(01)		Show the forces on the flapping hinges with a large offset (virtual hinge) and the resulting moments, and compare them with other rotor systems.			X	X	X			
082 05 05 00		**Blade sailing**								
082 05 05 01		***Blade sailing and causes***								
(01)		Define blade sailing, the influence of low rotor ~~RPM~~rpm and of a headwind.			X	X	X			

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
082 05 05 02		***Minimising the danger***								
(01)		Describe ~~the~~ actions ~~to~~ that minimise danger and the demonstrated wind envelope for engaging and disengaging rotors.			X	X	X			
082 05 05 03		***Droop stops***								
(01)		Explain the ~~utility of the~~ purpose of droop stops, and their retraction ~~of the stops~~.			X	X	X			
082 05 06 00		**Vibrations due to main rotor**								
082 05 06 01		***~~Origins of the vertical vibrations~~ Intentionally left blank***								
~~LO (01)~~		~~Explain the lift (thrust) variations per revolution of a blade and the resulting vertical (total) rotor thrust variation in the case of perfect identical blades.~~			~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~Show the resulting frequencies and amplitudes as a function of the number of blades.~~			~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~Explain the thrust variation in case of an out-of-track blade, causes, frequencies (one-per-revolution).~~			~~X~~	~~X~~	~~X~~			
~~LO (04)~~		~~Explain the importance of the hinges offset on the effect of the vibrations on the fuselage.~~			~~X~~	~~X~~	~~X~~			
082 05 06 02		***~~Lateral vibrations~~ Intentionally left blank***								
~~LO (01)~~		~~Explain imbalances of a blade, causes, and effects.~~			~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~Explain the frequencies lateral one-per-revolution vibration.~~			~~X~~	~~X~~	~~X~~			
082 06 00 00		**TAIL ROTORS**								

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
082 06 01 00		**Conventional tail rotor**								
082 06 01 01		***~~Tail rotor description~~ Intentionally left blank***								
~~LO (01)~~		~~Describe the two-bladed rotor with teetering hinge, the and rotors with more than two blades.~~			~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~Show the flapping hinges and the feathering bearing.~~			~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~Describe the dangers to ground personnel, to the rotor blades, and the possibilities of minimising these dangers.~~			~~X~~	~~X~~	~~X~~			
082 06 01 02		***Tail-rotor aerodynamics***								
(01)		Explain the airflow around the blades in the hover and in forward flight, and the effects of the tip speeds on ~~the~~ noise production and ~~the~~ compressibility~~, limits~~.			X	X	X			
(02)		Explain ~~in hovering~~ the effect of wind on ~~the~~ tail-rotor aerodynamics and thrust in the hover, and any problems.			X	X	X			
(03)		Explain ~~the~~ tail-rotor thrust and the control through pitch ~~control~~ alterations (feathering).			X	X	X			
(04)		Explain tail-rotor flapback, and the effects of ~~d~~Delta 3~~-three hinges~~.			X	X	X			
(05)		Describe the roll moment and drift as side effects of the tail rotor.			X	X	X			
(06)		Explain the effects of ~~the~~ tail-rotor failure.			X	X	X			
(07)		Explain the loss of tail-rotor effectiveness (LTE), tail-rotor vortex-ring state, causes, crosswind and yaw speed.			X	X	X			

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082 06 01 03		***Strakes on the tail boom***								
(01)		Describe the strake and explain ~~the~~ its function ~~of the device~~.			X	X	X			
~~**082 06 02 00**~~		~~**The fenestron**~~								
~~***082 06 02 01***~~		~~***Technical layout***~~								
~~LO (01)~~		~~Show Describe the technical details layout of a fenestron tail rotor.~~			~~X~~	~~X~~	~~X~~			
~~***082 06 02 02***~~		~~***Control concepts***~~								
~~LO (01)~~		~~Explain the control concepts of a fenestron tail rotor.~~			~~X~~	~~X~~	~~X~~			
~~***082 06 02 03***~~		~~***Advantages and disadvantages***~~								
~~LO (01)~~		~~Explain the advantages and disadvantages.~~			~~X~~	~~X~~	~~X~~			
~~**082 06 03 00**~~		~~**The NOTAR**~~								
~~***082 06 03 01***~~		~~***Technical layout***~~								
~~LO (01)~~		~~Show the technical layout.~~			~~X~~	~~X~~	~~X~~			
~~***082 06 03 02***~~		~~***Control concepts***~~								
~~LO (01)~~		~~Explain the control concepts.~~			~~X~~	~~X~~	~~X~~			
~~***082 06 03 03***~~		~~***Advantages and disadvantages***~~								
~~LO (01)~~		~~Explain the advantages and disadvantages.~~			~~X~~	~~X~~	~~X~~			
~~***082 06 04 00***~~		~~***Vibrations***~~								
~~***082 06 04 01***~~		~~***Tail-rotor vibrations***~~								
~~LO (01)~~		~~Explain the sources of vibration of the tail rotor and the resulting~~			~~X~~	~~X~~	~~X~~			

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		~~high frequencies.~~								
~~082 06 04 02~~		***~~Balancing and tracking~~***								
~~LO (01)~~		~~Explain balancing and tracking of the tail rotor.~~			~~X~~	~~X~~	~~X~~			
082 07 00 00		**EQUILIBRIUM, STABILITY AND CONTROL**								
082 07 01 00		**Equilibrium and helicopter attitudes**								
082 07 01 01		***Hover***								
(01)		Explain why the vector sum of forces and moments must be zero in any acceleration-free situation.			X	X	X			
(02)		Indicate the forces and the moments about the lateral axis in a steady hover.			X	X	X			
(03)		Indicate the forces and the moments about the longitudinal axis in a steady hover.			X	X	X			
(04)		Deduce how the roll angle in a steady hover without wind results from the moments about the longitudinal axis.			X	X	X			
(05)		Explain how the cyclic is used to ~~create equilibrium of~~ equalise moments about the lateral axis in a steady hover.			X	X	X			
(06)		Explain the consequence of the cyclic stick reaching its forward or aft limit during an attempt to take off to the hover.			X	X	X			
(07)		Explain the influence of ~~the~~ density altitude on the equilibrium of forces and moments in a steady hover.			X	X	X			
082 07 01 02		***Forward flight***								

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
(01)		Explain why the vector sum of forces and of moments must be zero in unaccelerated flight.			X	X	X			
(02)		Indicate the forces and the moments about the lateral axis ~~acting on a helicopter~~ in ~~a~~ steady straight and level flight.			X	X	X			
(03)		Explain the influence of ~~All-Up Mass (~~AUM~~)~~ on the forces and moments about the lateral axis in forward flight.			X	X	X			
(04)		Explain the influence of the CG position of the ~~centre of gravity~~ on the forces and moments about the lateral axis in forward flight.			X	X	X			
(05)		Explain the role of the cyclic stick position in creating equilibrium of forces and moments about the lateral axis in forward flight.			X	X	X			
(06)		Explain how forward speed influences the fuselage attitude.			X	X	X			
(07)		Describe and explain the inflow roll effect.			X	X	X			
082 07 02 00		**Stability**								
082 07 02 01		***Static longitudinal, roll and directional stability***								
(01)		Define static stability; give an example of static stability and of static instability.			X	X	X			
(02)		Explain the contribution of the main rotor to speed stability.			X	X	X			
(03)		Describe the influence of the horizontal stabiliser on static longitudinal stability.			X	X	X			
(04)		Explain the effect of hinge offset on static stability.			X	X	X			
(05)		Describe the influence of the tail rotor on static directional			X	X	X			

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		stability.								
(06)		Describe the influence of the vertical stabiliser on static directional stability.			X	X	X			
(07)		Explain the influence of the main rotor on ~~the~~ static roll stability.			X	X	X			
(08)		Describe the influence of the longitudinal position of the CG ~~centre of gravity~~ on ~~the~~ static longitudinal stability.			X	X	X			
082 07 02 02		***Static stability in the hover***								
(01)		Describe the initial movements of a hovering helicopter after the occurrence of a horizontal gust.			X	X	X			
082 07 02 03		***Dynamic stability***								
(01)		Define dynamic stability; give an example of dynamic stability and of dynamic instability.			X	X	X			
(02)		Explain why static stability is a precondition for dynamic stability.			X	X	X			
082 07 02 04		***Longitudinal stability***								
(01)		Explain the individual contributions of α~~angle of attack~~ and speed stability together with the stabiliser and fuselage on ~~the~~ dynamic longitudinal stability.			X	X	X			
~~LO (02)~~		~~Explain the principle of stability augmentation systems.~~			~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~Define the characteristics of a phugoid.~~			~~X~~	~~X~~	~~X~~			
082 07 02 05		***Roll stability and directional stability***								
~~LO (01)~~		~~Explain the effect of a dihedral on a helicopter.~~			~~X~~	~~X~~	~~X~~			

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
~~LO (02)~~		~~Describe how a dihedral influences the static roll stability.~~			~~X~~	~~X~~	~~X~~			
(03)		Know that a large static roll stability together with a small directional stability may lead to a Dutch roll.			X	X	X			
~~LO (04)~~		~~Explain which stability features taken together may result in spiral dive and the reason why.~~			~~X~~	~~X~~	~~X~~			
~~LO (05)~~		~~Explain the static directional stability features of a tandem rotor type helicopter.~~			~~X~~	~~X~~	~~X~~			
082 07 03 00		**Control**								
_082 07 03 01_		**_Manoeuvre~~r~~ stability_**								
~~LO (01)~~		~~Define the meaning of stick-force stability.~~			~~X~~	~~X~~	~~X~~			
~~LO (02)~~		~~Define the meaning of stick-position stability.~~			~~X~~	~~X~~	~~X~~			
~~LO (03)~~		~~Explain the meaning of the stick-force diagram and trim speed~~.			~~X~~	~~X~~	~~X~~			
~~LO (04)~~		~~Explain the meaning of stick force per G.~~			~~X~~	~~X~~	~~X~~			
~~LO (05)~~		~~Explain how a bob weight influences stick force per G.~~			~~X~~	~~X~~	~~X~~			
(06)		Explain how helicopter control can be limited because of available stick travel.			X	X	X			
(07)		Explain how the CG position of the ~~centre of gravity~~ influences the remaining stick travel.			X	X	X			
_082 07 03 02_		**_Control power_**								
(01)		Explain the meaning of the control moment.			X	X	X			

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(02)		Explain the importance of the CG ~~centre of gravity~~ position on the control moment.			X	X	X			
~~LO (03)~~		~~Explain how the changes of magnitude of rotor thrust of a helicopter during manoeuvres influence the control moment.~~			~~X~~	~~X~~	~~X~~			
~~LO (04)~~		~~Explain which control moment provides control for a helicopter rotor with zero-hinge offset (central flapping hinge).~~			~~X~~	~~X~~	~~X~~			
~~LO (05)~~		~~Explain the different type of rotor control moments which together provide the control of helicopters with a hingeless or a fully articulated rotor system.~~			~~X~~	~~X~~	~~X~~			
(06)		Explain the influence of hinge offset on controllability.			X	X	X			
082 07 03 03		***Static and dynamic rollover***								
(01)		Explain the mechanism which causes dynamic rollover.			X	X	X			
(02)		Explain the required pilot action when dynamic rollover is starting to develop.			X	X	X			
082 08 00 00		**HELICOPTER FLIGHT MECHANICS**								
082 08 01 00		**Flight limits**								
082 08 01 01		***Hover and vertical flight***								
(01)		Show the power required for HOGE and HIGE and the power available~~, the OGE and IGE maximum hover height (see subject 020, piston engines and turbine engines)~~.			X	X	X			
(02)		Explain the effects of ~~All-Up Mass (~~AUM~~)~~, ambient temperature			X	X	X			

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			ATPL	CPL	ATPL /IR	ATPL	CPL			
		and pressure, density altitude and moisture.								
(03)		~~Discuss~~ Describe the rate of climb in a vertical flight.			X	X	X			
082 08 01 02		***Forward flight***								
(01)		Compare the power required and the power available as a function of speed in straight and level flight.			X	X	X			
(02)		Define the maximum speed limited by power and the value relative to V_{NE} and V_{NO}.			X	X	X			
(03)		Use the power graph to determine the speeds of maximum rate of climb and the maximum angle of climb.			X	X	X			
(04)		Use the power graph to define ~~the~~ true airspeed (TAS) for maximum range and maximum endurance, and consider the case of ~~the~~ piston engine and ~~the~~ turbine engine. Explain the effects of tailwind or headwind on the speed for maximum range.			X	X	X			
(05)		Explain the effects of AUM, pressure and temperature, density altitude, and humidity.			X	X	X			
082 08 01 03		***Manoeuvring***								
(01)		Define the load factor, the radius ~~of turn~~ and the rate of turn.			X	X	X			
(02)		Explain the relationship between the ~~bank~~ angle of bank, the airspeed and the radius of turn, and between the ~~bank~~ angle of bank and the load factor.			X	X	X			
(03)		Explain the influence of ~~All Up Mass (~~AUM~~)~~, pressure and temperature, density altitude, and humidity.			X	X	X			

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~~LO (04)~~		~~Define the limit-load factors and the certification categories.~~			~~X~~	~~X~~	~~X~~			
082 08 02 00		**Special conditions**								
082 08 02 01		***Operating with limited power***								
(01)		Explain ~~the~~ operations with limited power, use the power graph to show the limitations on vertical ~~flight~~ and level flight, ~~discuss~~ and describe ~~the~~ power checks and procedures for take-off and landing.			X	X	X			
(02)		Describe manoeuvres with limited power.			X	X	X			
082 08 02 02		***Overpitch, overtorque***								
(01)		Describe overpitching and show the consequences.			X	X	X			
(02)		Describe situations likely to lead to overpitching.			X	X	X			
(03)		Describe ~~overtorqueing~~ overtorquing and show the consequences.			X	X	X			
(04)		Describe situations likely to lead to ~~overtorqueing~~ overtorquing.			X	X	X			

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