European Aviation Safety Agency

Acceptable Means of Compliance (AMC)

and

Guidance Material (GM)

to Part-PERS

Requirements for service providers concerning personnel training and competence assessment

Initial Issue

8 March 2017[1]

[1] For the date of entry into force of this issue, kindly refer to Decision 2017/001/R in the **Official Publication** of the Agency.

Table of contents

SUBPART A — AIR TRAFFIC SAFETY ELECTRONIC PERSONNEL

Section 1 — General

GM1 ATSEP.OR.100 Scope
GENERAL

Whilst it is acknowledged that 'power supply' and 'air conditioning' systems and equipment that can be critical elements of the aviation safety chain and that personnel should, therefore, be appropriately trained in those areas, it is not considered that this training should fall within the scope of the ATSEP training provisions. In general, ATSEP do not work on these systems, but rather control and manage the release of power and air conditioning systems, to and from operational service. In this situation, the person does not have, and is not expected to have, extensive knowledge of the aviation environment to provide the required service. Consequently, the vast majority of the Initial Training objectives would not be applicable to a power engineer.

GM1 ATSEP.OR.105 Training and competence assessment programme
GENERAL

The training and competence assessment programme should include:

(a) the training policy;

(b) the description of all training activities and the interrelations between different training activities;

(c) the description of the function/role of the phase/course supervisor, instructors and assessors;

(d) the description of the qualifications of instructional and competence assessment personnel;

(e) the target group of learners;

(f) the description of the minimum qualification of learners or required entry levels ('learner' is the generic term for a person performing a learning activity without any reference to his or her status (ab initio/student/trainee));

(g) the description of knowledge outcome and performance objectives;

(h) the record of supervisory, instructional and competence assessment personnel participating in a course;

(i) the training environment (e.g. infrastructure, equipment, etc.);

(j) the training methodology (e.g. classroom instruction, self-study, computer-based training (CBT), on-the-job training (OJT), etc.);

(k) the training material;

(l) the training schedule;

(m) the competence assessment method (e.g. pre-course, on-training evaluation, post-course, etc.);

(n) the record of individual learners training and competence assessment; and

(o) the feedback mechanisms.

GM2 ATSEP.OR.105 Training and competence assessment programme
CHANGE OF ORGANISATION

When already qualified and experienced ATSEP move from one service provider to another, the receiving service provider may conduct an analysis and/or competence assessment of their previous training. Any identified training shortcomings, relative to their new duties assignments should be addressed through additional training.

AMC1 ATSEP.OR.115 Language proficiency
LANGUAGE LEVEL

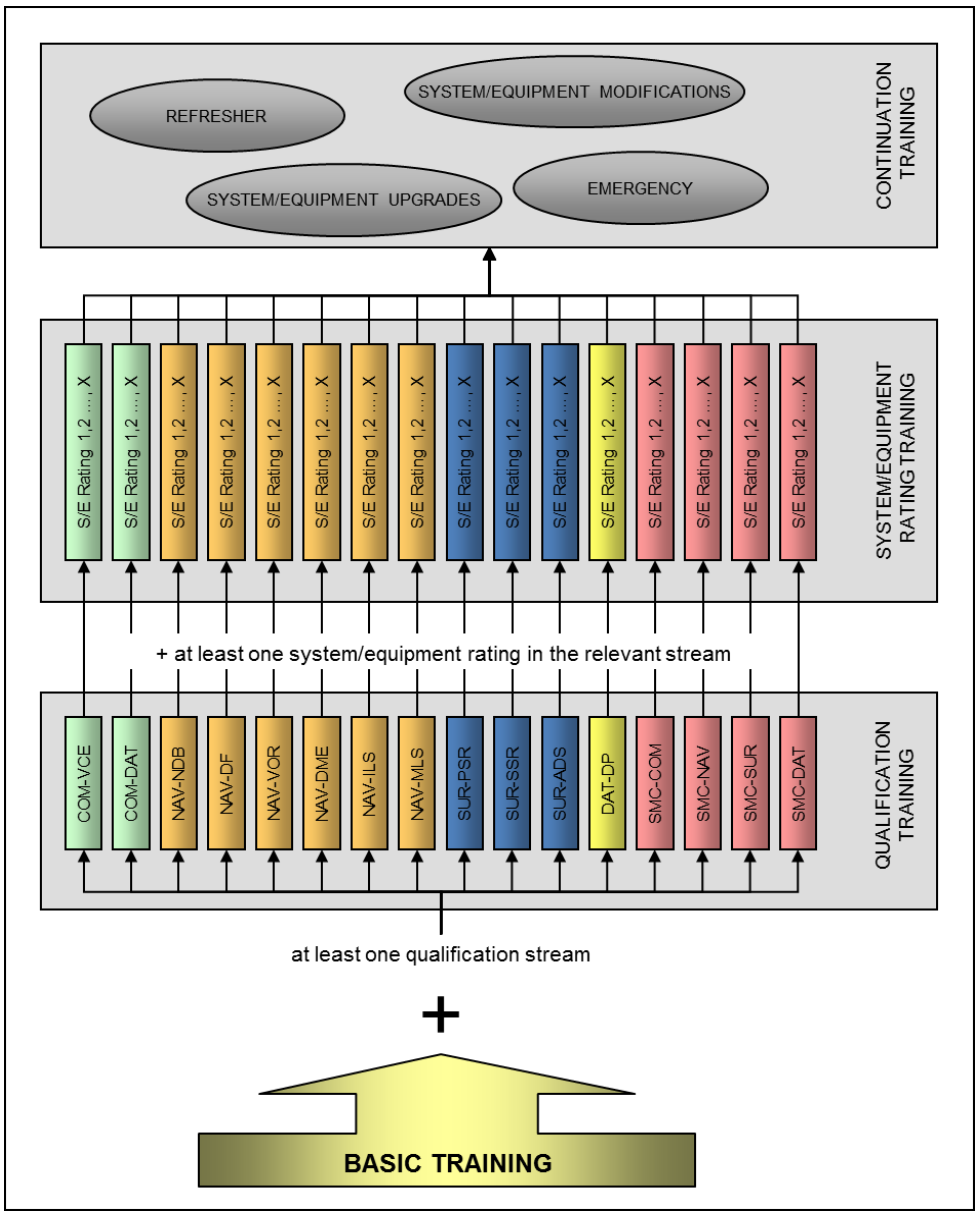
Service providers should determine the level of language proficiency based on the particular ATSEP duties, the safety criticality of the system ATSEP will need to work on, and taking into account the language requirements related to operating instructions, manuals, and the need to communicate across operational boundaries that require a common language.

Section 2 — Training requirements

GM1 ATSEP.OR.200 Training requirements — General

ATSEP TRAINING PHASES

The following diagram illustrates the phases of ATSEP training:



GM2 ATSEP.OR.200 Training requirements — General

STRUCTURE SYLLABI

Guidance material on how to read the tables in the appendices contained in this Subpart A of ANNEX XIII is provided in Appendix 5a.

GM1 ATSEP.OR.200(a) Training requirements — General

BASIC TRAINING

For the purpose of this section, 'basic training' is understood as being training designed to impart fundamental knowledge of the service provider's operational environment.

QUALIFICATION TRAINING

For the purpose of this section, 'qualification training' is understood as being training designed to impart knowledge and skills appropriate to the qualification stream to be pursued in the service provider's operational environment.

SYSTEM/EQUIPMENT RATING TRAINING

For the purpose of this section, 'system/equipment rating training' is understood as being training designed to impart system/equipment-related knowledge and skills leading towards operational competence.

CONTINUATION TRAINING

For the purpose of this section, 'continuation training' is understood as being training designed to maintain and/or augment existing knowledge and skills related to the ATSEP assigned responsibilities and duties.

AMC1 ATSEP.OR.205(a) Basic training

GENERAL

The subjects, topics, and sub-topics should be tailored to:

(a) the responsibility of the ATSEP regarding the service provider's activities; and

(b) prior experience and education of the candidate ATSEP.

AMC1 ATSEP.OR.205(a)(1) Basic training

SHARED

The objectives contained in Appendix 1a to this AMC should be included in the basic training course.

AMC1 ATSEP.OR.205(a)(2) Basic training

STREAMS

The topics, sub-topics and objectives contained in Appendix 2a to this AMC should be included in the basic training course.

GM1 ATSEP.OR.205(b) Basic training

ENTRY LEVEL

In some instances, only a limited number of training objectives will need to be taught to learners ATSEP. This is usually the case when the entry level of learners includes some form of previous qualification (e.g. engineering degree or diploma). In this case, the length of training and the number of objectives may be less than that of a course directed to learners who have little or no engineering or technical qualifications. If no engineering or technical qualifications are required prior to starting the basic training, then it may be necessary to include additional objectives in the training that will prepare learners to deal with the basic training.

GM1 ATSEP.OR.205 Basic training

MINIMUM TRAINING

The basic training contained within the requirement is the minimum training that needs to be followed by all who aim at becoming ATSEP. However, service providers may decide to add additional subjects or topics that may be specific to their national or local environment.

COMPOSITION OF COURSES

Basic training may be provided as a stand-alone course or as part of a larger initial training course (i.e. basic plus qualification training).

AMC1 ATSEP.OR.210 Qualification training

GENERAL

The subjects, topics, and sub-topics should be tailored to:

(a) the responsibility of the ATSEP regarding the service provider's activities; and

(b) prior experience and education of the candidate ATSEP.

AMC2 ATSEP.OR.210 Qualification training

SHARED

The objectives contained in Appendix 3a to this AMC should be included in the qualification training course.

GM1 ATSEP.OR.210 Qualification training

MINIMUM TRAINING

The qualification training contained within the requirement is the minimum training that needs to be followed by all who aim at becoming ATSEP. However, service providers may decide to add additional subjects or topics that may be specific to their national or local environment.

COMPOSITION OF COURSES

Qualification training may be provided as (a) stand-alone course(s) or as part of a larger course.

GM2 ATSEP.OR.210 Qualification training

FLEXIBILITY

Service providers may choose to add content to a qualification stream to tailor the training to meet the needs of the individual organisation.

AMC1 ATSEP.OR.210(a) Qualification training

STREAMS

The objectives contained in Appendix 4a to this AMC should be included in the qualification training course.

GM1 ATSEP.OR.210(b) Qualification training
STREAMS

For the purpose of this section, 'streams' is understood as being a cluster of training objectives that support a particular area of work.

GM2 ATSEP.OR.210(b) Qualification training
SYSTEM MONITORING AND CONTROL (SMC)

(a) There are two recognised routes to achieve SMC competence. Organisations may choose which route is most appropriate for their environment.

(b) Both SMC competence routes may be used by individuals and/or service providers at different times during their careers.

(c) In some organisations, SMC of operational system and equipment tasks are performed after the initial competence in a stream or collection of streams that make up a domain (e.g. the Communication domain comprises the COMMUNICATION-VOICE and COMMUNICATION-DATA streams) has been achieved and appropriate SMC development training has been completed. This route is considered to be the development route to SMC competence. The objectives contained within the four qualification training SMC stream(s) may be completed as part of this development training.

(d) The alternative option, used by some organisations, is to provide training for SMC duties directly after basic training. This is based on an arrangement where SMC operators perform level A tasks. If level B tasks are required, these are performed under supervision or are delegated to appropriately qualified personnel. This route is considered to be the direct route to SMC competence, and the four qualification training streams relating to SMC apply, such as, for instance, SMC Communication, SMC Navigation, SMC Surveillance and/or SMC Data. To start S/E rating training on level A tasks for the monitored and/or controlled S/E, no additional qualification training stream (e.g. QUAL NAV-VOR) is required because the relevant information is contained in the related SMC qualification training stream(s) already.

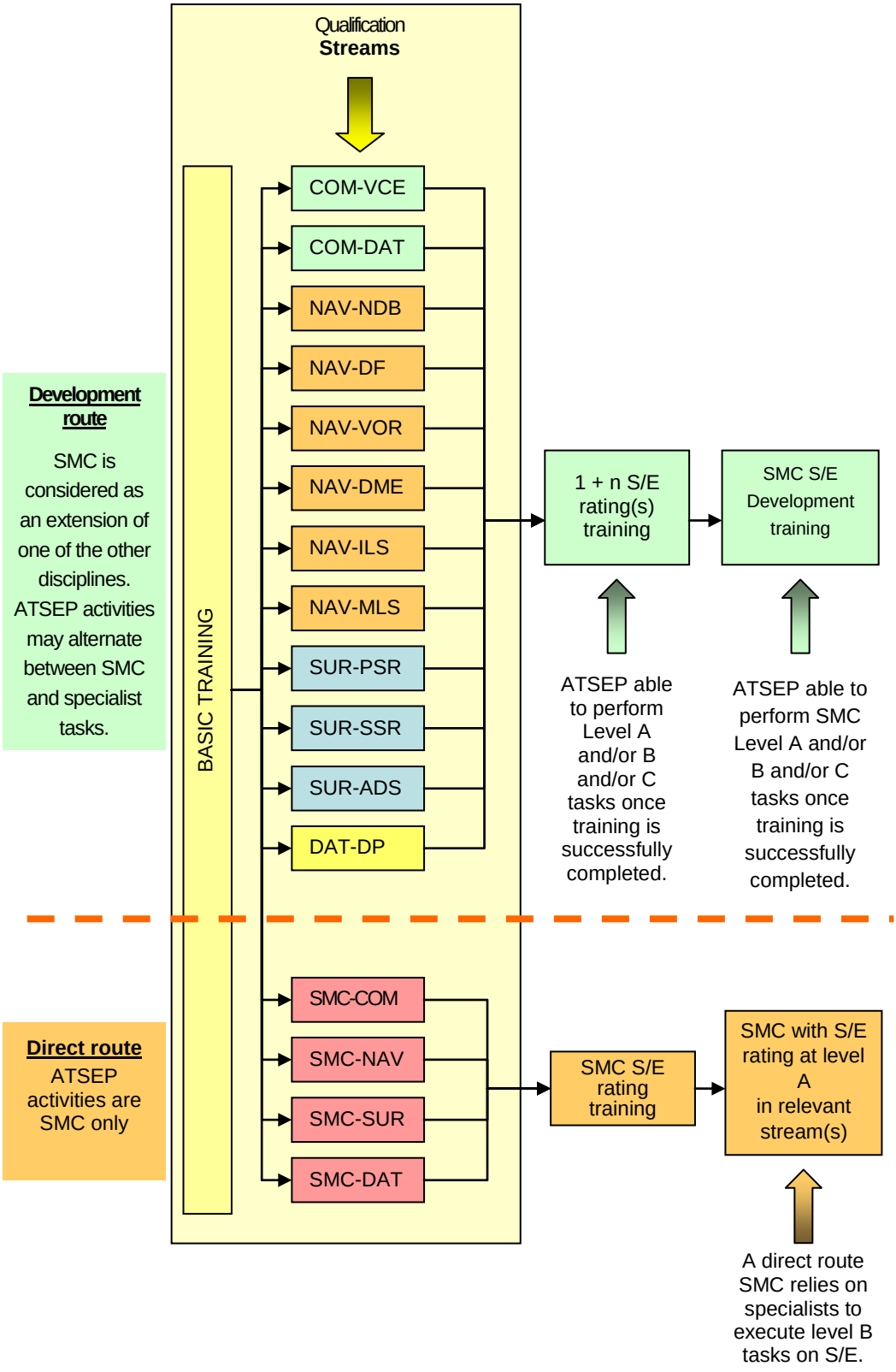
(e) Level tasks represent the categorisation by complexity, knowledge, skills and operational impact. Three categories will usually suffice, but could be further subdivided for highly complex or diverse systems:

(1) Level A tasks: Level A maintenance tasks are primarily associated with immediate service restoration or reconfiguration ('front-panel level'). They are appropriate for personnel that have been trained to understand the elements of an equipment or system(s), their interrelationships and functional purpose, but do not require in-depth knowledge of these elements.

(2) Level B tasks: Level B maintenance tasks involve in-depth fault analysis at the system/equipment level ('functional level'). They are usually carried out by personnel that have been trained for the more complicated maintenance tasks on the equipment/system.

(3) Level C tasks: Level C maintenance tasks involve the detailed diagnosis of a software problem, of a faulty Line Replacement Unit (LRU), Printed Circuit Board (PCB) or module ('component level'). They usually require the use of automated test equipment at a suitable location and are usually carried out by personnel that have been trained in detailed fault diagnosis and repair techniques. If a Level C task is carried out in an offline environment (e.g. a workshop), it is not mandatory that the personnel carrying out this task is trained as ATSEP. However, an organisation may choose to train that personnel as ATSEP.

(f) The diagram below illustrates the SMC competence routes.



GM1 ATSEP.OR.215 System and equipment rating training

SYSTEM AND EQUIPMENT RATING

A system and equipment rating is the authorisation which allows the ATSEP to perform operational tasks on specific system/equipment and may, optionally, include an association with operational site/s, location/s and/or maintenance task levels. The award of this rating follows the successful assessment of operational competence.

The term 'rating' in the definition of 'system/equipment rating training' should not be associated with the definition of 'rating' in Regulation (EC) No 216/2008.

AMC1 ATSEP.OR.220 Continuation training

GENERAL

The frequency and duration of continuation training should be determined by taking into account the ATSEP task exposure (recency) as well as the complexity of the operation and of the maintenance of systems.

GM1 ATSEP.OR.220 Continuation training

REFRESHER TRAINING

(a) For the purpose of this section, 'refresher training' is understood as being training designed to review, reinforce or upgrade existing knowledge and skills (including team skills).

(b) Refresher training may periodically include training to refresh and augment ATSEP team skills. Team skills include but are not limited to communication, negotiation, decision-making, conflict resolution and listening skills.

EMERGENCY TRAINING

(c) 'Emergency training' is understood as being training designed to broaden knowledge, skills, and behaviour in case of emergency, unusual or degraded situation. Most of the training will be site-specific or may make use of incident or accident analysis.

(d) The term 'emergency' is considered as a serious, unexpected and/or potentially dangerous situation requiring immediate action(s), e.g. complete loss of any of the following:

- radar display picture;
- Electronic Flight Progress Strip system;
- main, standby and emergency communications on multiple frequencies due to external interference blocking the radiotelephony channels.

(e) The term 'unusual situation' is considered as a set of circumstances which are neither habitually nor commonly experienced and for which an ATSEP has not developed a practised response.

(f) The term 'degraded situation' is considered as a situation that is the result of a technical system failure or malfunction or a set of circumstances arising from human error or violation of rules affecting the quality of the service provided (i.e. the service continues to be available, even though in a reduced or limited way). For instance, external main supply's failure to a Category III ILS localiser field site cabin or a normally dual channel DME having a fault on one channel.

Section 3 — Competence assessment requirements

GM1 ATSEP.OR.300(a) Competence assessment — General
MEANING

'Competence' is understood as a situation where ATSEP possess the required level of knowledge, technical and behavioural skills and experience, and language proficiency when required, in order to be authorised to perform duties on the system and equipment they are competent to work on.

GM1 ATSEP.OR.305(a)(1) Assessment of initial and ongoing competence
INITIAL COMPETENCE ASSESSMENT

If the competence assessment is done by the same person training the ATSEP learner during the S/E training phase, the service provider should have in place a process to reduce biases.

GM1 ATSEP.OR.305(a)(3) Assessment of initial and ongoing competence
SUPERVISION OF NON-COMPETENT PERSONNEL

Supervision of personnel for lack of competence may be necessary due to a number of circumstances including but not restricted to:

(a) the ATSEP still being trained;

(b) the ATSEP undergoing remedial training due to loss of competence; and

(c) the ATSEP having lost competence due to extended absence from tasks that require competence.

GM1 ATSEP.OR.305(b)(2) Assessment of initial and ongoing competence
BEHAVIOURAL SKILLS

Behavioural skills are non-technical skills and attitudes that ATSEP need to perform effectively. Examples of potential behavioural skills criteria related to initial and ongoing competence are:

(a) cooperation within a team;

(b) attitudes towards safety and security;

(c) flexibility;

(d) analytical thinking; and

(e) ability to communicate effectively.

Section 4 — Instructors and assessors

AMC1 ATSEP.OR.400 ATSEP training instructors
EXPERIENCE

To be considered suitably experienced, technical skills assessors should:

(a) have clear understanding of the service provider's assessment process and procedures applicable;

(b) have clear understanding of the performance required of the ATSEP during the assessment and/or on-going assessment;

(c) have the ability to evaluate, in an objective and independent manner, whether the ATSEP has achieved or is maintaining the level of performance required;

(d) have the ability to assess and, if required, act when intervention is necessary to ensure that safety is not compromised;

(e) have the ability to analyse and accurately describe and/or record strengths and weaknesses of an ATSEP performance; and

(f) use appropriate interpersonal and communication skills to brief and debrief an ATSEP, if required.

GM1 ATSEP.OR.405 Technical skills assessors

GENERAL

The technical skills assessor is the person who is considered suitable to determine whether an ATSEP is technically competent to operate, maintain, release from and return into operations systems that are necessary for the provision of services. This assessment may be in any context where assessment of technical skills is required, e.g. assessment of first competence, ongoing competence.

GM2 ATSEP.OR.405 Technical skills assessors

ASSESSMENT RESPONSIBILITIES

(a) Where a technical skills assessor works regularly with an ATSEP, he or she is required to assess the ATSEP. Continuous assessment may be appropriate, i.e. assessment may be achieved by the technical assessor observing the standard of an ATSEP's work on a continuous basis as he or she works with the ATSEP during normal operational duties.

(b) If the appointed technical assessor also acts as line manager to the individual ATSEP, the service provider should have in place a process to reduce biases. Responsibility for determining competence lies with the person having the safety accountability for the ATSEP function.

APPENDIX 1a

BASIC TRAINING — SHARED

The subjects, topics and sub-topics are repeated in this AMC for the convenience of the reader and do not form a part of it.

SUBJECT 1: INDUCTION

TOPIC 1: INDUCTION

SUB-TOPIC 1.1: Training and assessment overview

1.1.1	Describe the training scheme and progression towards ATSEP competence	2	Initial (basic and qualification), S/E rating and continuation training. Course aims, objectives, and topics.
1.1.2	State the assessment requirements, procedures, and methods	1	—

SUB-TOPIC 1.2: National organisation

1.2.1	Describe the organisational structure, purpose and functions of the service provider(s) and regulatory structures	2	e.g. headquarters, control centres, training facilities, airports, outstations, civil/military interfaces, regulatory interfaces.
1.2.2	Describe the structure and functions of the major departments within the service provider	2	e.g. organisational handbook (plans, concepts and structure, finance model).
1.2.3	State appropriate accountabilities and responsibilities of the service provider(s) and competent authority	1	—

SUB-TOPIC 1.3: Workplace

1.3.1	State the role of trade unions and professional organisations	1	e.g. international, European, national, local level
1.3.2	Consider security of site facilities and personnel against unlawful interference	2	Environmental, physical and information security measures, employee vetting, and reference checks.
1.3.3	Describe actions when suspecting a security breach	2	e.g. inform police, security agencies and managers. Security manual and/or contingency plan.

SUB-TOPIC 1.4: ATSEP role

1.4.1	Describe the key responsibilities of an ATSEP	2	Initial (basic and qualification), S/E rating and continuation training. Course aims, objectives, and topics.

SUB-TOPIC 1.5: European/worldwide dimension

1.5.1	Explain the relationship between States and its relevance to ATM operations	2	e.g. harmonisation, flow management, bilateral agreement, sharing of ATM relevant data, major studies, research programmes, and policy documents.

1.5.2	Define the regulatory framework of international and national ATM	1	e.g. ICAO, European and national concepts, responsibilities.
1.5.3	State the purpose of a range of international bodies	1	ICAO, EU, EASA e.g. ECAC, EUROCONTROL, FAA RTCA, EUROCAE

SUB-TOPIC 1.6: International Standards and Recommended Practices

1.6.1	Explain how the regulatory environment of ICAO notifies and implements legislation	2	Annexes, SARPs
1.6.2	State which major/key ATM engineering 'standards' and 'practices' are applicable	1	e.g. ICAO Annex 10, ICAO Doc 8071, ICAO Doc 9426-3, available EUROCONTROL standards, guidance material on reliability, maintainability and availability.

SUB-TOPIC 1.7: Data security

1.7.1	Explain the importance of ATM security	2	
1.7.2	Describe the security of operational data	2	Secure, restricted access by authorised personnel.
1.7.3	Explain security policies and practices for information and data	2	Backup, storing, hacking, confidentiality, copyright.
1.7.4	Describe the possible external interventions which may interrupt or corrupt ATM services	2	Introduction of software viruses, illegal broadcasts, jamming, spoofing.

SUB-TOPIC 1.8: Quality management

1.8.1	Explain the need for quality management	2	e.g. ISO, EFQM
1.8.2	Explain the need for configuration management	2	Importance for safe operations e.g. S/E build state, software adaption/version

SUB-TOPIC 1.9: Safety Management System

1.9.1	Explain why there is a need for high-level safety requirements for ATM/ANS activities	2	Safety policy and rules, system safety cases, system safety requirements.

SUB-TOPIC 1.10: Health and safety

1.10.1	Explain personal safety responsibilities in the work environment	2	Safety statement, first aid, rules about climbing
1.10.2	Explain potential hazards to health and safety generated by equipment, or contained within the work environment	2	e.g. health consequences of electric shock and static discharges, precautions with chemical products (batteries), mechanical hazards (rotating machinery/antennas), toxic materials (beryllium), biological hazards, faulty earthing
1.10.3	Describe fire safety and first-aid regulations and practices	2	Requirements and rules e.g. standards

1.10.4	State any applicable legal requirements and safety rules	1	National, international regulations e.g. for working on power supply and/or air conditioning
1.10.5	Describe the main features and uses of the different types of fire detectors and extinguishers	2	e.g. VESDA, Type A, B, C, D extinguishers

SUBJECT 2: AIR TRAFFIC FAMILIARISATION

TOPIC 1: AIR TRAFFIC FAMILIARISATION

SUB-TOPIC 1.1: Air Traffic Management

1.1.1	Define Air Traffic Management	1	ICAO, EU regulations
1.1.2	Describe operational ATM functions	2	ATFCM, ATS, ASM
1.1.3	Describe ATM concepts and associated terminology	2	e.g. concepts: FUA, free flight, gate-to-gate, performance-based ATM operations (PBN, RCP), operational concepts (ICAO, EUROCONTROL, SESAR).
1.1.4	Explain the operational importance of technical services required for ATM	2	e.g. Regulation (EC) No 552/2004
1.1.5	State future developments in systems and/or ATM/ANS practices which may impact on services provided	1	e.g. data link, satellite-based navigation, gate-to-gate (CDM), ATC tools, continuous approach, 4D trajectory, business trajectory, SWIM, NOP, SESAR (UDPP, modes of separation), ASAS.
1.1.6	List the standard units of measurement used in aviation	1	Speed, distance, vertical distance, time, direction, pressure, temperature.

SUB-TOPIC 1.2: Air Traffic Control

1.2.1	Define airspace organisation	1	ICAO Annex 11, Regulation (EU) No 923/2012 e.g. FIR, UTA, TMA, CTR, ATS routes
1.2.2	Describe commonly used airspace terminologies and concepts	2	e.g. sectorisation, identification of ATS routes, restricted airspace, significant points.
1.2.3	State the general organisation of aerodromes	1	e.g. obstacle limitation surfaces, different departure and arrival trajectories, approach and landing categories, operational status of radio navigation aids.
1.2.4	State the purpose of ATC	1	ICAO Doc 4444
1.2.5	State the organisation of ATC services	1	ICAO Doc 4444

SUB-TOPIC 1.3: Ground-based Safety nets

1.3.1	Describe the purpose of ground-based safety nets	2	e.g. STCA, MSAW, APW, runway incursion alerts

SUB-TOPIC 1.4: Air Traffic Control tools and monitoring aids

1.4.1	Explain the main characteristics and use of ATC support and monitoring tools	2	e.g. MTCD, sequencing and metering tools (AMAN, DMAN), A-SMGCS, CLAM, RAM, CORA

SUB-TOPIC 1.5: Familiarisation

1.5.1	Take account of ATC tasks	2	e.g. simulation, role play, PC, Part Task Trainer, observations in the operational environment
1.5.2	Explain the need for good communication, coordination and cooperation between operational staff	1	e.g. handovers, MIL/CIV, planner/tactical, SV Tech (SMC) and SV ATCO, site visit(s) to ATC units
1.5.3	Consider the purpose, function and role of various operational stations in respect of ATM-related operations	2	Site visit(s) to ATC units e.g. meteorological services providers, remote sites, airport operations
1.5.4	Define the phases of flight	1	Take-off, climb, cruise, descent and initial approach, final approach and landing
1.5.5	Recognise the cockpit environment and associated equipment, in relation to ATC	1	Relevant pilot HMI e.g. familiarisation flight or cockpit simulator training (where practicable), antenna
1.5.6	Define airborne collision avoidance systems	1	ACAS, EGPWS *e.g. TCAS*

APPENDIX 2a

BASIC TRAINING — STREAMS

The Subjects are repeated in this Appendix for the convenience of the reader and do not form a part of it.

SUBJECT 3: AERONAUTICAL INFORMATION SERVICES (AIS)

TOPIC 1: AERONAUTICAL INFORMATION SERVICES

SUB-TOPIC 1.1: Aeronautical Information Services

1.1.1	State the organisation of the AIS	1	—
1.1.2	Define the AIP	1	e.g. contents of AIP, AIC and types of publication: AIRAC, non-AIRAC, data collection and preparation, data format, distribution channels, supporting systems and tools
1.1.3	Define the aeronautical charting service	1	Types of aeronautical charts, operational use of charts, supporting systems and tools
1.1.4	Define the NOTAM services	1	—
1.1.5	Define the ATS Reporting Office	1	e.g. purpose of flight plans and other ATS messages, types of flight plans (FPL and RPL), contents of flight plans and other ATS messages, distribution of flight plans and other ATS messages, supporting systems and tools
1.1.6	Define the European AIS Database	1	e.g. central single source, validation, redundancy, EAD structure
1.1.7	Define procedures for providing Communications, Navigation and Surveillance (CNS) data	1	Information of a permanent nature, information of a temporary nature, status report of NAVAIDs

SUBJECT 4: METEOROLOGY

TOPIC 1: METEOROLOGY

SUB-TOPIC 1.1: Introduction to meteorology

1.1.1	State the relevance of meteorology in aviation	1	Influence on the operation of aircraft, flying conditions, aerodrome conditions
1.1.2	State the weather prediction and measurement systems available	1	—

SUB-TOPIC 1.2: Impact on aircraft and ATS operation

1.2.1	State the meteorological conditions and their impact on aircraft operations	1	e.g. atmospheric circulation, wind, visibility, temperature/humidity, clouds, precipitation
1.2.2	State the meteorological conditions hazardous to aircraft operations	1	e.g.; turbulence, thunderstorms, icing, microbursts, squall, macro bursts, wind shear, standing water on runways (aquaplaning)

1.2.3	Explain the impact of meteorological conditions and hazards on ATS operations	2	e.g. effects on equipment performance (e.g. temperature inversion, rain density), increased vertical and horizontal separation, low visibility procedures, anticipation of flights not adhering to tracks, diversions, missed approaches
1.2.4	Explain the effects of weather on propagation	2	e.g. anaprop, rain noise, sunspots

SUB-TOPIC 1.3: Meteorological parameters and information

1.3.1	List the main meteorological parameters	1	Wind, visibility, temperature, pressure, humidity
1.3.2	List the most common weather messages and broadcasts used in aviation	1	e.g. ICAO Annex 3 Meteorology messages: TAF, METAR, SNOWTAM Broadcasts: ATIS/flight meteorology broadcast (VOLMET)

SUB-TOPIC 1.4: Meteorological systems

1.4.1	Explain the basic principles of the main meteorological systems in use	2	e.g. weather display and information systems, wind speed (anemometer), wind direction (weather vane), visibility (types of IRVR, forward scatter), temperature probes, pressure (aneroid barometers), humidity, cloud base (laser ceilometers)

SUBJECT 5: COMMUNICATION

TOPIC 1: GENERAL INTRODUCTION

SUB-TOPIC 1.1: Introduction to communications

1.1.1	State the structure of the communication domain	1	Voice communication, data communication
1.1.2	State major substructures of the communication domain	1	Air-ground, ground-ground, air-air communications
1.1.3	State ATS requirements for safe communications	1	Safety, reliability, availability, coverage, QoS, latency
1.1.4	State the aeronautical communication services	1	Mobile, fixed

TOPIC 2: VOICE COMMUNICATION

SUB-TOPIC 2.1: Introduction to voice communications

2.1.1	Describe system architecture	2	—
2.1.2	Explain the purpose, principles and role of voice communication systems in ATS	2	e.g. audio bandwidth, dynamic range, fidelity, routing, switching, lineside/deskside, coverage, communication chain between controller and pilot

2.1.3	Describe the way in which voice communication systems function	2	Analogue/digital comparisons, distortion, harmonics
2.1.4	State methods used to route and switch voice communications	1	e.g. multichannels, multi-users, party lines, VHF/UHF linkage, HF, SELCAL
2.1.5	State how systems interface to produce an integrated service to ATS	1	—
2.1.6	State radio spectrum and frequency allocation constraints and procedures	1	Spectrum, interference sources, commercial allocations, world radio conference, ITU, common aviation position, efficient utilisation of frequency bands, channel spacing
2.1.7	State voice recording systems in use	1	e.g. digital recording equipment, analogue recording
2.1.8	State ICAO and local legal requirements regarding recording and retention of voice communications	1	Regulatory requirements, incident recording and playback, recording equipment
2.1.9	State the purpose of ATIS and VOLMET	1	—

SUB-TOPIC 2.2: Air-ground communication

2.2.1	State the functions and basic operation of routing and switching equipment in use in the ATS environment	1	Voice switching
2.2.2	Describe the purpose and operation of the elements of a communication chain in use in the ATS environment	2	Functionality, emergency systems, transmission/reception, CWP, on-board equipment e.g. channel spacing, antenna switching, CLIMAX, voting systems
2.2.3	State ways of achieving quality of service	1	e.g. importance of coverage and redundancy of equipment, overlapping coverage, backup system, functional redundancy vs element redundancy
2.2.4	Recognise the elements of the CWP that are used for air-ground communication	1	Frequency selection, emergency, station selection, coupling, microphone, headset, loudspeaker, footswitch, PTT
2.2.5	List future developments and techniques which may have an impact on ATS voice communications	1	*e.g. CPDLC, VDL Modes 2*

SUB-TOPIC 2.3: Ground-ground communication

2.3.1	State the functions and the basic operations of routing and switching equipment in use in ATS environment	1	General architecture
2.3.2	Describe how ground-ground systems interface to provide an integrated service to ATS environment	2	International/national links, ACC interoperability, voice and data integration

2.3.3	Describe the purpose and operation of the elements of a system	2	Functionality, emergency systems, PTT interfaces e.g. MFC and ATS-Qsig, switching, local PABX equipment
2.3.4	Recognise the elements of the CWP used for ground-ground communication	1	Selection, emergency, loudspeaker, headset, microphone
2.3.5	List developments in ground-ground technologies which may impact on ATS voice communication	1	e.g. protocols (TCP/IP, voice-over IP) future development

TOPIC 3: DATA COMMUNICATIONS

SUB-TOPIC 3.1: Introduction to data communications

3.1.1	Explain the purpose, principles and role of data communication systems in ATS	2	e.g. terminology, principles and theory of networks, layering (e.g.: OSI or TCP/IP), data links, LAN, WAN
3.1.2	Define the concept of data transmission	1	e.g. packet switching, protocols, multiplexing, demultiplexing, error detection and correction, routing, switching, hops, cost, bandwidth/speed
3.1.3	Describe the function of various elements of the data systems in use in ATS environment	2	Switch, router, gateways, end systems, redundancy
3.1.4	Define protocols in current use	1	e.g. TCP/IP, X.25, frame relay, asynchronous transfer mode

SUB-TOPIC 3.2: Networks

3.2.1	State ATS requirements for safe data communications	1	Reliability, availability
3.2.2	Describe the different types of networks	2	LAN, WAN, ATN, national network for ATM e.g. satellite-dedicated networks, AFTN
3.2.3	State the functions of a network management system	1	Priorities, rights e.g. SNMP

SUB-TOPIC 3.3: Aviation specific networks, applications and ATM/ANS providers

3.3.1	Name a range of air-ground aviation-related network concepts	12	ATN e.g. Subnetworks: ATN air-ground subnetwork, AMSS, VDL, HFDL Protocols: ACARS Communication service providers: ARINC, SITA, States, LINK16

3.3.2	Name a range of ground-ground aviation-related network concepts	12	ATN, PENS Optional content e.g. Physical networks: PENS, AFTN/CIDIN, RAPNET Communication protocols: IP, X.25, ASTERIX, FMTP Communication service providers: SITA, ARINC, national carriers, ANSPs Applications: AMHS, AIDC, OLDI

SUBJECT 6: NAVIGATION

TOPIC 1: INTRODUCTION

SUB-TOPIC 1.1: Purpose and use of navigation

1.1.1	Explain the need for navigation in aviation	2	Positioning, guidance, planning
1.1.2	Characterise navigation methods	2	e.g. historical overview, visual, celestial, electronic (on-board, radio, space-based and relative)

TOPIC 2: THE EARTH

SUB-TOPIC 2.1: Form of the Earth

2.1.1	Name the shape of the Earth	1	Oblate spheroid e.g. earth's parameters
2.1.2	Explain the Earth's properties and their effects	2	East, West, North and South, polar axis, direction of rotation
2.1.3	State the accepted conventions for describing 2D position on a globe	1	Meridians, parallels of latitude, equatorial plane

SUB-TOPIC 2.2: Coordinate systems, direction and distance

2.2.1	State the general principles of reference systems	1	Geoid, reference ellipsoids, WGS 84 Latitude and longitude, undulation
2.2.2	Explain why a global reference system is required for aviation	2	_

SUB-TOPIC 2.3: Earth's magnetism

2.3.1	State the general principles of Earth's magnetism	1	True North, magnetic North — e.g. variation, declination, deviation, inclination

TOPIC 3: NAVIGATIONAL SYSTEM PERFORMANCE

SUB-TOPIC 3.1: Factors affecting electronic navigation performance

3.1.1	State how radio waves propagate	1	Ground, sky, direct
3.1.2	State why the siting of a terrestrial navigation aid is important	1	Multipath, blanking

SUB-TOPIC 3.2: Performance of navigation systems

3.2.1	State the performance of navigation systems	1	Coverage, accuracy, integrity, continuity of service, availability
3.2.2	Explain the need for redundancy in navigation systems	2	Ensuring continuity of service, maintainability, reliability

SUB-TOPIC 3.3: Means of navigation

3.3.1	State the different means of navigation	1	Sole, primary, supplementary

TOPIC 4: NAVIGATION SYSTEMS

SUB-TOPIC 4.1: Terrestrial navigation aids

4.1.1	Explain the basic working principles of electronic positioning	2	Distance measurements (time and phase), angular measurements
4.1.2	Describe ground-based navigation systems	2	NDB, VOR, DME, ILS, DF, MLS e.g. Loran C, MLS, TACAN, marker beacons
4.1.3	Recognise how the navigation information is displayed on the relevant pilot HMI	1	_
4.1.4	Explain the operational use of ground-based navigation systems in the different phases of flight	2	NDB, VOR, DME, ILS, DF, MLS
4.1.5	Recognise the frequency bands used by the ground-based navigation systems	1	_
4.1.6	State the need for calibration	1	Flight calibration, ground-based calibration and/or maintenance

SUB-TOPIC 4.2: On-board navigation systems

4.2.1	State the use of on-board navigation systems	1	e.g. barometric altimetry, radio altimetry, INS/IRS, compass

SUB-TOPIC 4.3: Space-based navigation systems

4.3.1	Explain the basic working principles of satellite positioning	2	GPS e.g. Galileo

4.3.2	Recognise the basic architecture of a core satellite positioning system	1	GPS e.g. Galileo
4.3.3	Recognise the frequency bands used by the space-based navigational systems	1	—
4.3.4	State the benefits of satellite-based navigation	1	Global coverage, accuracy, time dissemination e.g. redundancy, interoperability, single set of avionics
4.3.5	State the current limitations of space-based navigation systems	1	e.g. single frequency, weak signal, ionospheric delay, institutional, military, multipath
4.3.6	State the basic working principles of satellite augmentation	1	e.g. ABAS (RAIM, AAIM), SBAS (WAAS, EGNOS), GBAS (GRAS, S-CAT 1)
4.3.7	State the current implementations of satellite-based navigation systems	1	GPS, GLONASS, GALILEO and augmentations e.g. ABAS, GBAS, SBAS

TOPIC 5: PERFORMANCE-BASED NAVIGATION

SUB-TOPIC 5.1: PBN

5.1.1	Describe the basic principle of area navigation	2	ICAO RNAV definition and PBN concept Conventional and area navigation e.g. navigation computer and FMS functionality
5.1.2	List the navigation applications in use in Europe	1	B-RNAV-5, P-RNAV-1, RNP approaches

SUB-TOPIC 5.2: Future developments

5.2.1	State future navigation developments	21	e.g. 4D-RNAV, free routes, rationalisation plans, advanced RNP1

SUBJECT 7: SURVEILLANCE

TOPIC 1: INTRODUCTION TO SURVEILLANCE

SUB-TOPIC 1.1: Introduction to surveillance

1.1.1	Define surveillance in the context of ATM	1	What (positioning/identification) and why (maintain separation)
1.1.2	Define the various surveillance domains	1	Air-air, ground-air, ground-ground
1.1.3	List the surveillance techniques	1	Non-cooperative, cooperative, dependent, independent techniques
1.1.4	Define the current and emerging surveillance systems in use in ATM	1	Radar technology, ADS technology, multilateration, TIS
1.1.5	Explain the role and the current use of surveillance equipment by ATM	2	Separation, vectoring, data acquisition Detection and ranging, safety nets e.g. weather mapping

1.1.6	State ICAO and any local legal requirements	1	e.g. ICAO Annex 10 Vol. IV
1.1.7	List the main users of surveillance data	1	HMI, safety nets, FDPS, air defence systems, flow management

SUB-TOPIC 1.2: Avionics

1.2.1	State the avionics used for the surveillance in ATM and their interdependencies	1	Transponder, GNSS, data link equipment, ACAS, ATC control panel e.g. FMS
1.2.2	Define the role of TCAS as a safety net	1	e.g. FMS_

SUB-TOPIC 1.3: Primary radar

1.3.1	Describe the need for and the use of primary radar in ATC	2	Non-cooperative detection, improvement of detection and tracking e.g. types of PSR (en-route, terminal, SMR, weather)
1.3.2	Explain the principles of operation, basic elements and overall architecture of a primary radar	2	Detection, range measurement, azimuth indication Doppler shift Antenna system, TX/RX, signal processing, plot extraction, local tracking, data transmission e.g. use of the parameters of the radar equation
1.3.3	State the limitations of primary radar	1	Line of sight, environmental, clutter, no identification of the target, no height information (in case of 2D radar)

SUB-TOPIC 1.4 Secondary radars

1.4.1	Describe needs for and the use of secondary radars in ATC	2	Cooperative detection, ICAO-defined standard, IFF, military and civil modes (include Mode S) and related code protocols, code limitations e.g. identification, SPI, flight level, BDS, specific and emergency codes
1.4.2	Explain the principles of operation, basic elements and overall architecture of a secondary radar	2	SSR, MSSR, Mode S antenna, TX/RX, extractor, tracking processor
1.4.3	State the limitations of secondary radar	1	FRUIT, garbling, ghost reply, code shortage, cooperation by the aircraft needed

SUB-TOPIC 1.5: Surveillance data message format

1.5.1	State the need for harmonisation	1	Surveillance data sharing, interoperability
1.5.2	State the techniques used for transmission of surveillance data	1	e.g. point-to-point, network, microwave, satellite
1.5.3	State main formats in use	1	ASTERIX, etc.

SUB-TOPIC 1.6: Automatic dependent surveillance (ADS)

1.6.1	State surveillance-related FANS concepts and their impact on ATM	1	Sources of aircraft parameters (e.g. FMS outputs), communication mediums Application within oceanic and other non-radar airspace, ATC requirements
1.6.2	Explain the principles of operation, basic elements and overall architecture of ADS-C and ADS-B and the differences between them	2	Advantages/disadvantages, standards, data update rates
1.6.3	State the data link technologies proposed and the current situation of deployment	1	Extended squitter 1 090 MHz e.g. VDL 4, HFDL, UAT, AMSS

SUB-TOPIC 1.7: Weather radar

1.7.1	Define the use of weather radar in ATM	1	e.g. role in adverse weather in dense airspace, antenna, coverage, polarisation, multi-elevation scanning, frequency band

SUB-TOPIC 1.8: Integration of surveillance information

1.8.1	Describe complementary use of different sensors	2	_

SUB-TOPIC 1.9: Multilateration

1.9.1	State the use of MLAT in ATC	1	LAM and WAM
1.9.2	Explain the principles of operation, basic elements and overall architecture of MLAT	12	TDOA principle, hyperboloic positioning, accuracy, transmissions used

SUB-TOPIC 1.10: Airport surface surveillance

1.10.1	State typical ATC requirements	1	e.g. safety (aircraft and mobiles), clear runway, low visibility, collision warnings, displays, mapping, data merging, aircraft identification, ground mobiles
1.10.2	State the current technologies for airport surface surveillance	1	Radar-based and MLAT-based technologies, example layout of airport surveillance infrastructure e.g. other systems (acoustic, vibration, induction loop, video, infrared, GNSS, ADS-B)

SUB-TOPIC 1.11: Display of surveillance information

1.11.1	Recognise surveillance information on a display	1	e.g. PSR and MSSR tracks, position identification, FL, speed vector, RDP and FDP information

SUB-TOPIC 1.12: Analysis Tools

1.12.1	State analysis tools	1	e.g. SASS-C, SASS-S, RAPS

SUBJECT 8: DATA PROCESSING

TOPIC 1: DATA PROCESSING

SUB-TOPIC 1.1: Introduction to data processing

1.1.1	Describe the functions and generic architecture of the systems	2	Generic FDP and SDP overall functional block diagrams
1.1.2	Describe how the systems interface with other systems	2	Surveillance sensors, displays, CFMU, recording, international ATM networks e.g. safety nets, military interfaces
1.1.3	Define basic software functions/applications	1	FDP (IFPS, route processing, code/call sign correlation, code allocation, strip distribution, track labelling) SDP (coordinate conversion, plot and track processing, MRP, safety nets, track labelling)
1.1.4	State the legal aspects for data processing in ATM	1	Traceability and recording of data and actions, configuration control
1.1.5	State the additional data used by ATM system	1	e.g. MET, airlines
1.1.6	State current developments and future possibilities	1	e.g. Coflight, iTEC, SESAR, multisensor tracking

SUB-TOPIC 1.2: System software and hardware principles

1.2.1	Describe the current hardware configurations used in ATM	2	Redundancy and backup e.g. driver, interfaces, hardware platforms, fault tolerant systems
1.2.2	Describe the current software platforms, used in ATM	2	Operating systems

SUB-TOPIC 1.3: Surveillance data processing

1.3.1	State ATC requirements	1	QoS, mandatory data recording, dependability
1.3.2	Explain the principles of SDP	2	e.g. single, multi, plot, track
1.3.3	Describe the functions of SDP	2	Plot processing, tracking, single sensor and multisensor tracker (e.g. radar, ADS, MLAT), estimating limits and accuracy of multisensor tracker, recording e.g. ARTAS tracker
1.3.4	Describe radar data inputs/outputs	2	Tracks, plots, messages, code/call sign, time, control and monitoring, conflict alerts, FDP interface, maps, adaptation
1.3.5	Describe the surveillance data-based monitoring functions	2	Safety nets, ATC tools e.g. safety nets: STCA, MSAW, APW, runway incursion alerts ATC Tools: MTCD, AMAN, DMAN, A-SMGCS

SUB-TOPIC 1.4: Flight data processing (FDP)

1.4.1	State ATC requirements	1	QoS, unambiguous, accurate, error free, timely
1.4.2	Explain the functions of FDP	2	Flight strip production, flight plan data updates, code/call sign correlation, flight progress monitoring, coordination and transfer *e.g. CIV/MIL coordination*
1.4.3	Define inputs and outputs	1	Flow control (CFMU/IFPS/FMP, ETFMS), flight strips/data displays, MRT, environmental data, static data, airspace adaptation
1.4.4	Describe the basic software functions/applications	2	FDP (IFPS, route processing, code/call sign correlation, code allocation, strip distribution, track labelling)
1.4.5	Describe the FPL data update process	2	Automatic and manual update

SUB-TOPIC 1.5: Human machine interface systems

1.5.1	Describe the different display technologies	2	Raster scan, common graphic display interface, LCD, plasma, TFT, Touch Input Device
1.5.2	Recognise what information is normally displayed on the ATCO and ATSEP HMI	1	—

SUB-TOPIC 1.6: Miscellaneous information

1.6.1	State the additional data used by ATM system	1	e.g. MET, airlines

SUBJECT 9: SYSTEM MONITORING AND CONTROL

TOPIC 1: SYSTEM MONITORING AND CONTROL (SMC)

SUB-TOPIC 1.1: Overview of SMC Function

1.1.1	Describe the principles and purpose of the operational management of the technical services	2	Service requirements, interfaces, boundaries of tactical responsibility e.g. hierarchy of authority for the technical and ATC structures
1.1.2	Describe the technical system architecture of the SMC function and its subordinate systems	2	Main monitoring and control architecture e.g. Surveillance: Radar stations, communications, processing, display Communications: TX/RX, circuit management, networks, HMI, standby facilities, recording Navigation: NDB, VOR, ILS, DF DP: FDPS, data communications Facilities: Power, generators, UPS, battery, environmental (heating, cooling), fire and security

1.1.3	Describe the transfer of responsibility for a service	2	Operational and technical responsibility Configuration and monitoring access and responsibility

SUB-TOPIC 1.2: System configuration:

1.2.1	Describe the range of configurations that can be used	2	Equipment or channel switching, parameter settings
1.2.2	Describe the general techniques that are employed to make configuration changes	2	e.g. physical switching
1.2.3	State procedures required to implement a planned major system change	1	e.g. safety requirement, authorisation, coordination, implementation plan, fallback strategies, major system change, activation of new version of software in a subordinate system, transfer of a service to a new system, change of a database

SUB-TOPIC 1.3: Monitoring and control functions

1.3.1	State the monitoring functions that are available	1	e.g. BITE, status, parameters, software and hardware watchdogs
1.3.2	State the control functions that are available	1	e.g. switching, parameters, set configurations
1.3.3	Explain the importance of SMC management and coordination of maintenance activities	2	—
1.3.4	State analysis tools associated with SMC	1	e.g. possible malfunctions (SASS-C, SASS-S, RAPS, track and noise monitoring tools)

SUB-TOPIC 1.4: Coordination and reporting

1.4.1	State why coordination and reporting is required and how it is achieved	1	Facility interrupts, deconflict multiple outages, legal requirements e.g. causes: service failure, planned outage, loss of backup, software upgrade Relevant parties: external service providers, ATC, other centres Relevant information: NOTAM, logbook

SUB-TOPIC 1.5: Emergency coordination

1.5.1	Describe situations where coordination and reporting will be necessary	2	e.g. hijack, mayday, R/T fail, loss of aircraft, MIL action, fire, flood, security, terrorist threat or action, medical
1.5.2	State which parties may be involved in the coordination and reporting of emergency situations	1	e.g. ATC supervisors (local and remote), ATSEP supervisors (local and remote), management, police, MIL, medical, accident investigation branch

1.5.3	Explain the responsibilities and/or duties of SMC members during an emergency situation by using an example scenario	2	—
1.5.4	State the succession of authorities and responsibilities in the event that the nominated person or function is not available	1	Hierarchy of responsibility

SUB-TOPIC 1.6: Equipment operating

1.6.1	Define the principles and ergonomics of the HMI of the SMC central system and its subordinate systems	1	Permissions, control tokens, ergonomic conventions (e.g. green is good or safe, red is fail or unsafe)
1.6.2	State the routine tasks required and the criticality of their completion and any legal requirements	1	e.g. audio circuit voice checking, audio recording checking, archive media changing and storage, VOLMET

SUBJECT 10: MAINTENANCE PROCEDURES

TOPIC 1: MAINTENANCE PROCEDURES

SUB-TOPIC 1.1: Maintenance procedures

1.1.1	Explain handling precautions to be taken to ensure equipment protection	2	Isolation, protection devices, electrostatic sensitive devices, power supplies, heavy loads, high voltage
1.1.2	Explain the classifications of maintenance	2	e.g. preventative, corrective, service configuration
1.1.3	Explain the maintenance strategy and rules	2	Organisation and planning of maintenance, rules controlling deviation from planned maintenance, intervention tracking, return to service
1.1.4	State the scope or responsibility of an S/E rated person	1	e.g. tracing maintenance actions and objectives, liability of maintenance personnel actions, safety of service, safety of equipment

APPENDIX 3a

QUALIFICATION TRAINING — SHARED

The subjects, topics and sub-topics are repeated in this AMC for the convenience of the reader and do not form a part of it.

SUBJECT 1: SAFETY

TOPIC 1: SAFETY MANAGEMENT

SUB-TOPIC 1.1: Policy and principles

1.1.1	Explain the underlying need for safety management policy and principles	2	ICAO Annex 19, lessons learnt from events, evolving environment, requirements
1.1.2	State the safety management policy	1	ICAO Annex 19, priority of safety, the safety objective of ATM, roles and responsibilities
1.1.3	Explain safety management principles	2	ICAO Annex 19, safety achievement, safety assurance, safety promotion
1.1.4	Appreciate the reactive and proactive nature of safety management policy and principles	3	*e.g.* ICAO Annex 19 e.g. nature of events, reason model, events investigation, safety assessment
1.1.5	Explain the link between safety management principles and the life cycle of an ATM system	2	ICAO Annex 19, safety occurrences, setting of safety levels, system safety assessment, safety surveys, safety monitoring, system safety assessment documentation, lesson dissemination, safety improvement, use of safety data to assist in decommissioning or replacement of system
1.1.6	Relate the ATSEP role and responsibilities to safety management	4	Competency, occurrence reporting
1.1.7	State the role and content of a typical SMS within an ANSP	1	ICAO Annex 19
1.1.8	Explain the 'just culture' concept	2	Benefits, prerequisites, constraints

SUB-TOPIC 1.2: Concept of risk and principles of risk assessment

1.2.1	Describe the concept of risk	2	Types of risk, components of risk, risk contributors (people, procedure, organisations and equipment)
1.2.2	State ways of assessing risk	1	Risk comparisons, risk analysis
1.2.3	Describe the concept of risk tolerability	2	Risk assessment and mitigation, ALARP Principle e.g. Risk perception, risk management

SUB-TOPIC 1.3: Safety assessment process

1.3.1	Explain the methods for the assessment of hazards and possible failures	2	e.g. Failure and hazard brainstorm session, Fault tree analysis
1.3.2	Appreciate the importance of adopting a total system approach covering human, procedure, organisation and equipment elements	3	ATM system description (including scope definition and limitation), end-to-end integrity of safety assessment *e.g. Concept of TRM*
1.3.3	Describe the overall safety assessment process and its relationships with risk assessment during the total life cycle of ANS system	2	Collection and presentation of results, contingency arrangements, back-up procedures *e.g. Risk-based process, FHA, (safety objectives), preliminary system safety assessment PSSA (safety requirements), system safety assessment SSA (safety monitoring and evidence)*

SUB-TOPIC 1.4: Air navigation system risk classification scheme

1.4.1	Describe the ATM system risk classification scheme	2	*e.g. Scenario of failure of air navigation system (incident chain), component of a risk classification scheme, severity classes, probability classes (qualitative and quantitative)*

SUB-TOPIC 1.5: Safety regulation

1.5.1	Describe the role of safety regulation	2	The purpose of European (EASA, EU) regulations and international standards, objective of the national regulator
1.5.2	Explain the relationship between the safety regulation documents	2	ICAO documentation (SARPS), EASA/EU Regulations, AMCs and GM, national regulation
1.5.3	Explain how the safety regulation documents affect ATM service provision	2	ICAO documentation (SARPS), EASA/EU Regulations, AMCs and GM, national regulation
1.5.4	Explain the interface between the safety regulator and the ANSP	2	Information to be provided to regulator by ANSP and vice versa, importance of incident reporting

SUBJECT 2: HEALTH AND SAFETY

TOPIC 1: HAZARD AWARENESS AND LEGAL RULES

SUB-TOPIC 1.1: Hazard awareness

1.1.1	State potential hazards to health and safety generated by equipment used in CNS/ATM	1	e.g. COM/SUR/SMC: mechanical hazards, electrical hazards (LV, HV, EMI), chemical hazards NAV: includes RF energy *DP: none*

SUB-TOPIC 1.2: Regulations and procedures

1.2.1	State applicable international requirements	1	e.g. European norms, CENELEC, DIN
1.2.2	State any applicable national requirements	1	—

1.2.3	State safety procedure for the persons working on or near relevant equipment	1	e.g. COM/NAV/SUR/SMC: isolation (clothing, tools), fire extinction types, safety man presence, safety interlocks, isolating switches, security of the site, climbing procedures, earthing, direct or indirect contact with HV

SUB-TOPIC 1.3: Handling of hazardous material

1.3.1	State European and local regulations for electronic device disposal	1	Protection of environment *e.g. recycling*

SUBJECT 3: HUMAN FACTORS

TOPIC 1: INTRODUCTION TO HUMAN FACTORS

SUB-TOPIC 1.1: Introduction

1.1.1	Explain why human factors are particularly important in the ATM environment	2	Historical background, safety impact on ATM, incidents
1.1.2	Define human factors	1	*e.g. ICAO Human Factors Training Manual*
1.1.3	Explain the concept of systems and its relevance in the ATM environment	2	People, procedures, equipment
1.1.4	Explain the use of the SHELL model	2	*e.g. ICAO Human Factors Training Manual, visits to OPS and technical rooms*
1.1.5	State the factors which can affect personal and team performance	1	*e.g. psychological, medical, physiological, social, organisational, communication, stress, human error, working knowledge and skills*

TOPIC 2: WORKING KNOWLEDGE AND SKILLS

SUB-TOPIC 2.1: ATSEP knowledge, skills and competence

2.1.1	Explain the importance of maintaining and updating professional knowledge and skills	2	Assure safety
2.1.2	Explain the importance of maintaining non-technical skills and professional competence	2	*e.g. communication, human relationship, knowledge of environment, human limit awareness*
2.1.3	State the available means to maintain professional knowledge and skills	1	*e.g. practice, personal study, briefing, seminars, courses, technical periodicals, technical books, OJT, simulation, CBT, e-learning, visits, feedback, TRM*

TOPIC 3: PSYCHOLOGICAL FACTORS

SUB-TOPIC 3.1: Cognition

3.1.1	Describe major aspects of human information processing	2	Perception, attention, memory, judgement, decision-making, response execution, control of execution
3.1.2	Describe the factors which influence information processing	2	*e.g. stress and strain, experience, knowledge, distraction, interpersonal relations, working environment, risk perception, attitude, workload, fatigue, confidence, job security*
3.1.3	Appreciate factors which influence information processing	3	*e.g. case study, simulation, role playing*

TOPIC 4: MEDICAL

SUB-TOPIC 4.1: Fatigue

4.1.1	Describe the effect of fatigue on human performance	2	Physiological, cognitive and relational effects *e.g. lack of concentration, irritability, frustration*
4.1.2	Recognise the signs of fatigue in oneself and in others	1	*e.g. making frequent mistakes, unable to concentrate, lack of normal humour, sleeping and/or eating disorders*
4.1.3	Explain how to respond to indications of fatigue in an appropriate manner	2	Take time off, rest for short periods of time, seek professional help

SUB-TOPIC 4.2: Fitness

4.2.1	Describe signs of lack of personal fitness	2	—
4.2.2	Describe actions to prevent or resolve lack of personal fitness	2	Healthy lifestyle *e.g. healthy diet, sleeping, physical and mental activities*
4.2.3	Explain the influence of psychoactive substances on human performance	2	*e.g. nervous system, medication, smoking, alcohol, habitual and occasional use of psychoactive substances*

SUB-TOPIC 4.3: Work environment

4.3.1	Describe the influence of the work environment on human performance	2	Ergonomics, effects of noise, electromagnetic waves, temperature, working circumstances

TOPIC 5: ORGANISATIONAL AND SOCIAL FACTORS

SUB-TOPIC 5.1: Basic needs of people at work

5.1.1	Explain basic needs of people at work	2	*e.g. balance between individual ability and workload, working time and rest periods; adequate working conditions, positive working environment*
5.1.2	Characterise the factors of work satisfaction	2	*e.g. money, motivation, achievement, recognition, advancement, challenge*

SUB-TOPIC 5.2: Team resource management

5.2.1	State the objectives of TRM	1	Experience sharing, feedback, improved interpersonal relations, indirect increase in safety

SUB-TOPIC 5.3: Teamwork and team roles

5.3.1	Describe the differences between social human relations and professional interactions	2	—
5.3.2	Identify reasons for loss of team effectiveness and actions to prevent it and prevent repetition	3	*e.g. roles poorly defined, goals poorly identified, bad planning, too many leaders or not enough, respect for others, divergence in values, misunderstandings*
5.3.3	Describe the principles of teamwork	2	*e.g. team membership, group dynamics, advantages/disadvantages of teamwork*
5.3.4	Identify reasons for conflict	3	—
5.3.5	Describe actions to prevent human conflicts	2	—
5.3.6	Describe strategies to cope with human conflicts	2	—

TOPIC 6: COMMUNICATION

SUB-TOPIC 6.1: Written report

6.1.1	Appreciate the importance of recording information by writing effectively	3	ATSEP technical report, logs, system degradation reports, specification, system manager report
6.1.2	Use appropriate terminology to communicate effectively in writing	3	Be concise, clear; common technical terms; convey key points

SUB-TOPIC 6.2: Verbal and non-verbal communication

6.2.1	Describe the human communication process	2	—
6.2.2	Characterise the factors which affect verbal communication	2	*e.g. Cognitive: lack of knowledge of the procedures, of technical terms, workload, poor receiver references* *Affective: being shy, feelings of not being listened to, not being part of the group, not being assertive, poor eye contact while talking, stress* *Physiological: stuttering, low voice level*
6.2.3	Describe factors which affect non-verbal communication	2	*e.g. touch, noise, interruption, body language*
6.2.4	Use appropriate vocabulary to communicate effectively on technical matters	3	Technical ‘jargon’, language differences, standard words/phrases
6.2.5	Use appropriate language for professional communication with non-ATSEP	3	Term sharing, translation, being concise, simple words, selection of information and detail level according to the receiver

TOPIC 7: STRESS

SUB-TOPIC 7.1: Stress

7.1.1	Explain the process of stress	2	Causes, stress mechanism, consequences in different work situations (e.g. *online intervention, maintenance, training)*
7.1.2	State the symptoms of stress	1	*e.g. frustration, anger, irritability, aggressive and/or irrational behaviour, helplessness*

SUB-TOPIC 7.2: Stress management

7.2.1	Act to relieve or minimise stress in self and/or others	3	The effect of personality in coping with stress, benefits of active stress management
7.2.2	Appreciate how assistance is obtained in stressful situations	3	Benefits of asking, offering and accepting help in stressful situations *e.g. CISM*
7.2.3	Recognise the effects of shocking and stressful situations	1	For oneself and for others, abnormal situations
7.2.4	Consider the benefits of critical incident stress management	2	—

TOPIC 8: HUMAN ERROR

SUB-TOPIC 8.1: Human error

8.1.1	Describe human error	2	—
8.1.2	Explain the relationship between human error and safety	2	Mechanism, error-prone conditions, consequences *e.g. reason model, feedback*
8.1.3	State different types of errors using an appropriate model	1	*e.g. Rasmussen model, Gagne model*
8.1.4	Differentiate between errors and violations	2	—
8.1.5	Explain how to detect errors	2	*e.g. individual and collective strategy, event report, procedure*
8.1.6	Explain, in general terms, how errors are mitigated	2	—
8.1.7	Appreciate two significant ATM incidents/accidents involving ATSEP/engineering contributory factors	3	—

APPENDIX 4a

QUALIFICATION TRAINING — STREAMS

Subjects, topics and sub-topics from Appendix 4a are repeated in this AMC for the convenience of the reader and do not form a part of it.

Stream COMMUNICATION — VOICE

SUBJECT 1: VOICE

TOPIC 1: AIR-GROUND

SUB-TOPIC 1.1:Transmission/reception

1.1.1	Perform typical measurements on a transmitter	3	Frequency (single carrier, offset carrier), modulation, channel spacing, output power, SWR
1.1.2	Adjust a generic radio transmitter	4	Noise, intermodulation, harmonics, power, bandwidth
1.1.3	Analyse the block diagram of a generic radio transmitter	4	Characteristics (modulation, single carrier, channel spacing), functionalities
1.1.4	Perform typical measurements on a receiver	3	Frequency, modulation, channel spacing, sensitivity, selectivity
1.1.5	Adjust a generic radio receiver	4	Signal to noise ratio, harmonics
1.1.6	Analyse the block diagram of a generic radio receiver	4	Characteristics (single carrier, channel spacing, sensitivity, selectivity)

SUB-TOPIC 1.2: Radio antenna systems

1.2.1	Explain antenna parameters	2	Impedance, polar diagram, bandwidth, polarisation, types of antennas
1.2.2	Characterise the coverage of the radio system	2	Polar diagram, types of antennas, frequency bands, propagation mode
1.2.3	Characterise budget link according to various conditions	2	Output power, antennae, propagation, geographic, meteorological, day and night
1.2.4	Characterise the elements of a generic antenna system	2	Filters, combiners, multi-cavity system
1.2.5	Check the conformity of a system to ITU and national regulation	3	Ref.: ICAO Annex 10 (VHF, UHF)
1.2.6	Perform measurements with generic radio test equipment	3	Spectrum analyser *e.g. scanner*

SUB-TOPIC 1.3: Voice switch

1.3.1	Analyse switching functionalities	4	General architecture, digital, analogue, multiplex types, PCM *e.g. cross-coupling, split headset (radio both ears, telephone single ear)*
1.3.2	Explain the principles of non-blocking switches	2	Advantages, disadvantages, delays (digital)

1.3.3	Describe the signal processing all along the chain	2	Signal tracing treatment, protocols (a few), data flow

SUB-TOPIC 1.4: Controller working position

1.4.1	Describe the most common features of a controller working position	2	Frequency selection, emergency, station selection, coupling, headset, loudspeaker, footswitch, Push to Talk *e.g. microphone (noise cancelling), short time recording*

SUB-TOPIC 1.5: Radio interfaces

1.5.1	Describe the different types of interface	2	Internal, external, phantom keying, in-band signal

TOPIC 2: GROUND-GROUND

SUB-TOPIC 2.1: Interfaces

2.1.1	Describe the different types of interfaces	2	Analogue (2, 4, 6 and 8 wires), digital (ISDN; 64 Kb, 2 Mb)
2.1.2	Explain the advantages and disadvantages of each type	2	Analogue (2, 4, 6 and 8 wires), digital (ISDN; 64 Kb, 2 Mb)
2.1.3	Operate measuring equipment	3	*e.g. dB meters, level meters, generators, sniffer*

SUB-TOPIC 2.2: Protocols

2.2.1	Operate standard protocol analysers	3	*e.g. MFC R2 and/or ATS QSIG (rerouting), impulse dialling and DTMF dialling, ISDN*
2.2.2	Analyse communication protocol with appropriate tools and documentation	4	*e.g. MFC R2 , ATS QSIG (rerouting), impulse dialling and DTMF dialling, ISDN, national protocols*

SUB-TOPIC 2.3: Switch

2.3.1	State the similarities between ground-ground and air-ground switches	1	Switching techniques
2.3.2	Describe the most commonly used functionality of PABX	2	General architecture, digital, analogue, multiplex types, PCM30
2.3.3	Analyse conversion analogue-digital, digital-analogue	4	General architecture, analogue-digital-analogue

SUB-TOPIC 2.4: Communication chain

2.4.1	Appreciate the replacement of components in a communication chain in a safe way	3	Continuity of service, communication chain integrity Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training

SUB-TOPIC 2.5: Controller working position

2.5.1	Describe the most common features of a controller working position and the HMI	2	—

SUBJECT 2: TRANSMISSION PATH

TOPIC 1: LINES

SUB-TOPIC 1.1: Lines theory

1.1.1	Calculate parameters of a line	3	*e.g. equation, attenuation, impedance, S-parameters, Smith chart, bandwidth, HF specifics (dipoles, multipoles), SWR*

SUB-TOPIC 1.2: Digital transmission

1.2.1	Calculate parameters for digital transmission	3	*e.g. signal definition, Fourier Theory, signal processing (sampling, etc.), bandwidth, carrier, modulation, noises, S/N, delays, group delay, line quality (signal distortion, rate of failure), transmission speed*

SUB-TOPIC 1.3: Types of lines

1.3.1	Describe the different types of lines and their physical characteristics	2	*e.g. copper wires (twisted pairs, symmetrical cables), optic fibres (monomodes or multimodes, connectors, splicer), coaxial* *attenuation, losses, bending, characteristic impedance, EMC and noise immunity*
1.3.2	Appreciate the appropriate type of line for a given specific application	3	*e.g. bandwidth, noise immunity*
1.3.3	Check the typical parameters of lines	3	*e.g. impedance, insulation, signal level, time delay*

TOPIC 2: SPECIFIC LINKS

SUB-TOPIC 2.1: Microwave link

2.1.1	Describe a microwave link	2	*e.g. carrier frequency, type of modulation, Fresnel Theory, loss, atmospheric influences*

SUB-TOPIC 2.2: Satellite

2.2.1	Describe the parameters of a satellite link	2	Uplinks, downlinks, antennas, footprint, delays, atmospheric influences

SUBJECT 3: RECORDERS

TOPIC 1: LEGAL RECORDERS

SUB-TOPIC 1.1: Regulations

1.1.1	Explain the international regulations	2	ICAO (recording and reproducing)
1.1.2	Explain national regulations	2	Appropriate national regulations
1.1.3	Explain how service providers comply with the regulations	2	*e.g. storage media, access to recording and reproducing room, time to store information (overwrite/erase voice or data), procedure to reproduce information.*

SUB-TOPIC 1.2: Principles

1.2.1	Explain the principles of recording and reproducing	2	*e.g. storage media (tape, optical and magnetic disc), A/D-D/A converters, frequency range (300 to 3 400 Hz), channel capacity, time synchronisation, connection to a network, synchronisation of radar and voice recording, replay limitations*

SUBJECT 4: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to communication system, safety reports and occurrences, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe the implications of functional failures in terms of exposure time, environment, effect on controller and effect on pilot	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output. Ref.: safety policy and implementation

Stream COMMUNICATION — DATA

SUBJECT 1: DATA

TOPIC 1: INTRODUCTION TO NETWORKS

SUB-TOPIC 1.1: Types

1.1.1	State the evolution of network topologies	1	LAN, WAN *e.g. architectures, size of the segments, length of the systems, quality of service*
1.1.2	Explain how networks meet requirements	2	Redundancy, bandwidth, BER, time delay, network security

SUB-TOPIC 1.2: Networks

1.2.1	Analyse the features of a network	4	Routing scheme, rate, internal networking, routers, bridges, gateways, modems, switches, firewalls *e.g. wireless networks*
1.2.2	Describe network standards and devices	2	Ethernet, fibre optic, wireless
1.2.3	Appreciate the replacement of components in a network in a safe way	3	Continuity of service, network integrity Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training

SUB-TOPIC 1.3: External network services

1.3.1	Define aspects of external network services	1	Provided QoS *e.g. SLAs*

SUB-TOPIC 1.4: Measuring tools

1.4.1	Operate the usual set of network measuring or monitoring tools to find the values of the main parameters	3	Data analyser (sniffer) *e.g.net scout*
1.4.2	Perform analysis to support fault-finding for correction	3	Data analyser (sniffer) *e.g.net scout*

SUB-TOPIC 1.5: Troubleshooting

1.5.1	Appreciate how to troubleshoot a network	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. broken lines, unusable network components, overload, integrity problems*

TOPIC 2: PROTOCOLS

SUB-TOPIC 2.1: Fundamental theory

2.1.1	Apply the principles of layers	3	Differences between layers *e.g. layer(s) of sniffer information*
2.1.2	Apply the principles of addressing strategy	3	Masks, subnets IP addressing, MAC addressing *e.g. same logical network computers and systems*
2.1.3	Apply the principles of routing strategy	3	Routing tables, priorities, fault tolerance, management of routing strategy, static and dynamic routing *e.g. unicast, multicast, broadcast*

SUB-TOPIC 2.2: General protocols

2.2.1	Describe the general protocols	2	TCP/IP (segments, packets, addressing) *e.g. X25, LAPB, pdH, sdH*
2.2.2	Analyse the general protocols using the appropriate tools and documentation	4	TCP/IP *e.g. X25, LAPB*

SUB-TOPIC 2.3: Specific protocols

2.3.1	Describe the specific protocols	2	*e.g. BATAP — ARINC 620, FMTP*

TOPIC 3: NATIONAL NETWORKS

SUB-TOPIC 3.1: National networks

3.1.1	Name the national networks to which the organisation is connected	1	*e.g. ANSP, MET, military, PTT, airlines, national network(s)*
3.1.2	Describe the interfaces between national and global networks	2	—

TOPIC 4: EUROPEAN NETWORKS

SUB-TOPIC 4.1: Network technologies

4.1.1	State emerging network technologies	1	*e.g.as used in EAN, NEAN, AMHS, PENS*
4.1.2	Describe the characteristics of current networks	2	Surveillance data, flight plan data and AIS networks *e.g. CIDIN, OLDI, CFMU-RCA, quality of service, architecture, FMTP, AMHS*

TOPIC 5: GLOBAL NETWORKS

SUB-TOPIC 5.1: Networks and standards

5.1.1	List the global networks and the standards on which they are based	1	*e.g. ICAO for AFTN/CIDIN/AMHS, ICAO for ATN, FANS 1 and FANS A for ACARS applications (SITA and ARINC)*

SUB-TOPIC 5.2: Description

5.2.1	Describe the characteristics of the AFTN networks	2	Users and data, architectures, quality of service

SUB-TOPIC 5.3: Global architecture

5.3.1	Describe the architecture of the ATN	2	Air-ground subnetworks, ground-ground subnetworks, airborne networks

SUB-TOPIC 5.4: Air-ground subnetworks

5.4.1	Describe the air-ground subnetworks	2	VDL (mode 2), HFDL, AMSS, SATCOM

SUB-TOPIC 5.5: Ground-ground subnetworks

5.5.1	Describe the composition of ground-ground subnetworks	2	PTT, commercial telecom providers, ARINC, SITA

SUB-TOPIC 5.6: Networks on board of the aircraft

5.6.1	State the existence of subnetworks inside the aircraft relevant for ATM communications	1	*e.g. AFDX — ARINC 429*

SUB-TOPIC 5.7: Air-ground applications

5.7.1	State the main communication applications using data link systems	1	*e.g. CPDLC, DLIC/AFN, ATIS, DCL*

SUBJECT 2: TRANSMISSION PATH

TOPIC 1: LINES

SUB-TOPIC 1.1: Lines theory

1.1.1	Calculate parameters of a line	3	*e.g. equation, attenuation, impedance, S-parameters, Smith chart, bandwidth, HF specifics (dipoles, multipoles), SWR*

SUB-TOPIC 1.2: Digital transmission

1.2.1	Calculate parameters for digital transmission	3	*e.g. signal definition, Fourier Theory, signal processing (sampling, etc.), bandwidth, carrier, modulation, noises, S/N, delays, group delay, line quality (signal distortion, rate of failure), transmission speed*

SUB-TOPIC 1.3: Types of lines

1.3.1	Describe the different types of lines and their physical characteristics	2	*e.g. copper wires (twisted pairs, symmetrical cables), optic fibres (monomodes or multimodes, connectors, splicer), coaxial attenuation, losses, bending, characteristic impedance, EMC and noise immunity*
1.3.2	Appreciate the appropriate type of line for a given specific application	3	*e.g. bandwidth, noise immunity*
1.3.3	Check the typical parameters of lines	3	*e.g. impedance, insulation, signal level, time delay*

TOPIC 2: SPECIFIC LINKS

SUB-TOPIC 2.1: Microwave link

2.1.1	Describe a microwave link	2	*e.g. carrier frequency, type of modulation, Fresnel Theory, loss, atmospheric influences*

SUB-TOPIC 2.2: Satellite

2.2.1	Describe the parameters of a satellite link	2	Uplinks, downlinks, antennas, footprint, delays, atmospheric influences

SUBJECT 3: RECORDERS

TOPIC 1: LEGAL RECORDERS

SUB-TOPIC 1.1: Regulations

1.1.1	Explain the international regulations	2	ICAO (recording and reproducing)
1.1.2	Explain national regulations	2	Appropriate national regulations
1.1.3	Explain how service providers comply with the regulations	2	*e.g. confidentiality when handling recorders, procedures for access to recorders, storage media, access to recording and reproducing room, time to store information (overwrite/erase voice or data), procedure to reproduce information*

SUB-TOPIC 1.2: Principles

1.2.1	Explain the principles of recording and reproducing	2	*e.g. storage media (tape, optical and magnetic disc), A/D-D/A converters, frequency range (300 to 3 400 Hz), channel capacity, time synchronisation, connection to a network, synchronisation of radar and voice recording, replay limitations*

SUBJECT 4: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to communication system, safety reports and occurrences, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe the implications of functional failures in terms of exposure time, environment, effect on controller and effect on pilot	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output. Ref.: safety policy and implementation

Stream NAVIGATION — NON-DIRECTIONAL BEACON (NDB)

SUBJECT 1: PERFORMANCE-BASED NAVIGATION

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: Operational requirements

1.1.1	Explain the main performance characteristics of a navigation system	2	Accuracy, precision, stability, integrity, availability, continuity of service, coverage, robustness *e.g. Time To First Fix*
1.1.2	Explain the relationship between performance measures and the phases of flight	2	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.2: Performance-based navigation

1.2.1	Describe the PBN concept	2	ICAO and EUROCONTROL documents, airspace concept, application supported by navigation infrastructure and navigation specifications, functionality of the avionics
1.2.2	Differentiate between an RNAV and an RNP navigation specification	2	On-Board Performance Monitoring and Alerting
1.2.3	State which navigation applications support the different phases of flight	1	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.3 Area navigation concept (RNAV)

1.3.1	Differentiate between conventional navigation and area navigation	2	Fixed route vs flexible route structure

SUB-TOPIC 1.4: NOTAM

1.4.1	Explain the need for NOTAMs	2	—

SUBJECT 2 GROUND-BASED SYSEMS — NDB

TOPIC 1: NDB/LOCATOR

SUB-TOPIC 1.1: Use of the system

1.1.1	Appreciate the principles of NDB	3	Relative bearing, measuring method
1.1.2	Describe the overall performance	2	Coverage, accuracy, availability of the system, integrity, continuity
1.1.3	Explain the technical limitations of NDB	2	Lack of accuracy, lack of integrity, sensitivity to interference
1.1.4	Describe the current situation	2	*e.g. number, type, users, user groups, European context*

SUB-TOPIC 1.2: Ground station architecture

1.2.1	Describe the main components of an NDB ground station	2	Electronic cabinet, antennas, power supply, remote controls and monitoring *e.g. auto-tune antenna units*

1.2.2	Relate NDB station design to operational requirements	4	Coverage, ID code, VOR backup, double beacon approach, siting

SUB-TOPIC 1.3: Transmitter subsystem

1.3.1	Characterise the main NDB signal parameters	2	Carrier and ident frequency, output power, depth of modulation
1.3.2	Perform typical measurements on the main NDB signal parameters	3	*e.g. carrier and ident frequency, power measurements, depth of modulation, audio distortion, antenna current, spectrum measurements, ID code*

SUB-TOPIC 1.4: Antenna subsystem

1.4.1	Explain NDB antenna characteristics	2	Impedance, polar diagram, polarisation, ground reflections
1.4.2	Appreciate the interface between power stage and the antenna	3	SWR, radiated power

SUB-TOPIC 1.5: Monitoring and control subsystems

1.5.1	Describe the purpose of monitoring	2	Integrity, continuity of service, availability
1.5.2	Describe which parameters are used for the monitoring	2	Antenna current, ID code, depth of modulation
1.5.3	Appreciate how the operational status of the NDB monitoring system is checked	3	System status Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training
1.5.4	Describe the issues associated with NDB obstacle limitations and obstacle removal	2	Siting

SUB-TOPIC 1.6: On-board equipment

1.6.1	Describe the on-board equipment (ADF)	2	Receiver, antenna, displays
1.6.2	Describe how NDB information is used on-board	2	ADF indicator, RMI, HSI, ND

SUB-TOPIC 1.7: System check and maintenance

1.7.1	Appreciate the conformity to international and national regulations	3	ITU regulations (EMC + SAR), ICAO Annex 10 *e.g. European regulations*
1.7.2	Appreciate calibration tasks and flight inspection results	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. maintenance and flight inspection manuals, procedures and reports*

1.7.3	Appreciate troubleshooting of an NDB	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. maintenance and flight inspection manuals, procedures and reports*
1.7.4	Appreciate the origins of NDB errors	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. multipath, EMC, interference with radio broadcast transmissions*

SUBJECT 3: GLOBAL NAVIGATION SATELLITE SYSTEM

TOPIC 1: GNSS

SUB-TOPIC 1.1: General view

1.1.1	Explain the importance and continuing development of GNSS	2	FANS CNS/ATM concept, ICAO Doc 9849, Navigation Application & NAVAID Infrastructure Strategy for the ECAC Area up to 2020, EUROCONTROL GNSS Policy, SESAR ATM Master Plan
1.1.2	Describe the elements of GNSS within Europe	2	Core constellations, ABAS, SBAS (EGNOS) *e.g. GBAS, SCAT 1, APV, ICAO Annex 10*
1.1.3	Appreciate the sources of interference to GNSS signals	3	Intentional, unintentional, ionospheric interference, solar activity
1.1.4	Explain who has responsibility for GNSS oversight in your State and how it is carried out	2	*e.g. EASA, GSA, NSA, ANSP*
1.1.5	Appreciate the impact of the modernisation of GNSS on the ARNS bands	3	Introduction of L5, E5A, E5B *e.g. COMPASS*
1.1.6	Explain the need for a minimum number of visible satellites needed to provide integrity monitoring	2	*e.g. AUGUR*
1.1.7	Describe the purpose of the GNSS NOTAM	2	ICAO Annex 10, Vol. 1

SUBJECT 4: ON-BOARD EQUIPMENT

TOPIC 1: ON-BOARD SYSTEMS

SUB-TOPIC 1.1: On-board systems

1.1.1	Explain the purpose and use of a navigation computer	2	Sensors, navigation database
1.1.2	Explain the purpose and use of an FMS	2	Sensors, navigation database, path steering, displays

TOPIC 2: AUTONOMOUS NAVIGATION

SUB-TOPIC 2.1: Inertial navigation

2.1.1	Describe the principles and key features of INS/IRS navigation	2	Gyros, accelerometer, accuracy, drift, updating

TOPIC 3: VERTICAL NAVIGATION

SUB-TOPIC 3.1: Vertical navigation

3.1.1	Describe the different types of vertical sensors and their limitations	2	Barometric, radio altimetry, geodetic *e.g. air data computers, manual intervention, dynamic information (AGL), undulation (WGS84)*

SUBJECT 5: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to navigation systems, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe in terms of exposure time, environment, effect on controller and effect on pilot, the types of functional failures	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

Stream NAVIGATION — DIRECTION FINDING (DF)

SUBJECT 1: PERFORMANCE-BASED NAVIGATION

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: Operational requirements

1.1.1	Explain the main performance characteristics of a navigation system	2	Accuracy, precision, stability, integrity, availability, continuity of service, coverage, robustness *e.g. Time To First Fix*
1.1.2	Explain the relationship between performance measures and the phases of flight	2	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.2: Performance-based navigation

1.2.1	Describe the PBN concept	2	ICAO and EUROCONTROL documents, airspace concept, application supported by navigation infrastructure and navigation specifications, functionality of the avionics
1.2.2	Differentiate between an RNAV and an RNP navigation specification	2	On-board performance monitoring and alerting
1.2.3	State which navigation applications support the different phases of flight	1	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.3 Area navigation concept (RNAV)

1.3.1	Differentiate between conventional navigation and area navigation	2	Fixed route vs flexible route structure

SUB-TOPIC 1.4: NOTAM

1.4.1	Explain the need for NOTAMs	2	—

SUBJECT 2: GROUND-BASED SYSTEMS — DFI

TOPIC 1: DF

SUB-TOPIC 1.1: Use of the system

1.1.1	State the different types of DF	1	VDF, DDF, IDF
1.1.2	Describe the user HMI	2	Indication on radar picture, DF indicator
1.1.3	Appreciate the principles of DF	3	Bearing, measuring method (standard, Doppler, interferometry)
1.1.4	Describe the overall performance	2	Coverage, accuracy, availability of the system, integrity, continuity
1.1.5	Explain the technical limitations of DF	2	Sensitivity to interference
1.1.6	Describe the current situation	2	*e.g. number, type, users, national context*

SUB-TOPIC 1.2: VDF/DDF equipment architecture

1.2.1	Describe the main components of DF equipment	2	Electronic cabinet, antennas, power supply, remote controls and monitoring

SUB-TOPIC 1.3: Receiver subsystem

1.3.1	Explain the main signal parameters	2	Frequency band (UHF, VHF)

SUB-TOPIC 1.4: Antenna subsystem

1.4.1	Explain DF antenna characteristics	2	Impedance, polar diagram, polarisation, types of antennas
1.4.2	Appreciate protection areas	3	Obstacles, ICAO Annex 10 *e.g. manufacturers manuals*

SUB-TOPIC 1.5: Monitoring and control subsystems

1.5.1	Describe the purpose of monitoring	2	Integrity, continuity of service, availability
1.5.2	Describe which parameters are used for the monitoring	2	Noise figure, stability of measurement
1.5.3	Appreciate how the operational status of the DF monitoring system is checked	3	System status Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training
1.5.4	Describe the issues associated with DF obstacle limitations and obstacle removal	2	Surrounding environment, protection of bearing accuracy

SUB-TOPIC 1.6: System check and maintenance

1.6.1	Appreciate the conformity to international and national regulations	3	ITU regulations (EMV + SAR), ICAO Annex 10 *e.g. European regulations*
1.6.2	Perform typical measurements on a DF system	3	Frequency, channel spacing, sensitivity, selectivity, bearing accuracy
1.6.3	Appreciate calibration tasks and flight inspection results	3	Ground-based bearing checks, test oscillator Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. North setting, range, multipath Maintenance and flight inspection manuals, procedures and reports*
1.6.4	Appreciate troubleshooting of DF	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. sensitivity, local oscillator level Maintenance and flight inspection manuals, procedures and reports*

1.6.5	Appreciate the origin of DF errors	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. multipath, EMC, interference with radio broadcast transmissions*

SUBJECT 3: GNSS

TOPIC 1: GNSS

SUB-TOPIC 1.1: General view

1.1.1	Explain the importance and continuing development of GNSS	2	FANS CNS/ATM concept, ICAO Doc 9849, Navigation Application & NAVAID Infrastructure Strategy for the ECAC Area up to 2020, EUROCONTROL GNSS Policy, SESAR ATM Master Plan
1.1.2	Describe the elements of GNSS within Europe	2	Core constellations, ABAS, SBAS (EGNOS) *e.g. GBAS, SCAT 1, APV, ICAO Annex 10*
1.1.3	Appreciate the sources of interference to GNSS signals	3	Intentional, unintentional, ionospheric interference, solar activity
1.1.4	Explain who has responsibility for GNSS oversight in your State and how it is carried out	2	*e.g.* *e.g. EASA, GSA, NSA, ANSP*
1.1.5	Appreciate the impact of the modernisation of GNSS on the ARNS bands	3	Introduction of L5, E5A, E5B *e.g. COMPASS*
1.1.6	Explain the need for a minimum number of visible satellites needed to provide integrity monitoring	2	*e.g. AUGUR*
1.1.7	Describe the purpose of the GNSS NOTAM	2	ICAO Annex 10, Vol. 1

SUBJECT 4: ON-BOARD EQUIPMENT

TOPIC 1: ON-BOARD SYSTEMS

SUB-TOPIC 1.1: On-board systems

1.1.1	Explain the purpose and use of a navigation computer	2	Sensors, navigation database
1.1.2	Explain the purpose and use of an FMS	2	Sensors, navigation database, path steering, displays

TOPIC 2: AUTONOMOUS NAVIGATION

SUB-TOPIC 2.1: Inertial navigation

2.1.1	Describe the principles and key features of INS/IRS navigation	2	Gyros, accelerometer, accuracy, drift, updating

TOPIC 3: VERTICAL NAVIGATION

SUB-TOPIC 3.1: Vertical navigation

3.1.1	Describe the different types of vertical sensors and their limitations	2	Barometric, radio altimetry, geodetic *e.g. air data computers, manual intervention, dynamic information (AGL), undulation (WGS84)*

SUBJECT 5: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to navigation systems, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe in terms of exposure time, environment, effect on controller and effect on pilot, the types of functional failures	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

Stream NAVIGATION — VHF OMNIDIRECTIONAL RADIO RANGE (VOR)

SUBJECT 1: PERFORMANCE-BASED NAVIGATION

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: Operational requirements

1.1.1	Explain the main performance characteristics of a navigation system	2	Accuracy, precision, stability, integrity, availability, continuity of service, coverage, robustness e.g. Time To First Fix
1.1.2	Explain the relationship between performance measures and the phases of flight	2	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.2: Performance-based navigation

1.2.1	Describe the PBN concept	2	ICAO and EUROCONTROL documents, airspace concept, application supported by navigation infrastructure and navigation specifications, functionality of the avionics
1.2.2	Differentiate between an RNAV and an RNP navigation specification	2	On-board performance monitoring and alerting
1.2.3	State which navigation applications support the different phases of flight	1	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.3: Area navigation concept (RNAV)

1.3.1	Differentiate between conventional navigation and area navigation	2	Fixed route vs flexible route structure

SUB-TOPIC 1.4: NOTAM

1.4.1	Explain the need for NOTAMs	2	—

SUBJECT 2: GROUND-BASED SYSTEMS — VOR

TOPIC 1: VOR

SUB-TOPIC 1.1: Use of the system

1.1.1	State the types of VOR Systems	1	Conventional, doppler
1.1.2	Describe the overall performance	2	Coverage, accuracy, availability of the system, integrity, continuity
1.1.3	Explain the technical limitations of CVOR	2	Type of information (azimuth), accuracy, integrity, suitable for a network of fixed routes
1.1.4	Appreciate the differences between CVOR and DVOR	3	Signal broadcast differences, bearing information robustness
1.1.5	Describe the current situation	2	*e.g. number, type, users, user groups, national context, European context*

SUB-TOPIC 1.2: Fundamentals of CVOR and/or DVOR

1.2.1	Appreciate the mathematical signal description	3	Declination, equations of CVOR and/or DVOR, reference and variable signals
1.2.2	Appreciate the principles for generating the variable signal	3	CVOR Rotating antenna principle Generating a rotating radiation pattern with static antennas and/or DVOR Frequency modulation through switching antenna

SUB-TOPIC 1.3: Ground station architecture

1.3.1	Describe the main components of a CVOR and/or DVOR ground station	2	Electronic cabinet, antenna system, power supply, remote controls and monitoring
1.3.2	Relate VOR station design to operational requirements	4	Siting, coverage, ID code, NDB backup

SUB-TOPIC 1.4: Transmitter subsystem

1.4.1	Characterise main signal parameters for a CVOR and/or DVOR	2	Carrier frequency stability, output power, signals generated
1.4.2	Perform typical transmitter measurements on VOR signals	3	Radiation pattern accuracy, power and modulation measurements, spectrum measurements, ID coding

SUB-TOPIC 1.5: Antenna subsystem

1.5.1	Explain VOR antenna characteristics	2	Impedance, polar diagram, polarisation, types of antennas
1.5.2	Appreciate the interface between power stage and the antennae	3	SWR, radiated power
1.5.3	Appreciate protection areas	3	Obstacles, ICAO Annex 10 *e.g. manufacturers manuals*

SUB-TOPIC 1.6: Monitoring and control subsystem

1.6.1	Describe the purpose of monitoring	2	Integrity, continuity of service, availability
1.6.2	Describe which VOR parameters are monitored	2	ICAO and RTCA/EUROCAE requirements e.g. NSA requirements
1.6.3	Describe the principles of the CVOR and/or DVOR monitoring systems	2	Near field sensors, far field sensors, recombination Local and remote monitoring

1.6.4	Appreciate how the operational status of the CVOR and/or DVOR monitoring systems are checked	3	Near field sensors, far field sensors, recombination Local and remote monitoring Additional: for achievement of competence, this objective should be applied practically, at the latest, by the end of the S/E rating training *e.g. BITE, Watchdog*
1.6.5	Describe the issues associated with VOR obstacle limitations and obstacle removal	2	Surrounding environment, multipath prevention
1.6.6	Explain the optional ILS interface	2	—

SUB-TOPIC 1.7: On-board equipment

1.7.1	Describe the on-board equipment	2	Antenna, receiver HMI *e.g. CDI, RMI, HSI, ND, PFD*
1.7.2	Describe how the VOR information is used on board	2	*e.g. single VOR, VOR-VOR, approach procedures, manual mode, automatic mode*

SUB-TOPIC 1.8: System check and maintenance

1.8.1	Appreciate the conformity to international and national regulations	3	ITU regulations (EMC + SAR), ICAO Annex 10
1.8.2	Perform typical system measurements	3	In space modulation, phase sideband/carrier, ground check for bearing errors
1.8.3	Appreciate calibration tasks and flight inspection results	3	Flight inspection (coverage, flight check for bearing errors and modulation) Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. maintenance manuals, procedures and reports*
1.8.4	Appreciate troubleshooting of a CVOR and/or DVOR	3	Carrier frequency deviation, depth of modulation, lack of power, harmonics ratio Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. maintenance and flight inspection manuals, procedures and reports*

1.8.5	Analyse the origins of CVOR and/or DVOR errors	4	CVOR System-dependent, adjustments, drifts, multipath, on-board errors and/or DVOR North Adjustment *e.g. DVOR: antenna feeding* *DVOR and CVOR: multipath, EMC, interference with radio broadcast transmissions*

SUBJECT 3: GNSS

TOPIC 1: GNSS

SUB-TOPIC 1.1: General view

1.1.1	Explain the importance and continuing development of GNSS	2	FANS CNS/ATM concept, ICAO Doc 9849, Navigation Application & NAVAID Infrastructure Strategy for the ECAC Area up to 2020, EUROCONTROL GNSS Policy, SESAR ATM Master Plan
1.1.2	Describe the elements of GNSS within Europe	2	Core constellations, ABAS, SBAS (EGNOS) *e.g. GBAS, SCAT 1, APV, ICAO Annex 10*
1.1.3	Appreciate the sources of interference to GNSS signals	3	Intentional, unintentional, ionospheric interference, solar activity
1.1.4	Explain who has responsibility for GNSS oversight in your State and how it is carried out	2	*e.g. EASA, GSA, NSA, ANSP*
1.1.5	Appreciate the impact of the modernisation of GNSS on the ARNS bands	3	Introduction of L5, E5A, E5B *e.g. COMPASS*
1.1.6	Explain the need for a minimum number of visible satellites needed to provide integrity monitoring	2	*e.g. AUGUR*
1.1.7	Describe the purpose of the GNSS NOTAM	2	ICAO Annex 10, Vol. 1

SUBJECT 4: ON-BOARD EQUIPMENT

TOPIC 1: ON-BOARD SYSTEMS

SUB-TOPIC 1.1: On-board systems

1.1.1	Explain the purpose and use of a navigation computer	2	Sensors, navigation database
1.1.2	Explain the purpose and use of an FMS	2	Sensors, navigation database, path steering, displays

TOPIC 2: AUTONOMOUS NAVIGATION

SUB-TOPIC 2.1: Inertial navigation

2.1.1	Describe the principles and key features of INS/IRS navigation	2	Gyros, accelerometer, accuracy, drift, updating

TOPIC 3: VERTICAL NAVIGATION

SUB-TOPIC 3.1: Vertical navigation

3.1.1	Describe the different types of vertical sensors and their limitations	2	Barometric, radio altimetry, geodetic *e.g. air data computers, manual intervention, dynamic information (AGL), undulation (WGS84)*

SUBJECT 5: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to navigation systems, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe in terms of exposure time, environment, effect on controller and effect on pilot, the types of functional failures	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

Stream NAVIGATION — DISTANCE MEASURING EQUIPMENT (DME)

SUBJECT 1: PERFORMANCE-BASED NAVIGATION

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: Operational requirements

1.1.1	Explain the main performance characteristics of a navigation system	2	Accuracy, precision, stability, integrity, availability, continuity of service, coverage, robustness *e.g. Time To First Fix*
1.1.2	Explain the relationship between performance measures and the phases of flight	2	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.2: Performance-based navigation

1.2.1	Describe the PBN concept	2	ICAO and EUROCONTROL documents, airspace concept, application supported by navigation infrastructure and navigation specifications, functionality of the avionics
1.2.2	Differentiate between an RNAV and an RNP navigation specification	2	On-board performance monitoring and alerting
1.2.3	State which navigation applications support the different phases of flight	1	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.3: Area navigation concept (RNAV)

1.3.1	Differentiate between conventional navigation and area navigation	2	Fixed route vs flexible route structure

SUB-TOPIC 1.4: NOTAM

1.4.1	Explain the need for NOTAMs	2	—

SUBJECT 2: GROUND-BASED SYSTEMS — DME

TOPIC 1: DME

SUB-TOPIC 1.1: Use of the system

1.1.1	Describe the overall performances for DME	2	Coverage, accuracy, availability of the system, integrity, continuity, number of users
1.1.2	Explain the limitations of DME	2	Accuracy, integrity, capacity
1.1.3	Describe the current situation	2	*e.g. number, types, users, user groups, national context, European context*
1.1.4	State the role of the DME infrastructure in the future navigation applications	1	PBN

1.1.5	Explain the differences between DME and TACAN for civilian use	2	*e.g. azimuth and range*

SUB-TOPIC 1.2: Fundamentals of DME

1.2.1	Describe the key elements of DME system operation	2	Two-way ranging technique, slant range, time measurement A/c interrogation, pulse pairs, ground reply, fixed time delay, interrogation stagger, 'X' and 'Y' channels
1.2.2	Explain the frequency spectrum and the channel spacing allocated	2	ICAO Annex 10, L-band

SUB-TOPIC 1.3: Ground station architecture

1.3.1	Describe the main components of a DME ground station	2	Electronic cabinet, antenna system, power supply, remote controls and monitoring
1.3.2	Relate DME station design to operational requirements	4	Coverage, ID code, siting

SUB-TOPIC 1.4: Receiver subsystem

1.4.1	Explain the main receiver parameters for a DME	2	Sensitivity, selectivity, dynamic range, jamming immunity
1.4.2	Perform the typical measurements on the interrogation signals	3	Sensitivity, selectivity, dynamic range, jamming immunity

SUB-TOPIC 1.5: Signal processing

1.5.1	Explain the functions performed by a DME/N signal processor	2	Decode, Reply Delay, Automatic Reply Rate Control, Encode, priority (Ident, DME signal, Squitter)
1.5.2	Perform the typical measurement on the DME/N transponder signals	3	Reply delay, Reply delay offset, decode parameters, rate of replies

SUB-TOPIC 1.6: Transmitter subsystem

1.6.1	Characterise the main signal parameters from the ground station	2	Carrier frequency, output power, pulse shape, pulse spacing, pulse repetition frequency, main delay, ID code
1.6.2	Perform the typical measurements on a DME	3	Power and pulse measurements, spectrum measurements, modulation measurements

SUB-TOPIC 1.7: Antenna subsystem

1.7.1	Explain DME antenna characteristics	2	Patterns, antennas
1.7.2	Appreciate the interface between power stage and the antenna	3	SWR, radiated power, propagation delay, distribution circuit (e.g. duplexer, circulator)
1.7.3	Appreciate protection areas	3	ICAO Annex 10, protection area criteria and enforcement *e.g. manufacturers manuals*

SUB-TOPIC 1.8: Monitoring and control subsystem

1.8.1	Describe the purpose of monitoring	2	Integrity, continuity of service
1.8.2	Describe which DME parameters are monitored	2	ICAO and RTCA/EUROCAE requirements *e.g. NSA requirements*
1.8.3	Appreciate how the operational status of the DME monitoring system is checked	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training
1.8.4	Describe the issues associated with DME obstacle limitations and obstacle removal	2	Multipath, blanking

SUB-TOPIC 1.9: On-board equipment

1.9.1	Describe the on-board equipment	2	Transmitter, antenna, receiver, HMI *e.g. HSI, DME range indication, ND*
1.9.2	Describe how the DME information is used on board	2	*e.g. single DME, multi-DME navigation (rho rho), approach procedures, manual mode, automatic mode*

SUB-TOPIC 1.10: System check and maintenance

1.10.1	Appreciate the conformity to international and national regulations	3	ITU regulations (EMC + SAR), ICAO Annex 10 *e.g. European regulations*
1.10.2	Appreciate calibration tasks and flight inspection results	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. maintenance and flight inspection manuals, procedures and reports*
1.10.3	Appreciate troubleshooting of a DME	3	Carrier frequency deviation, depth of modulation, lack of power, harmonics ratio Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. main delay and monitor shutdown errors, interference* *Maintenance and flight inspection manuals, procedures and reports*
1.10.4	Appreciate the origin of DME errors	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. Multipath, EMC, interference with radio broadcast transmissions (harmonics)*

SUBJECT 3: GNSS

TOPIC 1: GNSS

SUB-TOPIC 1.1: General view

1.1.1	Explain the importance and continuing development of GNSS	2	FANS CNS/ATM concept, ICAO Doc 9849, Navigation Application & NAVAID Infrastructure Strategy for the ECAC Area up to 2020, EUROCONTROL GNSS Policy, SESAR ATM Master Plan
1.1.2	Describe the elements of GNSS within Europe	2	Core constellations, ABAS, SBAS (EGNOS) *e.g. GBAS, SCAT 1, APV, ICAO Annex 10*
1.1.3	Appreciate the sources of interference to GNSS signals	3	Intentional, unintentional, ionospheric interference, solar activity
1.1.4	Explain who has responsibility for GNSS oversight in your State and how it is carried out	2	*e.g. EASA, GSA, NSA, ANSP*
1.1.5	Appreciate the impact of the modernisation of GNSS on the ARNS bands	3	Introduction of L5, E5A, E5B *e.g. COMPASS*
1.1.6	Explain the need for a minimum number of visible satellites needed to provide integrity monitoring	2	*e.g. AUGUR*
1.1.7	Describe the purpose of the GNSS NOTAM	2	ICAO Annex 10, Vol. 1

SUBJECT 4: ON-BOARD EQUIPMENT

TOPIC 1: ON-BOARD SYSTEMS

SUB-TOPIC 1.1: On-board systems

1.1.1	Explain the purpose and use of a navigation computer	2	Sensors, navigation database
1.1.2	Explain the purpose and use of an FMS	2	Sensors, navigation database, path steering, displays

TOPIC 2: AUTONOMOUS NAVIGATION

SUB-TOPIC 2.1: Inertial navigation

2.1.1	Describe the principles and key features of INS/IRS navigation	2	Gyros, accelerometer, accuracy, drift, updating

TOPIC 3: VERTICAL NAVIGATION

SUB-TOPIC 3.1: Vertical navigation

3.1.1	Describe the different types of vertical sensors and their limitations	2	Barometric, radio altimetry, geodetic *e.g. air data computers, manual intervention, dynamic information (AGL), undulation (WGS84)*

SUBJECT 5: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to navigation systems, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe in terms of exposure time, environment, effect on controller and effect on pilot, the types of functional failures	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

Stream NAVIGATION — INSTRUMENT LANDING SYSTEM (ILS)

SUBJECT 1: PERFORMANCE-BASED NAVIGATION

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: Operational requirements

1.1.1	Explain the main performance characteristics of a navigation system	2	Accuracy, precision, stability, integrity, availability, continuity of service, coverage, robustness *e.g. Time To First Fix*
1.1.2	Explain the relationship between performance measures and the phases of flight	2	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.2: Performance-based navigation

1.2.1	Describe the PBN concept	2	ICAO and EUROCONTROL documents, airspace concept, application supported by navigation infrastructure and navigation specifications, functionality of the avionics
1.2.2	Differentiate between an RNAV and an RNP navigation specification	2	On-board performance monitoring and alerting
1.2.3	State which navigation applications support the different phases of flight	1	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.3: Area navigation concept (RNAV)

1.3.1	Differentiate between conventional navigation and area navigation	2	Fixed route vs flexible route structure

SUB-TOPIC 1.4: NOTAM

1.4.1	Explain the need for NOTAMs	2	—

SUBJECT 2: GROUND-BASED SYSTEMS — ILS

TOPIC 1: ILS

SUB-TOPIC 1.1: Use of the system

1.1.1	Describe the overall performance for ILS	2	ICAO Annexes 10 and 14 Coverage, accuracy, availability of the system, integrity, continuity, number of users
1.1.2	Explain the limitations of ILS	2	ICAO Annexes 10 and 14 Only 40 channels, no segmented paths of approach, beam corruption due to multipath
1.1.3	Interpret ILS facility performance categories	5	ICAO Annexes 10 and 14 Cat I, Cat II, Cat III Different operational category depending on operational minima, equipment and airport facilities
1.1.4	Define obstacle-free zones for ILS components	1	ICAO Annexes 10 and 14 Dimensions *e.g. national regulations*
1.1.5	Explain the importance and need for ILS obstacle-free zones	2	ILS beam protection, increased significance during LVP conditions
1.1.6	Explain the current situation	2	*e.g. number, type, users, national context*
1.1.7	Consider the need for ATC ILS status indications	2	No continuous monitoring by ATSEP

SUB-TOPIC 1.2: Fundamentals of ILS

1.2.1	Explain how to obtain a change in depth of modulation of an amplitude-modulated signal as a function of angular position	2	Addition of a carrier signal and a side band signal in space
1.2.2	Characterise the signals to be radiated	2	Amplitude and phase relationship, antenna systems
1.2.3	Relate the adjustment of signals generated to the resulting beam patterns and standards	4	Phases and amplitudes in antenna array, modulations on carrier signal, phase and amplitude of side band
1.2.4	Describe the required performance of an antenna array	2	Beam bend potential, coverage, impact on location of critical and sensitive area

SUB-TOPIC 1.3: 2F-Systems

1.3.1	Explain the limitations of a 1F system	2	Multipath in adverse environment and terrain
1.3.2	Describe the capture effect	2	Capture effect in receiver circuits
1.3.3	Describe radiation parameters for 2F-LOC and 2F-GP	2	Types of antenna arrays, patterns, coverage, signal distribution, radiated power

SUB-TOPIC 1.4: Ground station architecture

1.4.1	Describe the layout of an ILS	2	—
1.4.2	Describe the main components of the LOC (1F and 2F), GP (1F and 2F), markers and field monitors	2	Electronic cabinet, antennas, power supply, remote controls and monitoring, tower indication *e.g. DME*
1.4.3	Relate ILS station design to operational requirements	4	Coverage, ID code, siting

SUB-TOPIC 1.5: Transmitter subsystem

1.5.1	Describe the main components of the LOC (1F and 2F), GP (1F and 2F), markers and field monitors	2	Electronic cabinet, antennas, power supply, remote controls and monitoring, tower indication *e.g. DME*
1.5.2	Relate ILS station design to operational requirements	4	Coverage, ID code, siting

SUB-TOPIC 1.6: Antenna subsystem

1.6.1	Explain ILS antenna characteristics: LOC, GP and Marker Beacons	2	Types, position, polarisation, patterns, coverage, antenna matching, distribution circuits, radiated power, ground reflection

SUB-TOPIC 1.7: Monitoring and control subsystem

1.7.1	Describe the purpose of monitoring	2	Integrity, continuity of service
1.7.2	Describe the parameters for the monitoring according to ICAO Annex 10: LOC, GP and Marker Beacons	2	RF level, DDM, SDM on position and width
1.7.3	Explain the key additional required monitoring: LOC and GP	2	External, internal and integral monitoring
1.7.4	Explain the purpose, advantages and disadvantages of the FFM system	2	*e.g. content position, width, requirement for Cat III operations (some States)*
1.7.5	Draw a diagram of the monitoring system: LOC, GP, FFM and Marker Beacons	1	Near-field, integral network, internal network, monitor signal processor *e.g. DME*
1.7.6	Explain the optional DME interface	2	Identity coding ratio

SUB-TOPIC 1.8: On-board equipment

1.8.1	Describe the on-board equipment associated with LOC, GP and Marker Beacon	2	Antennas, receiver, pilot interface (cross pointer) *e.g. FMS*
1.8.2	Describe how ILS information is used on board	2	*e.g. approach procedures, landing, roll-out, manual, automatic mode (auto-pilot)*

SUB-TOPIC 1.9: System check and maintenance

1.9.1	Appreciate the conformity of LOC, GP and marker beacons to international and national regulations	3	ITU regulations (EMC + SAR), ICAO Annex 10 *e.g. European regulations*
1.9.2	Justify the occasions when it is necessary to downgrade an ILS facility performance category	4	*e.g. system failures, environmental changes/disturbance*
1.9.3	Explain the implications of ILS facility performance categories to the pilot	2	Link with prevailing Instrument RVR, weather dictating decision height
1.9.4	Perform some typical measurements	3	Output power, spectrum analysis, modulation, ID code
1.9.5	Appreciate calibration tasks and flight inspection results	3	LOC, GP and marker beacons Flight inspection and ground calibration results, LOC Centreline measurement, width and centreline field measurements Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. RF interference monitoring maintenance and flight inspection manuals, procedures and reports*
1.9.6	Appreciate troubleshooting of ILS LOC, GP and marker beacons	3	DDM and SDM misalignment, coverage pilot reported errors, field checks, monitor checks Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. lack of power, carrier frequency deviation, harmonic ratio, depth of modulation maintenance and flight inspection manuals, procedures and reports*
1.9.7	Appreciate the origin of ILS errors	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. Multipath, EMC, interference with radio broadcast transmissions (harmonics)*

SUBJECT 3: GNSS

TOPIC 1: GNSS

SUB-TOPIC 1.1: General view

1.1.1	Explain the importance and continuing development of GNSS	2	FANS CNS/ATM concept, ICAO Doc 9849, Navigation Application & NAVAID Infrastructure Strategy for the ECAC Area up to 2020, EUROCONTROL GNSS Policy, SESAR ATM Master Plan
1.1.2	Describe the elements of GNSS within Europe	2	Core constellations, ABAS, SBAS (EGNOS) *e.g. GBAS, SCAT 1, APV, ICAO Annex 10*
1.1.3	Appreciate the sources of interference to GNSS signals	3	Intentional, unintentional, ionospheric interference, solar activity

1.1.4	Explain who has responsibility for GNSS oversight in your State and how it is carried out	2	*e.g. EASA, GSA, NSA, ANSP*
1.1.5	Appreciate the impact of the modernisation of GNSS on the ARNS bands	3	Introduction of L5, E5A, E5B *e.g. COMPASS*
1.1.6	Explain the need for a minimum number of visible satellites needed to provide integrity monitoring	2	*e.g. AUGUR*
1.1.7	Describe the purpose of the GNSS NOTAM	2	ICAO Annex 10, Vol. 1

SUBJECT 4: ON-BOARD EQUIPMENT

TOPIC 1: ON-BOARD SYSTEMS

SUB-TOPIC 1.1: On-board systems

1.1.1	Explain the purpose and use of a navigation computer	2	Sensors, navigation database
1.1.2	Explain the purpose and use of an FMS	2	Sensors, navigation database, path steering, displays

TOPIC 2: AUTONOMOUS NAVIGATION

SUB-TOPIC 2.1: Inertial navigation

2.1.1	Describe the principles and key features of INS/IRS navigation	2	Gyros, accelerometer, accuracy, drift, updating

TOPIC 3: VERTICAL NAVIGATION

SUB-TOPIC 3.1: Vertical navigation

3.1.1	Describe the different types of vertical sensors and their limitations	2	Barometric, radio altimetry, geodetic *e.g. air data computers, manual intervention, dynamic information (AGL), undulation (WGS84)*

SUBJECT 5: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to navigation systems, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe in terms of exposure time, environment, effect on controller and effect on pilot, the types of functional failures	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

Stream NAVIGATION — MICROWAVE LANDING SYSTEM (MLS)

SUBJECT 1: PERFORMANCE-BASED NAVIGATION

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: Operational requirements

1.1.1	Explain the main performance characteristics of a navigation system	2	Accuracy, precision, stability, integrity, availability, continuity of service, coverage, robustness *e.g. Time To First Fix*
1.1.2	Explain the relationship between performance measures and the phases of flight	2	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.2: Performance-based navigation

1.2.1	Describe the PBN concept	2	ICAO and EUROCONTROL documents, airspace concept, application supported by navigation infrastructure and navigation specifications, functionality of the avionics
1.2.2	Differentiate between an RNAV and an RNP navigation specification	2	On-board performance monitoring and alerting
1.2.3	State which navigation applications support the different phases of flight	1	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.3: Area navigation concept (RNAV)

1.3.1	Differentiate between conventional navigation and area navigation	2	Fixed route vs flexible route structure

SUB-TOPIC 1.4: NOTAM

1.4.1	Explain the need for NOTAMs	2	—

2. SUBJECT 2: GROUND-BASED SYSTEMS — MLS

TOPIC 1: MLS

SUB-TOPIC 1.1: Use of the system

1.1.1	Describe approach and landing path	2	Azimuth station, elevation station, back azimuth station, approach DME, equipment layout, ICAO defined benchmarks
1.1.2	Describe the overall performances for MLS	2	Coverage, accuracy, availability of the system, integrity, continuity, category and level
1.1.3	Explain the technical limitations of MLS	2	Sensitivity to weather conditions, complexity, sensitively to multipath, criticality of signal at edge of coverage
1.1.4	Explain the advantages of MLS	2	Type of information, accuracy, small critical and sensitive areas, number of channels, complex approach paths, less prone to interference, reduced sensitivity to multipath, size of antennae array

1.1.5	Interpret MLS facility performance categories	5	Cat 1, 2, 3 Different operational category depending on operational minima, equipment and airport facilities
1.1.6	Define MLS critical and sensitive areas	1	Critical and sensitive area dimensions
1.1.7	Explain the importance and need for MLS critical and sensitive areas	2	MLS beam protection, increased significance during LVP conditions
1.1.8	Describe the current situation	2	Multi-mode receivers, ground and aircraft equipment *e.g. low equipage, users, number of manufacturers*
1.1.9	Consider the need for ATC MLS status indications	2	No continuous monitoring by ATSEP

SUB-TOPIC 1.2: Fundamentals of MLS

1.2.1	Explain the principle for generating a scanning beam	2	Phase changes, phase relations
1.2.2	Describe the relationship between beam pattern and accuracy	2	Beam width, side lobe level reduction
1.2.3	Explain why data transmission is necessary	2	Station coordinates, ident, function synchronisation, time reference
1.2.4	Describe the data transmission structure	2	ICAO specification

SUB-TOPIC 1.3: Ground station architecture

1.3.1	Describe the layout of an MLS	2	—
1.3.2	Describe the main components of the azimuth, elevation, back azimuth and DME stations	2	Electronic cabinet, antennas, power supply, remote controls and monitoring, tower indication
1.3.3	Relate MLS station design to operational requirements	4	Coverage, ID code, siting

SUB-TOPIC 1.4: Transmitter subsystem

1.4.1	Characterise main signal parameters for azimuth, elevation and back azimuth station	2	Carrier frequency, output power, signals generated
1.4.2	Explain the main components of the transmitters	2	Azimuth, elevation, back azimuth station synthesiser, modulator, power amplifier, control coupler, RF changeover

SUB-TOPIC 1.5: Antenna subsystem

1.5.1	Explain MLS antenna characteristics: azimuth, elevation and back azimuth stations	2	Types, location, polarisation, pattern, coverage, distribution circuits, radiated power

SUB-TOPIC 1.6: Monitoring and control subsystem

1.6.1	Describe the purpose of monitoring	2	Integrity, continuity of service
1.6.2	Describe the parameters for the monitoring according to ICAO Annex 10: azimuth, elevation and back azimuth stations	2	RF level, beam width, scan speed
1.6.3	Explain how the parameters are monitored: azimuth, elevation and back azimuth station	2	External and internal monitoring
1.6.4	Explain the FFM system	2	Requirements for CAT 3 operations
1.6.5	Draw a diagram of the monitoring system	1	—

SUB-TOPIC 1.7: On-board equipment

1.7.1	Describe the on-board equipment	2	Antennas, receiver, pilot interface, HMI *e.g. FMS*
1.7.2	Describe how the MLS information is used on board	2	Approach procedures, ILS-like display

SUB-TOPIC 1.8: System check and maintenance

1.8.1	Appreciate the conformity to international and national regulations	3	ITU regulations (EMC + SAR), ICAO Annex 10 *e.g. European regulations*
1.8.2	Justify the occasions when it is necessary to downgrade an MLS facility performance category	4	—
1.8.3	Explain the implications of MLS facility performance categories to the pilot	2	Link with prevailing instrument RVR, weather dictating decision height
1.8.4	Consider the need for ATSEP MLS remote maintenance and monitoring systems	2	Control, status, performance monitoring including alarm logging
1.8.5	Perform the typical system measurements	3	Output power, spectrum analysis, data link modulation, ID code, Ground field checks
1.8.6	Appreciate calibration tasks and flight inspection results	3	Azimuth, back azimuth, azimuth centreline measurement, width and centreline measurements, elevation Flight inspection and ground calibration results Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. maintenance manuals, procedures and reports*

1.8.7	Appreciate troubleshooting of an MLS	3	Lack of power, carrier frequency deviation, harmonic ratio, beam pattern Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. maintenance and flight inspection manuals, procedures and reports*
1.8.8	Appreciate the origin of MLS errors	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. Multipath, EMC, weather influence*

SUBJECT 3: GNSS

TOPIC 1: GNSS

SUB-TOPIC 1.1: General view

1.1.1	Explain the importance and continuing development of GNSS	2	FANS CNS/ATM concept, ICAO Doc 9849, Navigation Application & NAVAID Infrastructure Strategy for the ECAC Area up to 2020, EUROCONTROL GNSS Policy, SESAR ATM Master Plan
1.1.2	Describe the elements of GNSS within Europe	2	Core constellations, ABAS, SBAS (EGNOS) *e.g. GBAS, SCAT 1, APV, ICAO Annex 10*
1.1.3	Appreciate the sources of interference to GNSS signals	3	Intentional, unintentional, ionospheric interference, solar activity
1.1.4	Explain who has responsibility for GNSS oversight in your State and how it is carried out	2	*e.g. EASA, GSA, NSA, ANSP*
1.1.5	Appreciate the impact of the modernisation of GNSS on the ARNS bands	3	Introduction of L5, E5A, E5B *e.g. COMPASS*
1.1.6	Explain the need for a minimum number of visible satellites needed to provide integrity monitoring	2	*e.g. AUGUR*
1.1.7	Describe the purpose of the GNSS NOTAM	2	ICAO Annex 10, Vol. 1

SUBJECT 4: ON-BOARD EQUIPMENT

TOPIC 1: ON-BOARD SYSTEMS

SUB-TOPIC 1.1: On-board systems

1.1.1	Explain the purpose and use of a navigation computer	2	Sensors, navigation database
1.1.2	Explain the purpose and use of an FMS	2	Sensors, navigation database, path steering, displays

TOPIC 2: AUTONOMOUS NAVIGATION

SUB-TOPIC 2.1: Inertial navigation

2.1.1	Describe the principles and key features of INS/IRS navigation	2	Gyros, accelerometer, accuracy, drift, updating

TOPIC 3: VERTICAL NAVIGATION

SUB-TOPIC 3.1: Vertical navigation

3.1.1	Describe the different types of vertical sensors and their limitations	2	Barometric, radio altimetry, geodetic *e.g. air data computers, manual intervention, dynamic information (AGL), undulation (WGS84)*

SUBJECT 5: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to navigation systems, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe in terms of exposure time, environment, effect on controller and effect on pilot, the types of functional failures	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

Stream SURVEILLANCE — PRIMARY SURVEILLANCE RADAR

SUBJECT 1: PRIMARY SURVEILLANCE RADAR

TOPIC 1: ATC SURVEILLANCE

SUB-TOPIC 1.1: Use of PSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach PSR	2	Range, resolution, coverage, availability
1.1.2	Relate key parameters of PSR to system performance	4	Key parameters: PRF, signal energy, frequency diversity, antenna gain, update rate, polarisation, receiver MDS, beamwidth Performance: range, accuracy, resolution, extractor minimum target threshold, weather influence, PD, blind speed, ambiguities, capacity *e.g. weather channel*

SUB-TOPIC 1.2: Antenna (PSR)

1.2.1	Describe antenna types, accuracy and problems	2	Antenna beam(s), side lobes, reflector antenna, active (phased array) antenna, rotating joints, waveguide interface, pressurisation, dehumidification, polarisation, azimuth encoding, drive systems

SUB-TOPIC 1.3: Transmitters

1.3.1	Describe the basic characteristics of a transmitter	2	Supply, EHT, RF source (appropriate to type chosen), modulation, interlocks
1.3.2	Describe the signals at all key points	2	Supply, EHT, RF source (appropriate to type chosen), modulation, interlocks
1.3.3	Describe a generic transmitter block diagram for both compressed and non-compressed system	2	*e.g. solid state, klystron, magnetron, travelling wave tube*
1.3.4	State possible failures and where they can occur in the transmitter system	1	*e.g. solid state modules, arcing, corona discharge, component stress, control loops, isolation*
1.3.5	State constraints and problems on the high voltage circuitry	1	*e.g. corona discharge, dielectric stress, isolation, arcing, ageing, interlocks, stability (including control loop)*

SUB-TOPIC 1.4: Characteristics of primary targets

1.4.1	Appreciate the characteristics of targets detected by PSR	3	Backscatter, radar cross section (such as reflectivity, stealth technologies, aspect), Doppler shift, ground speed, wind turbines *e.g. Swerling Case*

SUB-TOPIC 1.5: Receivers

1.5.1	Describe the basic characteristics of a receiver	2	Low noise, high dynamic range, bandwidth, detection, frequency, sensitivity, selectivity
1.5.2	Describe the basic elements of a generic receiver	2	LNA, local oscillator, coherent oscillator, down-converter, filtering, rejection, IF, PSD, AGC, STC, beam switching
1.5.3	Appreciate the importance of STC	3	Saturation, RF-IF dynamic range

SUB-TOPIC 1.6: Signal processing and plot extraction

1.6.1	Describe the basic function of data processing	2	Plot extraction (range bin reports, range correlation, azimuth correlation), target reports, sliding window, weighted centre, local tracking
1.6.2	Appreciate the basic functions of a current radar signal processor	3	A/D conversion, I/Q matching, target detection, detection criteria (fixed, adaptive), MTD and clutter maps
1.6.3	Describe the processing techniques to improve the quality of target reports using scan-to-scan information	2	Tracking, environment mapping, adaptive feedback to extraction parameters

SUB-TOPIC 1.7: Plot combining

1.7.1	Describe the basic function of plot combining	2	Secondary/primary combining, secondary/primary assigning, prime target, range and azimuth collimation
1.7.2	Describe the basic functions of a current radar plot combiner	2	Scan-to-scan correlation, angel filtering, vehicle filtering, output format

SUB-TOPIC 1.8: Characteristics of primary radar

1.8.1	Explain the basic principles of electromagnetism, propagation, signal detection, RF power generation and distribution	2	Frequency and phase, electromagnetic radiation, spectrum and bandwidth, noise, HPA, waveguide problems

TOPIC 2: SURFACE MOVEMENT RADAR

SUB-TOPIC 2.1: Use of SMR for Air Traffic Services

2.1.1	Describe the operational requirements of SMR	2	Range, resolution, coverage, MTBF, availability
2.1.2	Relate key parameters and necessity to achieve performances	4	Specific equations for ranging and power budget, PRF, frequency with respect to range and accuracy, PD, frequency diversity, range with respect to TX power, antenna gain, receiver MDS, update rate, beamwidth, extractor minimum target threshold, polarisation, influence to meteorology

SUB-TOPIC 2.2: Radar sensor

2.2.1	Explain the layout of the SMR	2	Dual system, service display
2.2.2	Describe the basic functions of the receiver/transmitter unit	2	Hardware/function overview
2.2.3	Describe how to operate a sensor	2	*e.g. block diagram, timing relations, video path, frequency diversity, polarisation, controller structure*
2.2.4	Describe the basic functions of the antenna unit	2	*e.g. hardware function overview, control/switch unit, external interface, azimuth encoding, monopulse techniques*

TOPIC 3: TEST AND MEASUREMENT

SUB-TOPIC 3.1: Test and measurement

3.1.1	Appreciate how measurements can be made on PSR and SMR	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. spectrum analyser, vector voltmeter, oscilloscope, SWR meter, sensor analysis tools*

SUBJECT 2: HUMAN MACHINE INTERFACE (HMI)

TOPIC 1: HMI

SUB-TOPIC 1.1: ATCO HMI

1.1.1	Describe the display types available	2	Video, synthetic, mixed
1.1.2	State the type of selections available	1	Source, range, maps, filters
1.1.3	Describe the advantages of different display types	2	Clarity, configurability, fallback, data integration

SUB-TOPIC 1.2: ATSEP HMI

1.2.1	Describe the user interface scope and ergonomics as seen by different users and at different locations	2	System management displays characteristics both control and monitoring
1.2.2	Describe the analytical and status data available to the users	2	Radar video, front panel and CMS data, HMI on each subsystem

SUB-TOPIC 1.3: Pilot HMI

1.3.1	Describe the transponder interface	2	Mode A, change procedure, SPI, Mode C, deselection, hijack
1.3.2	Be aware of the ACAS/TCAS display and future potential developments	0	Characteristics, accuracy, alerts, ADS B, CDTI
1.3.3	Be aware of the EGPWS display and of future potential developments	0	—

SUB-TOPIC 1.4: Displays

1.4.1	Describe the display types available and their advantages and disadvantages	2	Raster/rotating, raw/synthetic, monochrome/colour, CRT/LCD, performances (cost, availability, maintainability, ergonomics)

SUBJECT 3: SURVEILLANCE DATA TRANSMISSION

TOPIC 1: SURVEILLANCE DATA TRANSMISSION

SUB-TOPIC 1.1: Technology and protocols

1.1.1	Describe the implementation of formats and protocols	2	Network protocols, Surveillance Data Networks *e.g. RADNET, messages CAT 1+*
1.1.2	Decode ASTERIX messages	3	*e.g. categories 1, 2, 20, 21, 34, 48, 62*
1.1.3	Identify the data transmission architecture in a multisensor environment	3	Fault tolerance, redundancy of line equipment *e.g. software fallback capability, contingency of service, RADNET*
1.1.4	Characterise the degradations of the surveillance transmission network	2	*e.g. saturation, excess latency*

SUB-TOPIC 1.2: Verification methods

1.2.1	Identify the causes of a fault, based on test tool measurements	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. data analyser, line analyser*

SUBJECT 4: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to the surveillance systems, safety reports and occurrences, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe the implications of functional failures in terms of exposure time, environment, effect on controller and effect on pilot	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

SUBJECT 5: DATA PROCESSING SYSTEMS

TOPIC 1: SYSTEM COMPONENTS

SUB-TOPIC 1.1: Surveillance data processing systems

1.1.1	Identify all functions of an SDP system	3	Plot processing, tracking, single-sensor and multisensor tracker *e.g. radar, ADS, MLAT, estimating limits and accuracy of multisensor tracker, recording* *e.g. ARTAS tracker*
1.1.2	Describe all major components of an SDP	2	Functional architecture, technical architecture
1.1.3	Differentiate SDP features in the ATS units	2	Area control centres Approach control units Aerodrome control towers
1.1.4	Appreciate how to operate the system	3	*e.g. configuration, adjust parameters, start up and shut down, monitoring*
1.1.5	Explain the principles of emergency switching	2	—

Stream SURVEILLANCE — SECONDARY SURVEILLANCE RADAR

SUBJECT 1: SECONDARY SURVEILLANCE RADAR (SSR)

TOPIC 1: SSR AND MONO-PULSE SSR

SUB-TOPIC 1.1: Use of SSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach SSR	2	Range, coverage, resolution, performance, update rate ICAO Doc 9684
1.1.2	Relate key parameters of SSR to system performance	4	Key parameters: rotation rate, PRF, interlaced modes, capacity, frequencies, power budget (uplink, downlink), monopulse techniques Consequences: FRUIT, garbling, side lobes reception and transmission, transponder availability, PD, 2nd recurrence replies

SUB-TOPIC 1.2: Antenna (SSR)

1.2.1	Describe the principles of SSR/MSSR antenna	2	Monopulse antenna techniques, coaxial connection, sum, difference and control pattern, error angle measurement, azimuth encoding, beam sharpening, side lobes

SUB-TOPIC 1.3: Interrogator

1.3.1	Describe the characteristics of an interrogator	2	Frequency, spectrum, interrogation modes, duty cycle, ISLS, IISLS, staggering
1.3.2	Explain a generic interrogator	2	Timing, interface, modulator, BITE
1.3.3	Explain the need for integrity monitoring	2	Safeguards against erroneous transmission, BITE

SUB-TOPIC 1.4: Transponder

1.4.1	Explain the operational use of the transponder	2	Diagram of interaction between transponder and aeroplane
1.4.2	Define the global performances	1	Range, accuracy, fixed delay to respond
1.4.3	Describe the basic characteristics of a transponder	2	Transceiver, aerial location, switching and polar diagram, size ACAS Mode S and ADS compatibility, maximum reply rate, ISLS compatibility
1.4.4	Explain the advantages of the transponder	2	Longer range, more information
1.4.5	Explain the limitations of the transponder	2	Hundreds of feet precision, 3A limited codes
1.4.6	Describe the conformity to regulations	2	Equipage obligations, ICAO Annex 10
1.4.7	Describe the data format of the received transponder messages	2	P1, P2, P3, P4, P5, P6 signals and DPSK modulation (P6)

1.4.8	Describe the data format of the transmitted transponder messages	2	Field lengths, data bits, Gray code, unused bits, Mode S reply (preamble and data)
1.4.9	Describe the basic characteristics of a transmitter	2	Timing, modulation, pulse width, power output
1.4.10	Describe the use of the transponder as a field monitor	2	—

SUB-TOPIC 1.5: Receivers

1.5.1	Describe the basic characteristics of an SSR receiver	2	Standard/MSSR receiver, sensibility, bandwidth, dynamic range, GTC (normal, sectorised), monopulse processor, RSLS, multi-path and interferences

SUB-TOPIC 1.6: Signal processing and plot extraction

1.6.1	Describe monopulse extraction	2	Phase and amplitude modulation, off boresight angle calculation, azimuth encoding
1.6.2	Describe sliding window SSR extraction	2	Leading edge, trailing edge, azimuth accuracy, azimuth encoding
1.6.3	Describe the signal processing	2	Video digitiser, pulse processor, reply decoder (bracket pair detector), synchronous reply correlator
1.6.4	Decode a transponder message	3	Standard message with SPI set *e.g. Mode S*
1.6.5	Describe the SSR processing techniques	2	Discrete code correlation, general association, zones, categories, code swapping, general correlation Mode A code data, Mode C data, target position report
1.6.6	Explain the reasons for surveillance processing and the key options	2	False target identification and elimination, data validation, data correction, reflection identification and processing, enhanced resolution performance

SUB-TOPIC 1.7: Plot combining

1.7.1	Describe the basic function of plot combining	2	Secondary/primary combining, secondary/primary assigning, prime target, range and azimuth collimation
1.7.2	Describe the basic functions of a current radar plot combiner	2	_

SUB-TOPIC 1.8: Test and measurement

1.8.1	Appreciate how measurements can be made on SSR	3	Additional: for achievement of competence, this objective should be applied practically, at the latest, by the end of the S/E rating training *e.g. spectrum analyser, vector voltmeter, oscilloscope, SWR meter, sensor analysis tools*

TOPIC 2: MODE S

SUB-TOPIC 2.1: Introduction to Mode S

2.1.1	Explain the need for and benefits of Mode S	2	Classical SSR limitations, resolution, accuracy, integrity, enhanced data (e.g. 25 ft resolution, aircraft ID, BDS information)
2.1.2	Explain the working principles of Mode S	2	Mode S interrogation, Mode S reply, Mode S uplink and downlink capability, Mode S formats/protocols, ELS, EHS
2.1.3	Explain the complementary use of Mode S and conventional SSR	2	Mode interlace pattern, operational use of all-call, roll-call
2.1.4	Explain Mode S implementation	2	Elementary and enhanced surveillance, II and SI codes, use of BDS

SUB-TOPIC 2.2: Mode S system

2.2.1	Describe the theory of operation of Mode S hardware and software	2	Performance of the system, theory of operation of the system, interfaces to customer equipment
2.2.2	Describe testing possibilities for Mode S	2	*e.g. SASS-C, SASS-S*

TOPIC 3: MULTILATERATION

SUB-TOPIC 3.1: MLAT in use

3.1.1	Explain how pilot and controller operations are impacted by the use of an MLAT system	2	Mode A assigned at gate, coverage of MLAT
3.1.2	Describe the ground mode of transponders	2	Aircraft interrogations, squitters, change of transponder mode

SUB-TOPIC 3.2: MLAT principles

3.2.1	Explain the MLAT system architecture	2	Standards, transmitters and receivers, data processing/fusion, redundancy, performance, costs, timing solutions, etc.
3.2.2	Appreciate the principles of MLAT system	3	Triangulation, coverage, position calculation *e.g. SCAS*
3.2.3	Describe how to operate the system	2	Tracking, map creation and blanking
3.2.4	Describe testing possibilities for MLAT	2	*e.g. SASS-C*

TOPIC 4: SSR ENVIRONMENT

SUB-TOPIC 4.1: SSR Environment

4.1.1	Explain the operational use of ACAS and implications for pilots and controllers	2	Traffic Advisories, Resolution Advisories, pilot responses and controller information
4.1.2	Describe the users of the 1 030 MHz 1 090 MHz channels	2	Modes 1, 3, A, C and S, military, Mode S uplink and downlink capability, ACAS (TCAS), acquisition and extended squitter, PRF-FRUIT ratios, DME and other

			interferences

SUBJECT 2: HUMAN MACHINE INTERFACE (HMI)

TOPIC 1: HMI

SUB-TOPIC 1.1: ATCO HMI

1.1.1	Describe the display types available	2	Video, synthetic, mixed
1.1.2	State the type of selections available	1	Source, range, maps, filters
1.1.3	Describe the advantages of different display types	2	Clarity, configurability, fallback, data integration

SUB-TOPIC 1.2: ATSEP HMI

1.2.1	Describe the user interface scope and ergonomics as seen by different users and at different locations	2	System management displays characteristics, both control and monitoring
1.2.2	Describe the analytical and status data available to the users	2	Radar video, front panel and CMS data, HMI on each subsystem

SUB-TOPIC 1.3: Pilot HMI

1.3.1	Describe the transponder interface	2	Mode A, change procedure, SPI, Mode C, deselection, hijack
1.3.2	Be aware of the ACAS/TCAS display and future potential developments	0	Characteristics, accuracy, alerts, ADS B, CDTI
1.3.3	Be aware of the EGPWS display and of future potential developments	0	—

SUB-TOPIC 1.4: Displays

1.4.1	Describe the display types available and their advantages and disadvantages	2	Raster/rotating, raw/synthetic, monochrome/colour, CRT/LCD, performances (cost, availability, maintainability, ergonomics)

SUBJECT 3: SURVEILLANCE DATA TRANSMISSION

TOPIC 1: SURVEILLANCE DATA TRANSMISSION

SUB-TOPIC 1.1: Technology and protocols

1.1.1	Describe the implementation of formats and protocols	2	Network protocols, Surveillance Data Networks *e.g. RADNET, messages CAT 1+*
1.1.2	Decode ASTERIX messages	3	*e.g. categories 1, 2, 20, 21, 34, 48, 62*
1.1.3	Identify the data transmission architecture in a multisensor environment	3	Fault tolerance, redundancy of line equipment *e.g. software fallback capability, contingency of service, RADNET*
1.1.4	Characterise the degradations of the surveillance transmission network	2	*e.g. saturation, excess latency*

SUB-TOPIC 1.2: Verification methods

1.2.1	Identify the causes of a fault, based on test tool measurements	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training e.g. data analyser, line analyser

SUBJECT 4: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to the surveillance systems, safety reports and occurrences, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe the implications of functional failures in terms of exposure time, environment, effect on controller and effect on pilot	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation,

SUBJECT 5: DATA PROCESSING SYSTEMS

TOPIC 2: SYSTEM COMPONENTS

SUB-TOPIC 1.1: Surveillance data processing systems

1.1.1	Identify all functions of an SDP system	3	Plot processing, tracking, single-sensor and multisensor tracker (e.g. radar, ADS, MLAT), estimating limits and accuracy of multisensor tracker, recording e.g. ARTAS tracker
1.1.2	Describe all major components of an SDP	2	Functional architecture, technical architecture
1.1.3	Differentiate SDP features in the ATS units	2	Area control centres Approach control units Aerodrome control towers
1.1.4	Appreciate how to operate the system	3	*e.g. configuration, adjust parameters, start up and shut down, monitoring*
1.1.5	Explain the principles of emergency switching	2	—

Stream SURVEILLANCE — AUTOMATIC DEPENDENT SURVEILLANCE

SUBJECT 1: AUTOMATIC DEPENDENT SURVEILLANCE (ADS)

TOPIC 1: GENERAL VIEW ON ADS

SUB-TOPIC 1.1: Definition of ADS

1.1.1	Describe the basic characteristics of a ADS	2	Performance, integrity, latency, QoS, implementation options (e.g. ATN/FANS)
1.1.2	List the types of navigation sensors	1	GNSS, INS, radio NAVAIDs, navigation solutions from FMS, FoM
1.1.3	State the latest developments, implementation plans and projects	1	*e.g. current and recent test and trials, ICAO status, EUROCONTROL, FAA and other authorities positions, airline and equipment manufacturer positions, ATC procedures, time scales*

TOPIC 2: ADS-B

SUB-TOPIC 2.1: Introduction to ADS-B

2.1.1	Explain the basic principles of ADS-B	2	Autonomous operation, navigation solutions, link options, aircraft situation awareness
2.1.2	Identify the major elements of ADS-B	3	*e.g. ADS-B global chain (from the aircraft to the controller HMI), GNSS, FMS, encoding, scheduling, link*

SUB-TOPIC 2.2: Techniques of ADS-B

2.2.1	Explain the characteristics of the data links used in ADS B	2	VDL Mode 4, Mode S extended squitter, UAT
2.2.2	Describe the major ADS-B applications	2	*e.g. ADS-B-NRA, ADS-B-RAD, ASAS*

SUB-TOPIC 2.3: VDL Mode 4 (STDMA)

2.3.1	Describe the use of VDL Mode 4	2	High-level description

SUB-TOPIC 2.4: Mode S extended squitter

2.4.1	Describe the use of the Mode S extended squitter	2	High-level description
2.4.2	Explain the principles related to signals in space	2	Modulation scheme, signal structure, key data and frequency
2.4.3	Explain the principles related to random access technology	2	Consequences on the RF environment (1 090 MHz)
2.4.4	Explain the relevant messages	2	Information in each field, information encoding and decoding
2.4.5	Recognise the structure of a Mode S extended squitter signal	1	Signal timing and sequencing, data encoding

2.4.6	Explain the interface between the BDS and the extended squitter message	2	—

SUB-TOPIC 2.5: UAT

2.5.1	State the use of the UAT	1	High-level description

SUB-TOPIC 2.6: ASTERIX

2.6.1	Decode and analyse a signal coded according to the ASTERIX category 21 standard	3	Reference to ASTERIX standard Decode position, call sign, Mode S address, etc.

TOPIC 3: ADS-C

SUB-TOPIC 3.1: Introduction to ADS-C

3.1.1	Explain the basic principles of ADS-C	2	Contract, multi-contract, time, event triggering
3.1.2	Identify the major elements of the ADS-C system	3	ADS-C global chain (from the aircraft to the controller HMI), GNSS, processor, link, ground station

SUB-TOPIC 3.2: Techniques in ADS-C

3.2.1	Explain the characteristics of the data links used in ADS-C	2	*e.g. subnetworks (VDLs, AMSS, HFDL)*

SUBJECT 2: HUMAN MACHINE INTERFACE (HMI)

TOPIC 1: HMI

SUB-TOPIC: 1.1 ATCO HMI

1.1.1	Describe the display types available	2	Video, synthetic, mixed
1.1.2	State the type of selections available	1	Source, range, maps, filters
1.1.3	Describe the advantages of different display types	2	Clarity, configurability, fallback, data integration

SUB-TOPIC 1.2: ATSEP HMI

1.2.1	Describe the display types available	2	Video, synthetic, mixed
1.2.2	State the type of selections available	1	Source, range, maps, filters

SUB-TOPIC 1.3: Pilot HMI

1.3.1	Describe the transponder interface	2	Mode A, change procedure, SPI, Mode C, deselection, hijack
1.3.2	Be aware of the ACAS/TCAS display and future potential developments	0	Characteristics, accuracy, alerts, ADS B, CDTI
1.3.3	Be aware of the EGPWS display and of future potential developments	0	—

SUB-TOPIC 1.4: Displays

1.4.1	Describe the display types available and their advantages and disadvantages	2	Raster/rotating, raw/synthetic, monochrome/colour, CRT/LCD, performances (cost, availability, maintainability, ergonomics)

SUBJECT 3: SURVEILLANCE DATA TRANSMISSION

TOPIC 1: SURVEILLANCE DATA TRANSMISSION

SUB-TOPIC 1.1: Technology and protocols

1.1.1	Describe the implementation of formats and protocols	2	Network protocols, surveillance data networks *e.g. RADNET, messages CAT 1+*
1.1.2	Decode ASTERIX messages	3	*e.g. categories 1, 2, 20, 21, 34, 48, 62*
1.1.3	Identify the data transmission architecture in a multisensor environment	3	Fault tolerance, redundancy of line equipment *e.g. software fallback capability, contingency of service, RADNET*
1.1.4	Characterise the degradations of the surveillance transmission network	2	*e.g. saturation, excess latency*

SUB-TOPIC 1.2: Verification methods

1.2.1	Identify the causes of a fault, based on test tool measurements	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training e.g. data analyser, line analyser

SUBJECT 4: FUNCTIONAL SAFETY

TOPIC 1 SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to surveillance systems, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe the implications of functional failures in terms of exposure time, environment, effect on controller and effect on pilot	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

SUBJECT 5: DATA PROCESSING SYSTEMS

TOPIC 2: SYSTEM COMPONENTS

SUB-TOPIC 1.1: Surveillance data processing systems

1.1.1	Identify all functions of an SDP system	3	Plot processing, tracking, single-sensor and multisensor tracker (e.g. radar, ADS, MLAT), estimating limits and accuracy of multisensor tracker, recording *e.g. ARTAS tracker*
1.1.2	Describe all major components of an SDP	2	Functional architecture, technical architecture
1.1.3	Differentiate SDP features in the ATS units	2	Area Control Centres Approach Control Units Aerodrome Control Towers
1.1.4	Appreciate how to operate the system	3	*e.g. configuration, adjust parameters, start up and shut down, monitoring*
1.1.5	Explain the principles of emergency switching	2	—

Stream DATA — DATA PROCESSING

SUBJECT 1: FUNCTIONAL SAFETY

TOPIC 1: FUNCTIONAL SAFETY

SUB-TOPIC 1.1: Functional safety

1.1.1	Describe the implications of functional failure in terms of exposure time, environment, effect on controller and effect on pilot	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

SUB-TOPIC 1.2: Software integrity and security

1.2.1	Appreciate how a system can be defended against potential hostile intent via the data processing systems	3	Input verification, secure sources *e.g. leased lines, private networks, eligibility*
1.2.2	Explain how the normal output of a system could be used by non-authorised persons with hostile intent	2	*e.g. terrorists using radar data to coordinate an attack*
1.2.3	Estimate the impact of security and integrity failure to the operational service	3	*e.g. system crashes due to incorrect input data, main and standby and fallback systems all have same input, possible loss in total of system, results in capacity reductions and safety consequences*
1.2.4	Appreciate error detection and handling in data, hardware and process	3	Identification, consequence, scope, reporting, fault tolerance, soft fail, failsafe, monitoring, fallback

TOPIC 2: SAFETY ATTITUDE

SUB-TOPIC 2.1: Safety attitude

2.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to data processing systems, safety monitoring

SUBJECT 2: DATA PROCESSING SYSTEMS

TOPIC 1: USER REQUIREMENTS

SUB-TOPIC 1.1: Controller requirements

1.1.1	Explain ATCO missions and services needed in an area control centre	2	Operational requirements *e.g. separation, flight progress monitoring and coordination, trajectory prediction, coordination with adjacent centres*
1.1.2	Explain ATCO missions and services needed in an approach control unit	2	Operational requirements *e.g. vectoring, sequencing, AMAN, CDM*
1.1.3	Explain ATCO missions and services needed in an aerodrome control tower	2	Operational requirements *e.g. runway management, DMAN*

SUB-TOPIC 1.2: Trajectories, prediction and calculation

1.2.1	State different types of trajectories	1	*e.g. FPL-based, surveillance data-based, FMS-based*
1.2.2	Explain the main processes for trajectory prediction	2	SDP trajectory, FPL trajectory, merged trajectory, predicted trajectory

SUB-TOPIC 1.3: Ground safety nets

1.3.1	Describe the function of safety nets and their legal status	2	STCA, APW, MSAW, ASMGCS-based safety nets

SUB-TOPIC 1.4: Decision support

1.4.1	Explain the major steps in the air traffic planning process	2	ATFCM with strategic, pre-tactical and tactical, ATC sector planning, tactical control
1.4.2	Explain the principles of trajectory prediction, conformance monitoring and medium term conflict detection processes	2	Route adherence monitoring *e.g. CORA, MTCD, CLAM, Level adherence monitoring*
1.4.3	Explain the benefit of these tools for safety and efficiency	2	—

TOPIC 2: SYSTEM COMPONENTS

SUB-TOPIC 2.1: Processing systems

2.1.1	Describe all major components of a data processing system	2	Functional architecture, technical architecture, supervision

SUB-TOPIC 2.2: Flight data processing systems

2.2.1	Identify all functions of an FDP system	3	FDPS reference model, message handling, initial flight data handling, relationship with other functions, air-ground data link processing, trajectory prediction, flight data management and distribution, SSR Mode A code assignment and management, correlation, coordination and transfer
2.2.2	Describe all major components of an FDP	2	Functional architecture, technical architecture e.g. HMI, ATC tools, support tools (technical supervision, QoS monitors and logging)
2.2.3	Differentiate FDP features in the ATS units	2	Area control centres Approach control units Aerodrome control towers
2.2.4	Appreciate how to operate the system	3	*e.g. configuration, adjust parameters, start up and shut down, monitoring*
2.2.5	Explain the principles of emergency switching	2	—

SUB-TOPIC 2.3: Surveillance data processing systems

2.3.1	Identify all functions of an SDP system	3	Plot processing, tracking, single sensor and multisensor tracker (e.g. radar, ADS, MLAT), estimating limits and accuracy of multisensor tracker, recording *e.g. ARTAS tracker*
2.3.2	Describe all major components of an SDP	2	Functional architecture, technical architecture
2.3.3	Differentiate SDP features in the ATS units	2	Area control centres Approach control units Aerodrome control towers
2.3.4	Appreciate how to operate the system	3	*e.g. configuration, adjust parameters, start up and shut down, monitoring*
2.3.5	Explain the principles of emergency switching	2	—

SUBJECT 3: DATA PROCESS

TOPIC 1: SOFTWARE PROCESS

SUB-TOPIC 1.1: Middleware

1.1.1	Define middleware	1	Additional specialised functional built on the OS
1.1.2	List the middleware used on the national major systems	1	*e.g. CORBA, UBSS, OTM, EJB*
1.1.3	Demonstrate the use of a middleware in an ATM environment	2	Duel processing system

SUB-TOPIC 1.2: Operating systems

1.2.1	Describe the major aspects of a relevant operating system	2	*e.g. design, start-up, configuration, back-up and restore*
1.2.2	Perform relevant operating system commands	3	—
1.2.3	Characterise typical consequences of an OS upgrade	2	Some possible implications on HW (performance, memory), middleware (compatibility) and SW components
1.2.4	Explain downward compatibility	2	Checks on embedded SW modules ability to run under new OS version
1.2.5	Take account of hardware/software compatibility	2	Examples of HW requirements of specific SW implementations
1.2.6	Describe interactions between application and OS	2	Examples of OS calls by the application software if no middleware is in use
1.2.7	Describe the life cycle management of an operating system	2	*e.g. versions, releases, patches, migration*

SUB-TOPIC 1.3: Configuration control

1.3.1	Describe the principles of configuration control	2	Clear identification of all versions, proof of testing and 'build state', tool and mechanisms to aid control, authorisation, audit trail, appropriate quality standard requirements of the administration

SUB-TOPIC 1.4: Software development process

1.4.1	State the main software development processes	1	SWALs *e.g. life cycle, waterfall model, RUP*
1.4.2	List the main steps of two of the main software development processes	1	—
1.4.3	Explain the main differences between two software development processes	2	*e.g. advantages/disadvantages*

TOPIC 2: HARDWARE PLATFORM

SUB-TOPIC 2.1: Equipment upgrade

2.1.1	Explain the key factors that have to be considered when data processing equipment is upgraded or changed	2	Specification, compatibility, 'proven' or 'state-of-the-art' technology, maintenance and operating consequence (e.g. personnel, training, spares, procedures), environmental requirements (e.g. size, power requirements, temperature, interfaces), testing

SUB-TOPIC 2.2: COTS

2.2.1	Explain the advantages and disadvantages of commercial off-the-shelf equipment	2	Cost, multiplicity of suppliers, quality, maintainability, life cycle, liability

SUB-TOPIC 2.3: Interdependence

2.3.1	Describe the technical issues regarding the interdependence of various equipment and systems	2	Interface requirements, common point of failure, data conditioning, response time

SUB-TOPIC 2.4: Maintainability

2.4.1	Identify the issues that will affect the maintainability of hardware for the planned life of a system	3	Commercial product life, commercial support commitments, company volatility, spares provision, shelf life and logistics

TOPIC 3: TESTING

SUB-TOPIC 3.1: Testing

3.1.1	Appreciate the techniques available for system and performance requirements testing	3	*e.g. code walkthrough, modelling, simulation real time and fast time, black box testing, formal methods, use of independent test personnel, data corruption simulation, hardware failure simulation*
3.1.2	Appreciate the techniques available for system testing and integration	3	*e.g. system integration testing, load testing, regression testing*

SUBJECT 4: — DATA

TOPIC 1: DATA ESSENTIALS FEATURES

SUB-TOPIC 1.1: Data significance

1.1.1	Explain the significance of data	2	Criticality (critical/non critical), legality (ICAO, CAA, organisation), use (advisory, control)

SUB-TOPIC 1.2: Data configuration control

1.2.1	Explain the control procedures for changes to operational data	2	Designated roles/persons for authorising changes and verifying/checking changes

SUB-TOPIC 1.3 Data Standards

1.3.1	Name the authority responsible for standards	1	*e.g. EUROCONTROL, ICAO, ISO*
1.3.2	State the standards related to ATM data, their sources and their status	1	*e.g. ASTERIX, WGS84, OLDI, FMTP, AMHS, ADEX-P, FPL*
1.3.3	Decode a typical OLDI message	3	*e.g. ACT, PAC*
1.3.4	State the nature of ATM processing requirements	1	Data volatility (e.g. radar), system integrity, consequence of failure

TOPIC 2: ATM DATA DETAILED STRUCTURE

SUB-TOPIC 2.1: System area

2.1.1	Describe how a system area is defined	2	*e.g. size, system centre (reference point)*
2.1.2	Describe the data related to the system area	2	*e.g. radar data, flight plan data, maps, coordinates*

SUB-TOPIC 2.2: Characteristic points

2.2.1	State types of characteristic points used in an ATM system and their structure	1	Geographic, routing, sector *e.g. Geographic: airports and runways, ILS, radar, limit points* *Routing and sectors: coded routes, SID allocation parameters, area navigation waypoints, adjacent FIRs, holding, sectors*
2.2.2	Explain the importance of characteristic points in the correct presentation of data	2	—
2.2.3	Describe the process by which amended adaptation files are introduced	2	—

SUB-TOPIC 2.3: Aircraft performances

2.3.1	List the performance data used in FDPS	1	Example of data from in-house system
2.3.2	Describe the structure of aircraft performance data	2	—
2.3.3	*Define* speeds, rates and levels	1	—
2.3.4	Explain the consequences of the use of the wrong type of aircraft	2	—

SUB-TOPIC 2.4: Screen manager

2.4.1	Describe how the screen manager is used to set up the ATC HMI	2	—

SUB-TOPIC 2.5: Auto-coordination messages

2.5.1	Describe the meaning of coordination messages in the control process	2	Coordination parameters, conditions groups, OLDI conditions groups, characteristics of remote centres
2.5.2	Describe the characteristics of the remote centres relevant to OLDI	2	Civil and military

SUB-TOPIC 2.6: Configuration control data

2.6.1	Explain the structure of the configuration data	2	Sector CSU link, sectorisation plan, control parameters

SUB-TOPIC 2.7: Physical configuration data

2.7.1	Explain the structure of the physical configuration data	2	External configuration, device configuration

SUB-TOPIC 2.8: Relevant meteorology data

2.8.1	Explain the organisation of the data related to meteorology	2	Meteorology, QNH TL areas, CB activity

SUB-TOPIC 2.9: Alert and error messages to ATSEP

2.9.1	Explain the importance of alert and error messages	2	—
2.9.2	Describe different categories of two alert and error messages	2	—

SUB-TOPIC 2.10 Alert and error messages to ATCO

2.10.1	Describe the structure of the data used in these types of message	2	MSAW, conflict alert parameters
2.10.2	Explain alerts and error messages, and their importance from an ATCO point of view	2	*e.g. MSAW, conflict alert, MTCD*

SUBJECT 5: COMMUNICATION DATA

TOPIC 1: INTRODUCTION TO NETWORKS

SUB-TOPIC: 1.1 Types

1.1.1	State the evolution of network topologies	1	LAN, WAN e.g. architectures, size of the segments, length of the systems, quality of service
1.1.2	Explain how networks meet requirements	2	Redundancy, bandwidth, BER, time delay, network security

SUB-TOPIC 1.2: Networks

1.2.1	Analyse the features of a network	4	Routing scheme, rate, internal networking, routers, bridges, gateways, modems, switches, firewalls *e.g. wireless networks*
1.2.2	Describe network standards and devices	2	Ethernet, fibre optic, wireless
1.2.3	Appreciate the replacement of components in a network in a safe way	3	Continuity of service, network integrity Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training

SUB-TOPIC 1.3: External network services

1.3.1	Define aspects of external network services	1	Provided QoS *e.g. SLAs*

SUB-TOPIC 1.4: Measuring tools

1.4.1	Operate the usual set of network measuring or monitoring tools to find the values of the main parameters	3	Data analyser (sniffer) *e.g. net scout*
1.4.2	Perform analysis to support fault-finding for correction	3	Data analyser (sniffer) *e.g. net scout*

SUB-TOPIC 1.5: Troubleshooting

1.5.1	Appreciate how to troubleshoot a network	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. broken lines, unusable network components, overload, integrity problems*

TOPIC 2: PROTOCOLS

SUB-TOPIC 2.1: Fundamental theory

2.1.1	Apply the principles of layers	3	Differences between layers *e.g. layer(s) of sniffer information*
2.1.2	Apply the principles of the addressing strategy	3	Masks, subnets IP addressing, MAC addressing *e.g. same logical network computers and* systems

2.1.3	Apply the principles of the routing strategy	3	Routing tables, priorities, fault tolerance, management of routing strategy, static and dynamic routing *e.g. unicast, multicast, broadcast*

SUB-TOPIC 2.2: General protocols

2.2.1	Describe the general protocols	2	TCP/IP (segments, packets, addressing) *e.g. X25, LAPB, pdH, sdH*
2.2.2	Analyse the general protocols using the appropriate tools and documentation	4	TCP/IP *e.g. X25, LAPB*

SUB-TOPIC 2.3: Specific protocols

2.3.1	Describe the specific protocols	2	*e.g. BATAP — ARINC 620, FMTP*

TOPIC 3: NATIONAL NETWORKS

SUB-TOPIC 3.1: National networks

3.1.1	Name the national networks to which the organisation is connected	1	*e.g. ANSP, MET, military, PTT, airlines, national network(s)*
3.1.2	Describe the interfaces between national and global networks	2	—

SUBJECT 6: SURVEILLANCE PRIMARY

TOPIC 1: ATC SURVEILLANCE

SUB-TOPIC 1.1: Use of PSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach PSR	2	Range, resolution, coverage, availability

SUBJECT 7: SURVEILLANCE SECONDARY

TOPIC 1: SSR AND MSSR

SUB-TOPIC 1.1: Use of SSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach SSR	2	Range, coverage, resolution, performance, update rate ICAO Doc 9684
1.1.2	Relate key parameters of SSR to system performance	4	Key parameters: rotation rate, PRF, interlaced modes, capacity, frequencies, power budget (uplink, downlink), monopulse techniques Consequences: FRUIT, garbling, side lobes reception and transmission, transponder availability, PD, 2nd recurrence replies

TOPIC 2: MODE S

SUB-TOPIC 2.1: Introduction to Mode S

2.1.1	Explain the need for and benefits of Mode S	2	Classical SSR limitations, resolution, accuracy, integrity, enhanced data (e.g. 25 ft resolution, aircraft ID, BDS information)
2.1.2	Explain the working principles of Mode S	2	Mode S interrogation, Mode S reply, Mode S uplink and downlink capability, Mode S formats/protocols, ELS, EHS
2.1.3	Explain the complementary use of Mode S and conventional SSR	2	Mode interlace pattern, operational use of all-call, roll-call
2.1.4	Explain Mode S implementation	2	Elementary and enhanced surveillance, II and SI codes, use of BDS

TOPIC 3: MULTILATERATION

SUB-TOPIC 3.1: MLAT principles

3.1.1	Explain the MLAT system architecture	2	Standards, transmitters and receivers, data processing/fusion, redundancy, performance, costs, timing solutions, etc.
3.1.2	Appreciate the principles of MLAT system	3	Triangulation, coverage, position calculation e.g. SCAS
3.1.3	Describe how to operate the system	2	Tracking, map creation and blanking
3.1.4	Describe testing possibilities for MLAT	2	*e.g. SASS-C*

SUBJECT 8: SURVEILLANCE — HMI

TOPIC 1: HMI

SUB-TOPIC 1.1: ATCO HMI

1.1.1	Describe the display types available	2	Video, synthetic, mixed
1.1.2	State the type of selections available	1	Source, range, maps, filters
1.1.3	Describe the advantages of different display types	2	Clarity, configurability, fallback, data integration

SUBJECT 9: SURVEILLANCE DATA TRANSMISSION

TOPIC 1: SURVEILLANCE DATA TRANSMISSION

SUB-TOPIC 1.1: Technology and protocols

1.1.1	Describe the implementation of formats and protocols	2	Network protocols, surveillance data networks (e.g. RADNET), messages CAT 1+
1.1.2	Decode ASTERIX messages	3	*e.g. categories 1, 2, 20, 21, 34, 48, 62*
1.1.3	Identify the data transmission architecture in a multisensor environment	3	Fault tolerance, redundancy of line equipment e.g. software fallback capability, contingency of service, RADNET

1.1.4	Characterise the degradations of the surveillance transmission network	2	*e.g. saturation, excess latency*

Stream SYSTEM MONITORING AND CONTROL — COMMUNICATION

SUBJECT 1: SMC — ANS STRUCTURE

TOPIC 1: ANSP ORGANISATION AND OPERATION

SUB-TOPIC 1.1: ANSP organisation and operation

1.1.1	Describe the SMC function within the organisation	2	What the SMC does, interfaces with other functions, similarities and major differences between SMC function at different sites
1.1.2	Describe the structure, roles and responsibilities of the SMC team and any direct interfaces	2	—
1.1.3	Explain the duties of the ATC supervisor	2	—

TOPIC 2: ANSP MAINTENANCE PROGRAM

SUB-TOPIC 2.1: Policy

2.1.1	Describe, in general terms, the ANSP maintenance policy	2	—
2.1.2	Describe the aspects of the maintenance policy that apply specifically to SMC	2	—

TOPIC 3: ATM CONTEXT

SUB-TOPIC 3.1: ATM Context

3.1.1	Describe the ATM requirements and the related services provided by the SMC	2	Service level agreements, working arrangements *e.g. ASM, ATFCM*

TOPIC 4: ANSP ADMINISTRATIVE PRACTICES

SUB-TOPIC 4.1: Administration

4.1.1	Describe any ANSP administrative procedures, specifically applicable to SMC	2	Any non-technical practices *e.g. security, access control (building and platform), safety, fire*

SUBJECT 2: SMC — ANS SYSTEM/EQUIPMENT

TOPIC 1: OPERATIONAL IMPACTS

SUB-TOPIC 1.1: Degradation or loss of system/equipment services

1.1.1	Describe the importance of monitoring system performance	2	—
1.1.2	Describe possible ways in which the SMC may become aware of degradation of services and/or systems	2	*e.g. monitoring systems, telephone calls, aural alerts, user complaint*

1.1.3	Take account of the end users/customers affected	2	*e.g. ATC Units, airports, airlines*
1.1.4	Appreciate the implications for end users/customers	3	—
1.1.5	Appreciate the appropriate actions to restore service	3	*e.g. switching, replacing, reconfiguration, calling external service provider*
1.1.6	Appreciate the need for appropriate communication before and after restoring service	3	*e.g. users, customers, external and internal providers*

TOPIC 2: USER POSITION FUNCTIONALITY AND OPERATION

SUB-TOPIC 2.1 User working position

2.1.1	Appreciate working position performance to agreed parameters	3	*e.g. ATCO, Met, ATSEP, airport positions*

SUB-TOPIC 2.2: SMC working position

2.2.1	Appreciate SMC working position performance to agreed parameters	3	—

SUBJECT 3: SMC — TOOLS, PROCESSES AND PROCEDURES

TOPIC 1: REQUIREMENTS

SUB-TOPIC 1.1: SMS

1.1.1	Describe the ICAO and European requirements and the national and ATSP SMS	2	ICAO Annex 19, Annex IV to Regulation (EU) 2017/373

SUB-TOPIC 1.2: QMS

1.2.1	Describe the quality management system requirements	2	*e.g. ISO, EFQM*

SUB-TOPIC 1.3: SMS application in the working environment

1.3.1	Describe the relationship between the SMS and the application of SMC	2	Reporting procedures
1.3.2	Explain which occurrences require incident reporting and follow-up action(s)	2	*e.g. national categories for reporting, safety event processing*
1.3.3	Apply incident reporting procedures to example occurrence(s)	3	*e.g. safety event procedure*

TOPIC 2: MAINTENANCE AGREEMENTS WITH OUTSIDE AGENCIES REQUIREMENTS

SUB-TOPIC 2.1: Principles of agreements

2.1.1	Describe the principles and need for maintenance agreements	2	*e.g. types of service level provided*

2.1.2	Describe within which functional areas maintenance agreements will occur	2	*e.g. network providers, facilities management, communications*
2.1.3	Describe where in the SMS manual these agreements are included or referenced	2	—

TOPIC 3: SMC GENERAL PROCESSES

SUB-TOPIC 3.1: Roles and responsibilities

3.1.1	Describe the role and general method of operations of the SMC	2	—
3.1.2	Describe the need to monitor service conditions and the way to take appropriate action to ensure service performance	2	*e.g. process to interrupt services for planned maintenance purposes, management of service provision during corrective maintenance, continuity of service, availability*
3.1.3	Describe the coordination role of the SMC	2	*e.g. ATSEPs, ATCOs, external* service providers, ATM stakeholders
3.1.4	Describe how risk analysis can contribute towards decision-making	2	*e.g. assessing risk, handling of service interventions*

TOPIC 4: MAINTENANCE MANAGEMENT SYSTEMS

SUB-TOPIC 4.1: Reporting

4.1.1	Describe how maintenance activities and SMC events/actions are recorded	2	*e.g. procedures to follow, terminology to use, record keeping for traceability*
4.1.2	Explain the importance of accurate record keeping and dissemination for handover and quality management purposes	2	*e.g. information is logged in database or report is generated and distributed according to defined procedures*

SUBJECT 4: SMC — TECHNOLOGY

TOPIC 1: TECHNOLOGIES AND PRINCIPLES

SUB-TOPIC 1.1: General

1.1.1	Describe the principles of control and monitoring systems used	2	*e.g. national basis, colour codes, ergonomics*

SUB-TOPIC 1.2: Communication

1.2.1	Describe the key aspects of control and monitoring system capability	2	*e.g. parameters presented to the SMC and types of actions that can be taken*
1.2.2	Appreciate the impact of the replacement of components in a communication chain	3	Continuity of service, communication chain integrity

SUB-TOPIC 1.3: Facilities

1.3.1	Describe the key aspects of system management capability	2	*e.g. parameters presented to the SMC and types of actions that can be taken*
1.3.2	Appreciate the impact of the loss of supply and/or replacement of components in facility equipment	3	Continuity of service, integrity

SUBJECT 5: COMMUNICATION VOICE

TOPIC 1: AIR-GROUND

SUB-TOPIC 1.1: Controller working position

1.1.1	Describe the most common features of a controller working position	2	Frequency selection, emergency, station selection, coupling, headset, loudspeaker, footswitch, push to talk *e.g. microphone (noise cancelling), short time recording*

TOPIC 2: GROUND-GROUND

SUB-TOPIC 2.1: Interfaces

2.1.1	Describe the different types of interfaces	2	Analogue (2, 4, 6 and 8 wires), digital ISDN (64 Kb, 2 Mb)

SUB-TOPIC 2.2: Switch

2.2.1	State the similarities between ground-ground and air-ground switches	1	Switching techniques
2.2.2	Describe the most commonly used functionality of PABX	2	General architecture, digital, analogue, multiplex types, PCM30
2.2.3	Analyse conversion analogue-digital, digital-analogue	4	General architecture, analogue-digital-analogue

SUB-TOPIC 2.3: Controller working position

2.3.1	Describe the two most common features of a controller working position and the HMI	2	—

SUBJECT 6: COMMUNICATION DATA

TOPIC 1: EUROPEAN NETWORKS

SUB-TOPIC 1.1: Network technologies

1.1.1	State emerging network technologies	1	*e.g. as used in EAN, NEAN, AMHS, PENS*
1.1.2	Describe the characteristics of the current networks	2	Surveillance data, flight plan data and AIS networks e.g. CIDIN, OLDI, CFMU-RCA, quality of service, architecture, FMTP, AMHS

TOPIC 2: GLOBAL NETWORKS

SUB-TOPIC 2.1: Networks and standards

2.1.1	List the global networks and the standards on which they are based	1	*e.g. ICAO for AFTN/CIDIN/AMHS, ICAO for ATN, FANS 1 and FANS A for ACARS applications (SITA and ARINC)*

SUB-TOPIC 2.2: Description

2.2.1	Describe the characteristics of the AFTN networks	2	Users and data, architectures, quality of service

SUB-TOPIC 2.3: Global architecture

2.3.1	Describe the architecture of the ATN	2	Air-ground subnetworks, ground-ground subnetworks, airborne networks

SUB-TOPIC 2.4: Air-ground subnetworks

2.4.1	Describe air-ground subnetworks	2	VDL (mode 2), HFDL, AMSS, SATCOM

SUB-TOPIC 2.5: Ground-ground subnetworks

2.5.1	Describe the composition of ground-ground subnetworks	2	PTT, commercial telecom providers, ARINC, SITA

SUB-TOPIC 2.6: Air-ground applications

2.6.1	State the main communication applications using data link systems	1	*e.g. CPDLC, DLIC/AFN, ATIS, DCL*

SUBJECT 7: COMMUNICATION RECORDERS

TOPIC 1: LEGAL RECORDERS

SUB-TOPIC 1.1: Regulations

1.1.1	Explain international regulations	2	ICAO (recording and reproducing)
1.1.2	Explain national regulations	2	Appropriate national regulations
1.1.3	Explain how the service provider complies with the regulations	2	*e.g. storage media, access to recording and reproducing room, time to store information (overwrite/erase voice or data), procedure to reproduce information*

SUB-TOPIC 1.2: Principles

1.2.1	Explain the principles of recording and reproducing	2	*e.g. storage media (tape, optical and magnetic disc), A/D-D/A converters, frequency range (300 to 3 400 Hz), channel capacity, time synchronisation, connection to a network, synchronisation of radar and voice recording, replay limitations*

SUBJECT 8: NAVIGATION — PBN

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: NOTAM

1.1.1	Explain the need for NOTAMs	2	—

Stream SYSTEM MONITORING AND CONTROL — NAVIGATION

SUBJECT 1: SMC — ANS STRUCTURE

TOPIC 1: ANSP ORGANISATION AND OPERATION

SUB-TOPIC 1.1: ANSP organisation and operation

1.1.1	Describe the SMC function within the organisation	2	What the SMC does, interfaces with other functions, similarities and major differences between SMC function at different sites
1.1.2	Describe the structure, roles and responsibilities of the SMC team and any direct interfaces	2	—
1.1.3	Explain the duties of the ATC supervisor	2	—

TOPIC 2: ANSP MAINTENANCE PROGRAM

SUB-TOPIC 2.1: Policy

2.1.1	Describe, in general terms, the ANSP maintenance policy	2	—
2.1.2	Describe the aspects of the maintenance policy that apply specifically to SMC	2	—

TOPIC 3: ATM CONTEXT

SUB-TOPIC 3.1: ATM context

3.1.1	Describe the ATM requirements and the related services provided by the SMC	2	Service level agreements, working arrangements *e.g. ASM, AFTCM*

TOPIC 4: ANSP ADMINISTRATIVE PRACTICES

SUB-TOPIC 4.1: Administration

4.1.1	Describe any ANSP administrative procedures, specifically applicable to SMC	2	Any non-technical practices *e.g. security, access control (building and platform), safety, fire*

SUBJECT 2: SMC — ANS SYSTEM/EQUIPMENT

TOPIC 1: OPERATIONAL IMPACTS

SUB-TOPIC 1.1: Degradation or loss of system/equipment services

1.1.1	Describe the importance of monitoring system performance	2	—
1.1.2	Describe possible ways in which the SMC may become aware of degradation of services and/or systems	2	*e.g. monitoring systems, telephone calls, aural alerts, user complaint*

1.1.3	Take account of the end users/customers affected	2	*e.g. ATC units, airports, airlines*
1.1.4	Appreciate the implications for end users/customers	3	—
1.1.5	Appreciate the appropriate actions to restore service	3	*e.g. switching, replacing, reconfiguration, calling external service provider*
1.1.6	Appreciate the need for appropriate communication before and after restoring service	3	*e.g. users, customers, external and internal providers*

TOPIC 2: USER POSITION FUNCTIONALITY AND OPERATION

SUB-TOPIC 2.1: User working position

2.1.1	Appreciate working position performance to agreed parameters	3	*e.g. ATCO, MET, ATSEP, airport positions*

SUB-TOPIC 2.2: SMC working position

2.2.1	Appreciate SMC working position performance to agreed parameters	3	—

SUBJECT 3: SMC — TOOLS, PROCESSES AND PROCEDURES

TOPIC 1: REQUIREMENTS

SUB-TOPIC 1.1: SMS

1.1.1	Describe the ICAO and European requirements and the national and ATSP SMS	2	ICAO Annex 19

SUB-TOPIC 1.2: QMS

1.2.1	Describe the quality management system requirements	2	*e.g. ISO, EFQM*

SUB-TOPIC 1.3: SMS application in the working environment

1.3.1	Describe the relationship between the SMS and the application of SMC	2	Reporting procedures
1.3.2	Explain which occurrences require incident reporting and follow-up action(s)	2	*e.g. national categories for reporting, Safety Event Processing*
1.3.3	Apply incident reporting procedures to example occurrence(s)	3	*e.g. Safety Event Procedure*

TOPIC 2: MAINTENANCE AGREEMENTS WITH OUTSIDE AGENCIES REQUIREMENTS

SUB-TOPIC 2.1: Principles of agreements

2.1.1	Describe the principles and need for maintenance agreements	2	*e.g. types of service level provided*
2.1.2	Describe within which functional areas maintenance agreements will occur	2	*e.g. network providers, facilities management, communications*

2.1.3	Describe where in the SMS manual these agreements are included or referenced	2	—

TOPIC 3: SMC GENERAL PROCESSES

SUB-TOPIC 3.1: Roles and responsibilities

3.1.1	Describe the role and general method of operations of the SMC	2	—
3.1.2	Describe the need to monitor service conditions and the way to take appropriate action to ensure service performance	2	*e.g. process to interrupt services for planned maintenance purposes, management of service provision during corrective maintenance, continuity of service, availability*
3.1.3	Describe the coordination role of the SMC	2	*e.g. ATSEPs, ATCOs, external service providers, ATM stakeholders*
3.1.4	Describe how risk analysis can contribute towards decision-making	2	*e.g. assessing risk, handling of service interventions*

TOPIC 4: MAINTENANCE MANAGEMENT SYSTEMS

SUB-TOPIC 4.1: Reporting

4.1.1	Describe how maintenance activities and SMC events/actions are recorded	2	*e.g. procedures to follow, terminology to use, record keeping for traceability*
4.1.2	Explain the importance of accurate record keeping and dissemination for handover and quality management purposes	2	*e.g. information is logged in database or report is generated and distributed according to defined procedures*

SUBJECT 4: SMC — TECHNOLOGY

TOPIC 1: TECHNOLOGIES AND PRINCIPLES

SUB-TOPIC 1.1: General

1.1.1	Describe the principles of control and monitoring systems used	2	*e.g. national basis, colour codes, ergonomics*

SUB-TOPIC 1.3: Navigation

1.3.1	Describe the key aspects of control and monitoring system capability	2	e.g. parameters presented to the SMC and types of actions that can be taken
1.3.2	Appreciate the impact of the replacement of components in navigation equipment	3	Continuity of service, navigation aid integrity

SUB-TOPIC 1.6: Facilities

1.6.1	Describe the key aspects of system management capability	2	*e.g. parameters presented to the SMC and types of actions that can be taken*
1.6.2	Appreciate the impact of the loss of supply and/or replacement of components in facility equipment	3	Continuity of service, integrity

SUBJECT 5: COMMUNICATION DATA

TOPIC 1: EUROPEAN NETWORKS

SUB-TOPIC 1.1: Network technologies

1.1.1	State emerging network technologies	1	*e.g. as used in EAN, NEAN, AMHS, PENS*
1.1.2	Describe the characteristics of the current networks	2	Surveillance data, flight plan data and AIS networks *e.g. CIDIN, OLDI, CFMU-RCA, quality of service, architecture, FMTP, AMHS*

TOPIC 2: GLOBAL NETWORKS

SUB-TOPIC 2.1: Networks and standards

2.1.1	List the global networks and the standards on which they are based	1	e.g. ICAO for AFTN/CIDIN/AMHS, ICAO for ATN, FANS 1 and FANS A for ACARS applications (SITA and ARINC)

SUB-TOPIC 2.2: Description

2.2.1	Describe the characteristics of the AFTN networks	2	Users and data, architectures, quality of service

SUB-TOPIC 2.3: Global architecture

2.3.1	Describe the architecture of the ATN	2	Air-ground subnetworks, ground-ground subnetworks, airborne networks

SUB-TOPIC 2.4: Air-ground subnetworks

2.4.1	Describe the air-ground subnetworks	2	VDL (mode 2), HFDL, AMSS, SATCOM

SUB-TOPIC 2.5: Ground-ground subnetworks course

2.5.1	Describe the composition of ground-ground subnetworks	2	PTT, commercial telecom providers, ARINC, SITA

SUB-TOPIC 2.6: Air-ground applications

2.6.1	State the main communication applications using data link systems	1	*e.g. CPDLC, DLIC/AFN, ATIS, DCL*

SUBJECT 6: COMMUNICATION RECORDERS

TOPIC 1: LEGAL RECORDERS

SUB-TOPIC 1.1: Regulations

1.1.1	Explain international regulations	2	ICAO (recording and reproducing)
1.1.2	Explain national regulations	2	Appropriate national regulations
1.1.3	Explain how service providers comply with the regulations	2	*e.g. storage media, access to recording and reproducing room, time to store information (overwrite/erase voice or data), procedure to reproduce information.*

SUB-TOPIC 1.2: Principles

1.2.1	Explain the principles of recording and reproducing	2	*e.g. storage media (tape, optical and magnetic disc), A/D-D/A converters, frequency range (300 to 3 400 Hz), channel capacity, time synchronisation, connection to a network, synchronisation of radar and voice recording, replay limitations*

SUBJECT 7: NAVIGATION — PBN

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: NOTAM

1.1.1	Explain the need for NOTAMs	2	—

SUBJECT 8: NAVIGATION — GROUND-BASED SYSTEMS-NDB

TOPIC 1: NDB LOCATOR

SUB-TOPIC 1.1: Use of the system

1.1.1	Appreciate the principles of NDB	3	Relative bearing, measuring method
1.1.2	Describe the overall performance	2	Coverage, accuracy, availability of the system, integrity, continuity
1.1.3	Explain the technical limitations of NDB	2	Lack of accuracy, lack of integrity, sensitivity to interference
1.1.4	Describe the current situation	2	*e.g. number, type, users, user groups, European context*

SUBJECT 9: NAVIGATION — GROUND-BASED SYSTEMS-DF

TOPIC 1: DF

SUB-TOPIC 1.1: Use of the system

1.1.1	State the different types of DF	1	VDF, DDF, IDF
1.1.2	Describe the user HMI	2	Indication on radar picture, DF indicator
1.1.3	Appreciate the principles of DF	3	Bearing, measuring method (standard, Doppler, interferometry)
1.1.4	Describe the overall performance	2	Coverage, accuracy, availability of the system, integrity, continuity
1.1.5	Explain the technical limitations of DF	2	Sensitivity to interference
1.1.6	Describe the current situation	2	*e.g. number, type, users, national context*

SUBJECT 10: NAVIGATION — GROUND-BASED SYSTEMS-VOR

TOPIC 1 VOR

SUB-TOPIC 1.1: Use of the system

1.1.1	State the types of VOR Systems	1	Conventional, doppler
1.1.2	Describe the overall performance	2	Coverage, accuracy, availability of the system, integrity, continuity

1.1.3	Explain the technical limitations of CVOR	2	Type of information (azimuth), accuracy, integrity, suitable for a network of fixed routes
1.1.4	Appreciate the differences between CVOR and DVOR	3	Signal broadcast differences, bearing information robustness
1.1.5	Describe the current situation	2	*e.g. number, type, users, user groups, national context, European context*

SUBJECT 11: NAVIGATION — GROUND-BASED SYSTEMS-DME

TOPIC 1: DME

SUB-TOPIC 1.1: Use of the system

1.1.1	Describe the overall performances for DME	2	Coverage, accuracy, availability of the system, integrity, continuity, number of users
1.1.2	Explain the limitations of DME	2	Accuracy, integrity, capacity
1.1.3	Describe the current situation	2	*e.g. number, types, users, user groups, national context, European context*
1.1.4	State the role of the DME infrastructure in the future navigation applications	1	PBN
1.1.5	Explain the differences between DME and TACAN for civilian use	2	*e.g. azimuth and range*

SUBJECT 12: NAVIGATION — GROUND-BASED SYSTEMS-ILS

TOPIC 1: ILS

SUB-TOPIC 1.1: Use of the system

1.1.1	Describe the overall performances for ILS	2	ICAO Annexes 10 and 14 Coverage, accuracy, availability of the system, integrity, continuity, number of users
1.1.2	Explain the technical limitations of ILS	2	ICAO Annexes 10 and 14 Only 40 channels, no segmented paths of approach, beam corruption due to multi-path
1.1.3	Interpret ILS Facility Performance Categories	5	ICAO Annexes 10 and 14 Cat I, Cat II, Cat III Different operational category depending on operational minima, equipment and airport facilities
1.1.4	Define obstacle free zones for ILS components	1	ICAO Annexes 10 and 14 Dimensions *e.g. national regulations*
1.1.5	Explain the importance and need for ILS obstacle free zones	2	ILS beam protection, increased significance during LVP conditions
1.1.6	Explain the current situation	2	*e.g. number, type, users, national context*

1.1.7	Consider the need for ATC ILS status indications	2	No continuous monitoring by ATSEP

Stream SYSTEM MONITORING AND CONTROL — SURVEILLANCE

SUBJECT 1: SMC — ANS STRUCTURE

TOPIC 1: ANSP ORGANISATION AND OPERATION

SUB-TOPIC 1.1: ANSP organisation and operation

1.1.1	Describe the SMC function within the organisation	2	What the SMC does, interfaces with other functions, similarities and major differences between SMC function at different sites
1.1.2	Describe the structure, roles and responsibilities of the SMC team and any direct interfaces	2	—
1.1.3	Explain the duties of the ATC supervisor	2	—

TOPIC 2: ANSP MAINTENANCE PROGRAM

SUB-TOPIC 2.1: Policy

2.1.1	Describe, in general terms, the ANSP maintenance policy	2	—
2.1.2	Describe the aspects of the maintenance policy that apply specifically to SMC	2	—

TOPIC 3: ATM CONTEXT

SUB-TOPIC 3.1: ATM context

3.1.1	Describe the ATM requirements and the related services provided by the SMC	2	Service level agreements, working arrangements *e.g. ASM, AFTCM*

TOPIC 4: ANSP ADMINISTRATIVE PRACTICES

SUB-TOPIC 4.1: Administration

4.1.1	Describe any ANSP administrative procedures, specifically applicable to SMC	2	Any non-technical practices *e.g. security, access control (building and platform), safety, fire*

SUBJECT 2: SMC — ANS SYSTEM/EQUIPMENT

TOPIC 1: OPERATIONAL IMPACTS

SUB-TOPIC 1.1: Degradation or loss of system/equipment services

1.1.1	Describe the importance of monitoring system performance	2	—
1.1.2	Describe possible ways in which the SMC may become aware of degradation of services and/or systems	2	*e.g. monitoring systems, telephone calls, aural alerts, user complaint*

1.1.3	Take account of the end users/customers affected	2	*e.g. ATC units, airports, airlines*
1.1.4	Appreciate the implications for end users/customers	3	—
1.1.5	Appreciating the appropriate actions to restore service	3	*e.g. switching, replacing, reconfiguration, calling external service provider*
1.1.6	Appreciate the need for appropriate communication before and after restoring service	3	*e.g. users, customers, external and internal providers*

TOPIC 2: USER POSITION FUNCTIONALITY AND OPERATION

SUB-TOPIC 2.1: User working position

2.1.1	Appreciate working position performance to agreed parameters	3	*e.g. ATCO, MET, ATSEP, airport positions*

SUB-TOPIC 2.2: SMC working position

2.2.1	Appreciate SMC working position performance to agreed parameters	3	—

SUBJECT 3: SMC — TOOLS, PROCESSES AND PROCEDURES

TOPIC 1: REQUIREMENTS

SUB-TOPIC 1.1: SMS

1.1.1	Describe the ICAO and European requirements and the national and ATSP SMS	2	ICAO Annex 19

SUB-TOPIC 1.2: QMS

1.2.1	Describe the quality management system requirements	2	*e.g. ISO, EFQM*

SUB-TOPIC 1.3: SMS application in the working environment

1.3.1	Describe the relationship between the SMS and the application of SMC	2	Reporting procedures
1.3.2	Explain which occurrences require incident reporting and follow-up action(s)	2	*e.g. national categories for reporting, safety event processing*
1.3.3	Apply incident reporting procedures to example occurrence(s)	3	*e.g. safety event procedure*

TOPIC 2: MAINTENANCE AGREEMENTS WITH OUTSIDE AGENCIES REQUIREMENTS

SUB-TOPIC 2.1: Principles of agreements

2.1.1	Describe the principles and need for maintenance agreements	2	*e.g. types of service level provided*
2.1.2	Describe within which functional areas maintenance agreements will occur	2	*e.g. network providers, facilities management, communications*
2.1.3	Describe where in the SMS Manual these agreements are included or referenced	2	—

TOPIC 3: SMC GENERAL PROCESSES

SUB-TOPIC 3.1: Roles and responsibilities

3.1.1	Describe the role and general method of operations of the SMC	2	—
3.1.2	Describe the need to monitor service conditions and the way to take appropriate action to ensure service performance	2	*e.g. process to interrupt services for planned maintenance purposes, management of service provision during corrective maintenance, continuity of service, availability*
3.1.3	Describe the coordination role of the SMC	2	*e.g. ATSEPs, ATCOs, external service providers, ATM stakeholders*
3.1.4	Describe how risk analysis can contribute towards decision-making	2	*e.g. assessing risk, handling of service interventions*

TOPIC 4: MAINTENANCE MANAGEMENT SYSTEMS

SUB-TOPIC 4.1: Reporting

4.1.1	Describe how maintenance activities and SMC events/actions are recorded	2	*e.g. procedures to follow, terminology to use, record keeping for traceability*
4.1.2	Explain the importance of accurate record keeping and dissemination for handover and quality management purposes	2	*e.g. information is logged in database or report is generated and distributed according to defined procedures*

SUBJECT 4: SMC — TECHNOLOGY

TOPIC 1: TECHNOLOGIES AND PRINCIPLES

SUB-TOPIC 1.1: General

1.1.1	Describe the principles of control and monitoring systems used	2	*e.g. national basis, colour codes, ergonomics*

SUB-TOPIC 1.4 Surveillance

1.4.1	Describe the key aspects of control and monitoring system capability	2	e.g. parameters presented to the SMC and types of actions that can be taken
1.4.2	Appreciate the impact of the replacement of components in a	3	Continuity of service, surveillance chain integrity

	surveillance chain		

SUB-TOPIC 1.6 Facilities

1.6.1	Describe the key aspects of system management capability	2	*e.g. parameters presented to the SMC and types of actions that can be taken*
1.6.2	Appreciate the impact of the loss of supply and/or replacement of components in facility equipment	3	Continuity of service, integrity

SUBJECT 5: COMMUNICATION DATA

TOPIC 1: EUROPEAN NETWORKS

SUB-TOPIC 1.1: Network technologies

1.1.1	State emerging network technologies	1	*e.g. as used in EAN, NEAN, AMHS, PENS*
1.1.2	Describe the characteristics of the current networks	2	Surveillance data, flight plan data and AIS networks *e.g. CIDIN, OLDI, CFMU-RCA, quality of service, architecture, FMTP, AMHS*

TOPIC 2: GLOBAL NETWORKS

SUB-TOPIC 2.1: Networks and standards

2.1.1	List the global networks and the standards on which they are based	1	*e.g. ICAO for AFTN/CIDIN/AMHS, ICAO for ATN, FANS 1 and FANS A for ACARS applications (SITA and ARINC)*

SUB-TOPIC 2.2: Description

2.2.1	Describe the characteristics of the AFTN networks	2	Users and data, architectures, quality of service

SUB-TOPIC 2.3: Global architecture

2.3.1	Describe the architecture of the ATN	2	Air-ground subnetworks, ground-ground subnetworks, airborne networks

SUB-TOPIC 2.4: Air-ground subnetworks

2.4.1	Describe the air-ground subnetworks	2	VDL (mode 2), HFDL, AMSS, SATCOM

SUB-TOPIC 2.5: Ground-ground subnetworks

2.5.1	Describe the composition of ground-ground subnetworks	2	PTT, commercial telecom providers, ARINC, SITA

SUB-TOPIC 2.6: Air-ground applications

2.6.1	State the main communication applications using data link systems	1	*e.g. CPDLC, DLIC/AFN, ATIS, DCL*

SUBJECT 6: COMMUNICATION RECORDERS

TOPIC 1: LEGAL RECORDERS

SUB-TOPIC 1.1: Regulations

1.1.1	Explain the international regulations	2	ICAO (recording and reproducing)
1.1.2	Explain national regulations	2	Appropriate national regulations
1.1.3	Explain how service providers comply with the regulations	2	*e.g. storage media, access to recording and reproducing room, time to store information (overwrite/erase voice or data), procedure to reproduce information*

SUB-TOPIC 1.2: Principles

1.2.1	Explain the principles of recording and reproducing	2	*e.g. storage media (tape, optical and magnetic disc), A/D-D/A converters, frequency range (300 to 3 400 Hz), channel capacity, time synchronisation, connection to a network, synchronisation of radar and voice recording, replay limitations*

SUBJECT 7: NAVIGATION — PBN

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: NOTAM

1.1.1	Explaining the need for NOTAMs	2	—

SUBJECT 8: SURVEILLANCE — PRIMARY

TOPIC 1: ATC SURVEILLANCE

SUB-TOPIC 1.1: Use of PSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach PSR	2	Range, resolution, coverage, availability

SUBJECT 9: SURVEILLANCE — SECONDARY

TOPIC 1: SSR AND MSSR

SUB-TOPIC 1.1: Use of SSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach SSR	2	Range, coverage, resolution, performance, update rate ICAO Doc 9684

TOPIC 2: MODE S

SUB-TOPIC 2.1: Introduction to Mode S

2.1.1	Explain the need for and benefits of Mode S	2	Classical SSR limitations, resolution, accuracy, integrity, enhanced data (e.g. 25 ft resolution, aircraft ID, BDS information)
2.1.2	Explain the working principles of Mode S	2	Mode S interrogation, Mode S reply, Mode S uplink and downlink capability, Mode S formats/protocols, ELS, EHS
2.1.3	Explain the complementary use of Mode S and conventional SSR	2	Mode Interlace Pattern, Operational use of All- call, Roll-call
2.1.4	Explain Mode S implementation	2	Elementary and enhanced surveillance, II and SI codes, use of BDS

TOPIC 3: MULTILATERATION

SUB-TOPIC 3.1: MLAT principles

3.1.1	Explain the MLAT system architecture	2	Standards, transmitters and receivers, data processing/fusion, redundancy, performance, costs, timing solutions, etc.
3.1.2	Appreciate the principles of MLAT system	3	Triangulation, coverage, position calculation *e.g. SCAS*
3.1.3	Describe how to operate the system	2	Tracking, map creation and blanking
3.1.4	Describe testing possibilities for MLAT	2	*e.g. SASS-C*

SUBJECT 10: SURVEILLANCE — HMI

TOPIC 1: HMI

SUB-TOPIC 1.1: ATCO HMI

1.1.1	Describe the display types available	2	Video, synthetic, mixed
1.1.2	State the type of selections available	1	Source, range, maps, filters
1.1.3	Describe the advantages of different display types	2	Clarity, configurability, fallback, data integration

SUBJECT 11: SURVEILLANCE — DATA TRANSMISSION

TOPIC 1: SURVEILLANCE DATA TRANSMISSION

SUB-TOPIC 1.1: Technology and protocols

1.1.1	Describe the implementation of formats and protocols	2	Network protocols, surveillance data networks *e.g. RADNET, messages CAT 1+*
1.1.2	Decode ASTERIX messages	3	*e.g. categories 1, 2, 20, 21, 34, 48, 62*
1.1.3	Identify the data transmission architecture in a multisensor environment	3	Fault tolerance, redundancy of line equipment *e.g. software fallback capability, contingency of service, RADNET*

1.1.4	Characterise the degradations of the surveillance transmission network	2	*e.g. saturation, excess latency*

Stream SYSTEM MONITORING AND CONTROL — DATA

SUBJECT 1: SMC — ANS STRUCTURE

TOPIC 1: ANSP ORGANISATION AND OPERATION

SUB-TOPIC 1.1: ANSP organisation and operation

1.1.1	Describe the SMC function within the organisation	2	What the SMC does, interfaces with other functions, similarities and major differences between SMC function at different sites
1.1.2	Describe the structure, roles and responsibilities of the SMC team and any direct interfaces	2	—
1.1.3	Explain the duties of the ATC supervisor	2	—

TOPIC 2: ANSP MAINTENANCE PROGRAM

SUB-TOPIC 2.1: Policy

2.1.1	Describe, in general terms, the ANSP maintenance policy	2	—
2.1.2	Describe the aspects of the maintenance policy that apply specifically to SMC	2	—

TOPIC 3: ATM CONTEXT

SUB-TOPIC 3.1: ATM context

3.1.1	Describe the ATM requirements and the related services provided by the SMC	2	Service level agreements, working arrangements *e.g. ASM, AFTCM*

TOPIC 4: ANSP ADMINISTRATIVE PRACTICES

SUB-TOPIC 4.1: Administration

4.1.1	Describe any ANSP administrative procedures, specifically applicable to SMC	2	Any non-technical practices e.g. security, access control (building and platform), safety, fire

SUBJECT 2: SMC — ANS SYSTEM/EQUIPMENT

TOPIC 1: OPERATIONAL IMPACTS

SUB-TOPIC 1.1: Degradation or loss of system/equipment services

1.1.1	Describe the importance of monitoring system performance	2	—
1.1.2	Describe possible ways in which the SMC may become aware of degradation of services and/or systems	2	*e.g. monitoring systems, telephone calls, aural alerts, user complaint*

1.1.3	Take account of the end users/customers affected	2	*e.g. ATC Units, airports, airlines*
1.1.4	Appreciate the implications for end users/customers	3	—
1.1.5	Appreciate the appropriate actions to restore service	3	*e.g. switching, replacing, reconfiguration, calling external service provider*
1.1.6	Appreciate the need for appropriate communication before and after restoring service	3	*e.g. users, customers, external and internal providers*

TOPIC 2: USER POSITION FUNCTIONALITY AND OPERATION

SUB-TOPIC 2.1: User working position

2.1.1	Appreciate working position performance to agreed parameters	3	*e.g. ATCO, MET, ATSEP, airport positions*

SUB-TOPIC 2.2: SMC working position

2.2.1	Appreciate SMC working position performance to agreed parameters	3	—

SUBJECT 3: SMC — TOOLS, PROCESSES AND PROCEDURES

TOPIC 1: REQUIREMENTS

SUB-TOPIC 1.1: SMS

1.1.1	Describe the ICAO and European requirements and the national and ATSP SMS	2	ICAO Annex 19, Annex II to Regulation (EU) 2017/373.

SUB-TOPIC 1.2: QMS

1.2.1	Describe the quality management system requirements	2	*e.g. ISO, EFQM*

SUB-TOPIC 1.3: SMS application in the working environment

1.3.1	Describe the relationship between the SMS and the application of SMC	2	Reporting procedures
1.3.2	Explain which occurrences require incident reporting and follow-up action(s)	2	*e.g. national categories for reporting, safety event processing*
1.3.3	Apply incident reporting procedures to example occurrence(s)	3	*e.g. safety event procedure*

TOPIC 2: MAINTENANCE AGREEMENTS WITH OUTSIDE AGENCIES REQUIREMENTS

SUB-TOPIC 2.1: Principles of agreements

2.1.1	Describe the principles and need for maintenance agreements	2	*e.g. types of service level provided*
2.1.2	Describe within which functional areas maintenance agreements will occur	2	*e.g. network providers, facilities management, communications*

2.1.3	Describe where in the SMS Manual these agreements are included or referenced	2	—

TOPIC 3: SMC GENERAL PROCESSES

SUB-TOPIC 3.1: Roles and responsibilities

3.1.1	Describe the role and general method of operations of the SMC	2	—
3.1.2	Describe the need to monitor service conditions and the way to take appropriate action to ensure service performance	2	*e.g. process to interrupt services for planned maintenance purposes, management of service provision during corrective maintenance, continuity of service, availability*
3.1.3	Describe the coordination role of the SMC	2	*e.g. ATSEPs, ATCOs, external service providers, ATM stakeholders*
3.1.4	Describe how risk analysis can contribute towards decision-making	2	*e.g. assessing risk, handling of service interventions*

TOPIC 4: MAINTENANCE MANAGEMENT SYSTEMS

SUB-TOPIC 4.1: Reporting

4.1.1	Describe how maintenance activities and SMC events/actions are recorded	2	*e.g. procedures to follow, terminology to use, record keeping for traceability*
4.1.2	Explain the importance of accurate record keeping and dissemination for handover and quality management purposes	2	*e.g. information is logged in database or report is generated and distributed according to defined procedures*

SUBJECT 4: SMC — TECHNOLOGY

TOPIC 1: TECHNOLOGIES AND PRINCIPLES

SUB-TOPIC 1.1: General

1.1.1	Describe the principles of control and monitoring systems used	2	*e.g. national basis, colour codes, ergonomics*

SUB-TOPIC 1.5: Data processing

1.5.1	Describe the key aspects of control and monitoring system capability	2	e.g. parameters presented to the SMC and types of actions that can be taken
1.5.2	Appreciate the impact of the replacement of components in data processing chain	3	Continuity of service, data processing, chain integrity

SUB-TOPIC 1.6: Facilities

1.6.1	Describe the key aspects of system management capability	2	*e.g. parameters presented to the SMC and types of actions that can be taken*
1.6.2	Appreciate the impact of the loss of supply and/or replacement of components in facility equipment	3	Continuity of service, integrity

SUBJECT 5: COMMUNICATION DATA

TOPIC 1: EUROPEAN NETWORKS

SUB-TOPIC 1.1: Network technologies

1.1.1	State emerging network technologies	1	*e.g. as used in EAN, NEAN, AMHS, PENS*
1.1.2	Describe the characteristics of the current networks	2	Surveillance data, flight plan data and AIS networks *e.g. CIDIN, OLDI, CFMU-RCA, quality of service, architecture, FMTP, AMHS*

TOPIC 2: GLOBAL NETWORKS

SUB-TOPIC 2.1: Networks and standards

2.1.1	List the global networks and the standards on which they are based	1	*e.g. ICAO for AFTN/CIDIN/AMHS, ICAO for ATN, FANS 1 and FANS A for ACARS applications (SITA and ARINC)*

SUB-TOPIC 2.2: Description

2.2.1	Describe the characteristics of the AFTN networks	2	Users and data, architectures, quality of service

SUB-TOPIC 2.3: Global architecture

2.3.1	Describe the architecture of the ATN	2	Air-ground subnetworks, ground-ground subnetworks, airborne networks

SUB-TOPIC 2.4: Air-ground subnetworks

2.4.1	Describe the air-ground subnetworks	2	VDL (mode 2), HFDL, AMSS, SATCOM

SUB-TOPIC 2.5: Ground-ground subnetworks

2.5.1	Describe the composition of ground-ground subnetworks	2	PTT, commercial telecom providers, ARINC, SITA

SUB-TOPIC 2.6: Air-ground applications

2.6.1	State the main communication applications using data link systems	1	*e.g. CPDLC, DLIC/AFN, ATIS, DCL*

SUBJECT 6: COMMUNICATION RECORDERS

TOPIC 1: LEGAL RECORDERS

SUB-TOPIC 1.1: Regulations

1.1.1	Explain the international regulations	2	ICAO (recording and reproducing)
1.1.2	Explain national regulations	2	Appropriate national regulations
1.1.3	Explain how the service provider complies with the regulations	2	*e.g. storage media, access to recording and reproducing room, time to store information (overwrite/erase voice or data), procedure to reproduce information*

SUB-TOPIC 1.2: Principles

1.2.1	Explain the principles of recording and reproducing	2	*e.g. storage media (tape, optical and magnetic disc), A/D-D/A converters, frequency range (300 to 3 400 Hz), channel capacity, time synchronisation, connection to a network, synchronisation of radar and voice recording, replay limitations*

SUBJECT 7: NAVIGATION — PBN

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: NOTAM

1.1.1	Explain the need for NOTAMs	2	—

SUBJECT 8: SURVEILLANCE — PRIMARY

TOPIC 1: ATC SURVEILLANCE

SUB-TOPIC 1.1: Use of PSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach PSR	2	Range, resolution, coverage, availability

SUBJECT 9: SURVEILLANCE — SECONDARY

TOPIC 1: SSR AND MSSR

SUB-TOPIC 1.1: Use of SSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach SSR	2	Range, coverage, resolution, performance, update rate ICAO Doc 9684

TOPIC 2: MODE S

SUB-TOPIC 2.1: Introduction to Mode S

2.1.1	Explain the need for and benefits of Mode S	2	Classical SSR limitations, resolution, accuracy, integrity, enhanced data (e.g. 25 ft resolution, aircraft ID, BDS information)
2.1.2	Explain the working principles of Mode S	2	Mode S interrogation, Mode S reply, Mode S uplink and downlink capability, Mode S formats/protocols, ELS, EHS
2.1.3	Explain the complementary use of Mode S and conventional SSR	2	Mode interlace pattern, operational use of all-call, roll-call
2.1.4	Explain Mode S implementation	2	Elementary and enhanced surveillance, II and SI codes, use of BDS

TOPIC 3: MULTILATERATION

SUB-TOPIC 3.1: MLAT principles

3.1.1	Explain the MLAT system architecture	2	Standards, transmitters and receivers, data processing/fusion, redundancy, performance, costs, timing solutions, etc.
3.1.2	Appreciate the principles of MLAT system	3	Triangulation, coverage, position calculation *e.g. SCAS*
3.1.3	Describe how to operate the system	2	Tracking, map creation and blanking
3.1.4	Describe testing possibilities for MLAT	2	*e.g. SASS-C*

SUBJECT 10: SURVEILLANCE — HMI

TOPIC 1: HMI

SUB-TOPIC 1.1: ATCO HMI

1.1.1	Describe the display types available	2	Video, synthetic, mixed
1.1.2	State the type of selections available	1	Source, range, maps, filters
1.1.3	Describe the advantages of different display types	2	Clarity, configurability, fallback, data integration

SUBJECT 11: SURVEILLANCE — DATA TRANSMISSION

TOPIC 1: SURVEILLANCE DATA TRANSMISSION

SUB-TOPIC 1.1: Technology and protocols

1.1.1	Describe the implementation of formats and protocols	2	Network protocols, surveillance data networks *e.g. RADNET, messages CAT 1+*
1.1.2	Decode ASTERIX messages	3	*e.g. categories 1, 2, 20, 21, 34, 48, and 62*
1.1.3	Identify the data transmission architecture in a multisensor environment	3	Fault tolerance, redundancy of line equipment *e.g. software fallback capability, contingency of service, RADNET*
1.1.4	Characterise the degradations of the surveillance transmission network	2	*e.g. saturation, excess latency*

SUBJECT 12: DATA PROCESSING — DPS SYSTEMS

TOPIC 1: USER REQUIREMENTS

SUB-TOPIC 1.1: Controller requirements

1.1.1	Explain ATCO missions and services needed in an area control centre	2	Operational requirements *e.g. separation, flight progress monitoring and coordination, trajectory prediction, coordination with adjacent centres*
1.1.2	Explain ATCO missions and services needed in an approach control unit	2	Operational requirements *e.g. vectoring, sequencing, AMAN, CDM*

1.1.3	Explain ATCO missions and services needed in an aerodrome control tower	2	Operational requirements *e.g. runway management, DMAN*

SUB-TOPIC 1.2: Trajectories, prediction and calculation

1.2.1	State different types of trajectories	1	*e.g. FPL-based, surveillance data-based, FMS-based*
1.2.2	Explain the main processes for trajectory prediction	2	SDP trajectory, FPL trajectory, merged trajectory, predicted trajectory

SUB-TOPIC 1.3: Ground safety nets

1.3.1	Describe the function of safety nets and their legal status	2	STCA, APW, MSAW, ASMGCS-based safety nets

SUB-TOPIC 1.4: Decision support

1.4.1	Explain the major steps in the air traffic planning process	2	ATFCM with strategic, pre-tactical and tactical, ATC sector planning, tactical control
1.4.2	Explain the principles of trajectory prediction, conformance monitoring and medium term conflict detection processes	2	Route adherence monitoring *e.g. CORA, MTCD, CLAM, level adherence monitoring*
1.4.3	Explain the benefit of these tools for safety and efficiency	2	—

SUBJECT 13: DATA PROCESSING — DATA PROCESS

TOPIC 1: HARDWARE PLATFORM

SUB-TOPIC 1.1: Equipment upgrade

1.1.1	Explain the key factors that have to be considered when data processing equipment is upgraded or changed	2	Specification, compatibility, 'proven' or 'state-of-the-art' technology, maintenance and operating consequence (e.g. personnel, training, spares, procedures), environmental requirements (e.g. size, power requirements, temperature, interfaces), testing

SUB-TOPIC 2.2: COTS

2.2.1	Explain the advantages and disadvantages of commercial off-the-shelf equipment	2	Cost, multiplicity of suppliers, quality, maintainability, life cycle, liability

SUB-TOPIC 2.3: Interdependence

2.3.1	Describe the technical issues regarding the interdependence of various equipment and systems	2	Interface requirements, common point of failure, data conditioning, response time

SUBJECT 14: DATA PROCESSING — DATA

TOPIC 1: DATA ESSENTIALS FEATURES

SUB-TOPIC 1.1: Data significance

1.1.1	Explain the significance of data	2	Criticality (critical/non critical), legality (ICAO, CAA, organisations), use (advisory, control)

SUB-TOPIC 1.2: Data configuration control

1.2.1	Explain the control procedures for changes to operational data	2	Designated roles/persons for authorising changes and verifying/checking changes

SUB-TOPIC 1.3: Data standards

1.3.1	Name the authority responsible for standards	1	*e.g. EUROCONTROL, ICAO, ISO*
1.3.2	State the standards related to ATM data, their sources and their status	1	*e.g. ASTERIX, WGS84, OLDI, FMTP, AMHS, ADEX-P, FPL,*
1.3.3	Decode a typical OLDI message	3	*e.g. ACT, PAC*
1.3.4	State the nature of ATM processing requirements	1	Data volatility (*e.g. radar*), system integrity, consequence of failure

APPENDIX 5a

SYLLABI STRUCTURE

This guidance material provides explanatory material on how to read the tables in the appendices contained in this Subpart A of ANNEX XIII.

(a) Structure of the syllabi

Each table represents a syllabus which has been structured according to the following:

(1) for ease of reading, each table repeats the titles of all subjects that are listed in the Implementing Rule; and

(2) these subjects are further divided into the topics that are listed in the Implementing Rule; then

(3) topics are divided into one or more sub-topics; and

(4) sub-topics contain one or more training objectives.

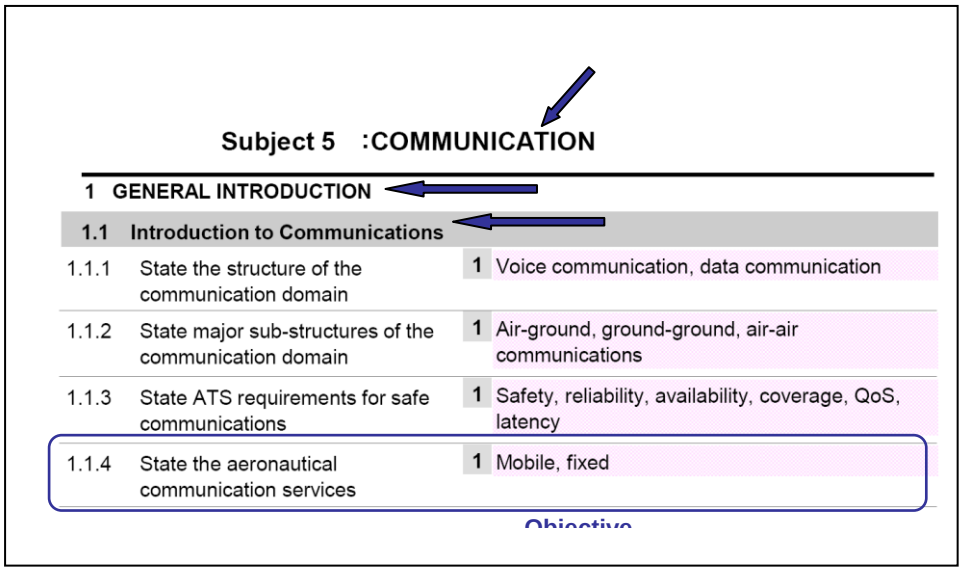


Figure 1: Structure of tables

(b) Training objectives

Each training objective should be understood to contain three mandatory elements:

(1) Corpus, which is a description of the required performance. It always contains an action verb at the beginning of the sentence to ensure that the outcome is observable. The action verb is always associated with a defined taxonomy.

(2) Taxonomy Level, which is the numerical representation of the classification of the action verb.

(3) Content.

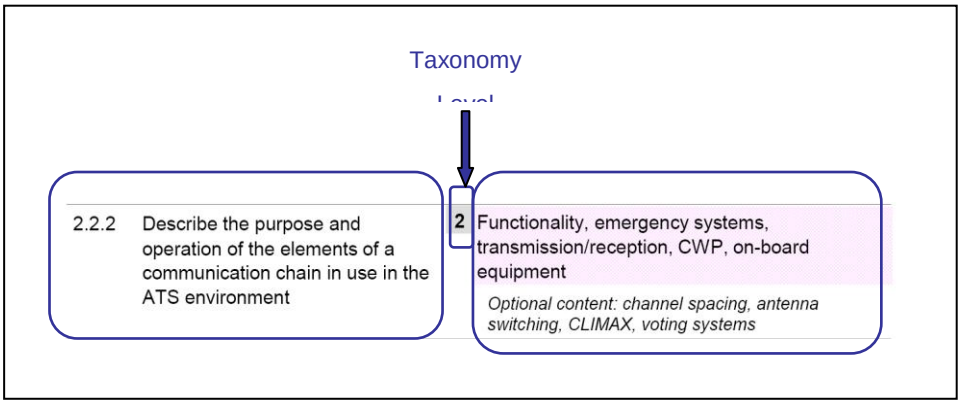


Figure 2: A training objective consists of corpus, taxonomy level and content.

(c) Corpus

Objectives relate to single activities, where possible.

A number of the objectives refer to 'generic equipment' within the corpus. In this context, generic equipment is considered a piece of equipment and/or didactic device which can be used to meet objectives. The equipment/device is not necessarily identical or similar to the operational equipment.
Note: Generic equipment gives flexibility to the course designer. In some instances, operating organisations may, as an alternative to the above, choose to conduct the training on equipment that is similar or identical to the operational equipment that will be used during system/equipment rating training.

1.1.2	Adjust a generic radio transmitter	4	Noise, intermodulation, harmonics, power, bandwidth

Figure 3: Example of an objective with generic equipment

The objective above may be achieved through the use of any type of radio transmitter.

(d) Taxonomy levels

The five taxonomy levels should be understood to have the following levels of complexity:

(1) Level 1 — Basic knowledge of the subject. It is the ability to remember essential points, to memorise data, and retrieve it.

(2) Level 2 — The ability to understand and to discuss the subject matter intelligently in order to represent and act upon certain objects and events.

(3) Level 3 — Thorough knowledge of the subject and the ability to apply it with accuracy. The ability to make use of the repertoire of knowledge to develop plans and activate them.

(4) Level 4 — The ability to establish a line of action within a unit of known applications following the correct chronology and the adequate method to resolve a problem situation. This involves the integration of known applications in a familiar situation.

(5) Level 5 — The ability to analyse new situations in order to elaborate and apply one or another relevant strategy to solve a complex problem. The defining feature is that the situation is qualitatively different to those previous met, requiring judgement and evaluation of options.

(e) Content

The content illustrates and details performance.

It may be composed of two parts: implicit and explicit. The explicit content is what is written in the content field proper to the objective, while the implicit content is not written in the content field of each objective, but rather implied in the corpus of the objective and other elements (stream, subject, etc.).

When the items are in a list, each of them is to be addressed as a minimum.

Optional content items are italicised and clearly preceded with the words 'Optional content'. They help to illustrate the type of content that may be used to achieve given objectives.

Even when all of the items are optional, the objective has to be performed according to the action verb included.

Where content refers to other documents (e.g. ICAO Standards and Recommended Practices), users should take care to use the most recent version of the referenced document(s) or its parts.

(f) Additional note in content

(1) Contained within the content of some objectives that have been assigned, the action verb 'Appreciate' is an additional note that elaborates on the ultimate intentions of the objective. The additional note states: 'For achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training.'

1.2.1	Identify the causes of a fault, based on test tool measurements	3	Additional: for achievement of competence, this objective should be applied practically, at the latest, by the end of the S/E rating training *e.g. data analyser, line analyser*

Figure 4: Example of an objective with 'Appreciate + additional note'

(2) When the verb 'appreciate' is used with the additional note, the objective may, as a minimum, be taught as a theoretical objective during qualification training. This is permitted when using 'appreciate', i.e. learners should be able to understand a situation and know what is involved in a problem-solving situation, to state a plan without applying it. However, it is acknowledged that these objectives, without any practical application, are of extremely limited operational competence value. Therefore, these objectives should, at the latest, be achieved practically during system/equipment rating training.

(g) Common training objectives

An objective should be considered common to two or more qualification streams if the objective recurs verbatim and the context within which the objective is applied does not change.

Common objectives should be taught at least once when:

(1) training for two or more qualification streams are combined to form one course; or

(h) a course is provided for the purpose of an ATSEP acquiring an additional qualification stream.

Action verbs

The tables below list action verbs and their associated taxonomy levels that are used in training objectives.

Definition of verbs — Level 1

Verb	Definition	Example
Define	State what it is and what its limits are; state the definition.	Define airborne safety nets.
Draw	Produce a picture, pattern, or diagram.	Draw the MLAT system architecture.
List	Say one after the other.	List the most common weather messages.
Name	Give the name of objects or procedures.	Name a range of air-ground aviation-related network concepts.
Recognise	Know what it is, because you have seen it before.	Recognise surveillance information on a display.
State	Say or write in a formal or definite way.	State the function of a network management system.

Definition of verbs — Level 2

Verb	Definition	Example
Characterise	Describe the quality of features in something.	Characterise navigation methods.
Consider	Think carefully about it.	Consider the benefits of Critical Incident Stress Management (CISM).
Demonstrate	Describe and explain. Logically or mathematically, prove the truth of the statement.	Demonstrate the use of middleware in an ATM environment.
Describe	Say what it is like or what happened.	Describe the elements of Global Navigation Satellite System (GNSS) in Europe.
Differentiate	Show the difference between things.	Differentiate conventional navigation from area navigation.
Explain	Give details about something or describe so that it can be understood.	Explain the function of FDP.
Take account of	Take into consideration before deciding.	Take account of hardware/software compatibility.

Definition of verbs — Level 3

Verb	Definition	Example
Apply	Use something in a situation or activity.	Apply the principles of layers.
Appreciate	Understand a situation and know what is involved in a problem-solving situation, to state a plan without applying it.	Appreciate how to troubleshoot a network.

Calculate	Discover from information you already have by arithmetic; to think about a possible cause of action in order to form an opinion or decide what to do.	Calculate parameters of a line.
Check	Make sure the information is correct (satisfactory).	Check the conformity of a system to ITU and national regulation.
Decode	Turn into ordinary writing, decipher.	Decode a typical OLDI message.
Estimate	Form an approximate judgement of a number, form an opinion.	Estimate the impact of security and integrity failure to the operational service.
Identify	Associate oneself inseparably with, establish the identity.	Identify the major elements of the ADS-C system.
Operate	Conduct work on equipment.	Operate measuring equipment.
Perform	Carry into effect, go through, execute.	Perform measurements with generic radio test equipment.
Use	Employ for a purpose, handle as instrument, put into operation.	Use appropriate vocabulary to communicate effectively on technical matters.

Definition of verbs — Level 4

Verb	Definition	Example
Adjust	Change to a new position, value or setting.	Adjust a generic radio receiver.
Analyse	Examine minutely the constitution of.	Analyse the block diagram of a generic radio receiver.
Justify	Show the rightness of a choice or of an option.	Justify the occasions when it is necessary to downgrade an ILS facility performance category.
Relate	Establish link with.	Relate VOR station design to operational requirement.

Definition of verbs — Level 5

Verb	Definition	Example
Interpret	Decide on the meaning or significance of something when there is a choice.	Interpret ILS facility performance categories.

(i) Acronyms

The following abbreviations are applied within the tables:

AAIM	Aircraft Autonomous Integrity Monitoring
ABAS	Aircraft-Based Augmentation System
ACARS	Aircraft Communications Addressing and Reporting System
ACAS	Airborne Collision Avoidance System
ACC	Area Control Centre
A/D	Analogue/Digital
ADEX-P	ATS Data Exchange Presentation
ADS	Automatic Dependent Surveillance
ADS B	ADS — Broadcast

ADS C	ADS — Contract
ADF	Automatic Direction Finder
AFDX	Avionics Full-duplex Ethernet Switch
AFTN	Aeronautical Fixed Telecommunications Network
AGC	Automatic Gain Control
AIC	Aeronautical Information Circular
AIDC	ATS Interfacility Data Communications
AIP	Aeronautical Information Publication
AIRAC	Aeronautical Information Regulation and Control
AIS	Aeronautical Information Services
ALARP	As Low As Reasonably Practicable
AMAN	Arrival Manager
AMHS	Aeronautical Message Handling System
AMSS	Automatic Message Switching System
ANS	Air Navigation Services
ANSP	ANS Provider
APV	Approach Procedure with Vertical guidance
APW	Area Proximity Warning
ARINC	Aeronautical Radio Incorporated
ARTAS	ATC Radar Tracker and Server
ASAS	Airborne Separation Assistance/Assurance System
ASM	Airspace Management
ASMGCS	Advanced SMGCS
ASTERIX	All-purpose Structured EUROCONTROL Radar Information Exchange
ATC	Air Traffic Control
ATFCM	Air Traffic Flow and Capacity Management
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management
ATN	Aeronautical Telecommunication Network
ATS	Air Traffic Services
ATSEP	Air Traffic Safety Electronics Personnel
AUGUR	EUROCONTROL RAIM Prediction Tool
BATAP	‘Type-B’ Application-to-Application Protocol
BDS	Binary Data Store
BER	Bit Error Rate
BITE	Built-In Test Equipment
B-RNAV	Basic-RNAV
CAA	Civil Aviation Authority
CB	Cumulonimbus
CBT	Computer-Based Training
CDM	Collaborative Decision-Making
CDTI	Cockpit Display of Traffic Information
CFMU	Central Flow Management Unit
CIDIN	Common ICAO Data Interchange Network
CISM	Critical Incident Stress Management
CIV	Civil
CLAM	Cleared flight Level Adherence Monitoring
CLIMAX	Multi-station carrier offset mode, with voting override
CMS	Control and Monitoring System
CNS/ATM	Communication Navigation and Surveillance/Air Traffic Management
CORA	Conflict Resolution Advisory
CORBA	Common Object Request Broker Architecture
COTS	Commercial off-the-Shelf
CPDLC	Controller-Pilot Data Link Communications
CRT	Cathode Ray Tube
CSU	Control Sector Unit
CTR	Control Zone
CVOR	Conventional VOR
CWP	Controller Work Position

DCL	Departure Clearance
DDF	Doppler DF
DDM	Difference of Depth of Modulation
DF	Direction Finding
DLIC	Data Link Initiation Capability
DMAN	Departure Manager
DME	Distance Measuring Equipment
DME/N	DME/Normal
DME/P	DME/Precision
DPSK	Differential Phase Shift Keying
DTMF	Dual Tone Modulation-Frequency
DVOR	Doppler VOR
EAD	European Aeronautical Database
EAN	European ANSP Network
EASA	European Aviation Safety Agency
ECAC	European Civil Aviation Conference
EFQM	European Foundation for Quality Management
EGNOS	European Geostationary Navigation Overlay Service
EGPWS	Enhanced Ground Proximity Warning System
EHS	Enhanced Mode S
EHT	Extremely High Tension
EJB	Enterprise Java Bean
ELS	Elementary Mode S
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ETFMS	Enhanced Tactical FMS
EU	European Union
EUROCAE	European Civil Aviation Electronics
EUROCONTROL	European Organisation for the Safety of Air Navigation
FAA	Federal Aviation Administration (US)
FANS	Future Air Navigation Systems
FDP	Flight Data Processing
FDPS	FDP System
FFM	Far Field Monitor
FHA	Functional Hazard Assessment
FIR	Flight Information Region
FMS	Flight Management System
FMTP	Flight Plan Messaging Transport Protocol
FoM	Figures of Merit
FPL	(Filed) Flight Plan
FRUIT	False Reply Unsynchronised in Time
FUA	Flexible Use of Airspace
GALILEO	Satellite radio navigation system
GBAS	Ground-Based Augmentation System
GLONASS	GLObal'naya NAvigatsionnaya Sputnikovaya Sistema (Global Navigation Satellite System)
GNSS	Global Navigation Satellite System
GP	Glide Path
GPS	Global Positioning System
GRAS	Ground-based Regional Augmentation System
GSA	GNSS Supervisory Authority
GTC	Gain/Time Control
HF	High Frequency
HFDL	High Frequency Data Link
HMI	Human-Machine Interface
HPA	High Power Amplifier
HSI	Horizontal Situation Indication
HV	High Voltage
HW	Hardware
Hz	Hertz

ICAO	International Civil Aviation Organization
IDF	Interferometric DF
IF	Intermediate Frequency
IFF	Identification Friend/Foe
IFPS	(Integrated) Initial Flight Plan Processing System
ILS	Instrument Landing System
INS	Inertial Navigation System
I/O	Input/Output
IP	Internet Protocol
IRS	Inertial Reference System
IRVR	Instrument Runway Visual Range
I/Q	In phase and Quadrature
ISDN	Integrated Services Digital Network
ISLS	Interrogator Side Lobe Suppression
IISLS	Improved Interrogator Side Lobe Suppression
iTEC	Interoperability Through European Collaboration
ITU	International Telecommunication Union
ISO	International Standards Organisation
LAM	Local Area Multilateration
LAN	Local Area Network
LAPB	Link Access Protocol, Balanced
LCD	Liquid-Crystal Display
LLZ	Localiser
LNA	Low Noise Amplifier
LVP	Low Visibility Procedures
MDS	Minimum Detectable Signal
MET	Meteorology
METAR	Meteorological Actual Report
MFC	Multi-Frequency Coding
MHz	Megahertz
MIL	Military
MLAT	Multilateration
MLS	Microwave Landing System
MOTNE	Meteorological Operational Telecommunications Network Europe
MRP	Multi-radar Processing
MRT	Multi-radar Tracker
MSAW	Minimum Safe Altitude Warning
MSSR	Mono-pulse SSR
MTBF	Mean Time Between Failure
MTCD	Medium-Term Conflict Detection
MTD	Moving Target Detection
NAVAID	Navigation(al) Aid
ND	Navigation Display
NEAN	North European ADS-B Network
NDB	Non-Directional Beacon
NOP	Network Operations Plan
NOTAM	Notice to Airmen
NPA	Non-Precision Approach
NRA	Non-Radar Area
NSA	National Supervisory Authority
OJTI	On-The-Job Training Instructor
OLDI	On-Line Data Interchange
OS	Operating System
OSI	Open System Interconnection
OST	On-site Training
OTM	Object Transaction Monitor
PA	Precision Approach
PABX	Private Automatic Branch Exchange
PBN	Performance-Based Navigation

PCM	Pulse Code Modulation
PD	Probability of Detection
PENS	Pan-European Fixed Network Services
PFD	Primary Flight Display
PPI	Plan Position Indicator
PRF	Pulse Repetition Frequency
P-RNAV	Precision RNAV
PSD	Phase Sensitive Detector
PSSA	Preliminary System Safety Assessment
PSR	Primary Surveillance Radar
PTT	Post, Telephone and Telegraph (generic term to identify the provider)
QoS	Quality of Service
QNH	Q-code for atmospheric pressure at sea level
Qsig	Quality of signal
RAIM	Receiver Autonomous Integrity Monitoring
RAPNET	(European) Regional Aeronautical Packet switched Network (CBN + DAKOS)
RAPS	Recording, Analysis, Playback and Simulation system for radar data (COMSOFT)
RDP	Radar Data Processing
RCA	Remote Client Application
RF	Radio Frequency
RMI	Relative Magnetic Indicator
RNAV	Area Navigation
RNP	Required Navigation Performance
RPL	Repetitive Flight Plan
RSLS	Receiver Sidelobe Suppression
R/T	Radiotelephony
RTCA	Radio Technical Commission for Aeronautics
RUP	Rational Unified Process
RVR	Runway Visual Range
RX	Receiver
SAR	Specific Energy Absorption Rate
SARPS	Standards And Recommended Practices
SASS	Surveillance Analysis Support System
SASS-C	SASS-Centre
SASS-S	SASS-Sensor
SATCOM	Satellite Communications
SBAS	Space/Satellite-Based Augmentation System
SCAS	Surveillance Coverage Analysis Suite
SCAT-1	Special Category 1
SDM	Sum of Depth of Modulation
SDP	Surveillance Data Processing
S/E	System/Equipment
SELCAL	Selective Calling
SESAR	Single European Sky AM Research
SID	Standard Instrument Departure
SITA	Société Internationale de Télécommunications Aéronautiques (France)
SMC	System Monitoring and Control
SMR	Surface Movement Radar
SMS	Safety Management System
S/N	Signal/Noise
SNOWTAM	NOTAM on Snow conditions
SNMP	Simple Network Management Protocol
SPI	Special Pulse Identification *or* Special Position Identification Pulse (SSR)
SRC	Safety Regulation Commission *(*EUROCONTROL*)*
SSA	System Safety Assessment
SSR	Secondary Surveillance Radar
STC	Sensitivity Time Control
STCA	Short-Term Conflict Alert
SV	Supervisor

SW	Software
SWALs	Software Assurance Levels
SWIM	System Wide Information Management
SWR	Standing Wave Ratio
TACAN	UHF Tactical Air Navigation aid
TAF	Terminal Area Forecast
TCAS	Transponder Collision Avoidance System
TCP	Transmission Control Protocol
TDOA	Time Difference on Arrival
TFT	Thin Film Transistor
TIS	Traffic Information Service
TMA	Terminal Area
TRM	Team Resource Management
TX	Transmitter
UAT	Universal Access Transceiver
UBSS	UNIX Basic System Software
UHF	Ultra High Frequency
UPS	Uninterruptible Power Supply
UTA	Upper (Traffic) Control Area
VCS	Voice Communications System
VDF	VHF DF Station
VDL	VHF Digital/Data Link
VESDA	Very Early Smoke Detection Alarm
VHF	Very High Frequency
VOLMET	Routine Voice broadcasts for Meteorological Information
VOR	VHF Omnidirectional Radio Range
VORTAC	VOR and TACAN combination
WAAS	Wide Area Augmentation System (US)
WAM	Wide Area Multilateration
WAN	Wide Area Network
WGS84	World Global System 84
X25	Packet Switched Data Network Protocol