IFATSEA BASIC OBJECTIVES SYLLABUS

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Preface/Notes

This document was created with contributions and support from the IFATSEA General Assembly 48, as well as numerous individual contributions.

Syllabus Purpose:
The purpose of this document is to provide additional guidance for the creation of training courses and programs to help ensure ATSEPs achieve Basic Objectives as outlined in Appendix B of ICAO Doc. 10057. An overview of the Basic Training is provided in Chapter 3 of the Doc. 10057.

Target Audience:

- All ATSEP responsible for the installation, maintenance and monitoring of ANSP's globally

Syllabus Notes:

- Objectives and Main Points are as listed in Appendix B of 10057
- Development Notes provide further information to support the development of course content to meet the stated objectives
- Resource provides additional support and/or reference information for developers
- All times listed in syllabus are in minutes
- Times are to provide guidance for the length of the individual objectives and are estimates only. Overall training time savings can be realized through the developer's course design.
- Content is to be adapted to each participating ANSP's organization, policies, procedures, site agreements etc.

April 30, 2021

Subject 1: Induction

Sub-Topic 1.1: Training and Assessment Overview

No	Objective	Main Points	Development Notes	Resource	Time
1.1.1	Describe the training scheme and progression	Initial (basic and qualification) S/E rating and continuation training. Course aims, objectives, and topics.	• Overview of 10057 manual • Overview of course syllabus	10057	120
1.1.2	State the assessment requirements, procedures, and methods		• Describe assessment for training	ANSP/ PANS 9868 Chapter 3	30

Sub-Topic 1.2: National Organization

No	Objective	Main Points	Development Notes	Resource	Time
1.2.1	Describe the organizational structure, purpose and functions of the national service provider(s) and regulatory structure	E.g. Headquarters, control centers, training facilities, airports, outstations, civil/military interfaces, regulatory interfaces	• National Civil aviation overview • Introduction to Civil aviation ministry / authority. • Introduction to ANSPs role. • Functions of ANSPs, Regulatory authority's role and structure. • Civil aviation training institutes. Introduction to Civil military coordination units.	ANSP	60
1.2.2	Describe the structure and functions of the major departments within the service provider national organization	E.g. organizational handbook (plans, concepts and structures, finance model)	• Structure of major ANSP departments and their roles- CNS handbook (ANSP organizational chart, Operations, planning, calibration and training)	ANSP	30

No	Objective	Main Points	Development Notes	Resource	Time
1.2.3	State appropriate accountabilities and responsibilities of the service provider(s) and competent authority		• Accountabilities on planning, installation, commissioning, operation and safety and quality management of ANS facilities.	ANSP	20

Sub-Topic 1.3: Workplace

No	Objective	Main Points	Development Notes	Resource	Time
1.3.1	State the role of trade unions and professional organizations	E.g. International, regional, national	• Brief introduction on national level CNS affiliated professional organization, ILO, IFALPA, IFATSEA, IFATCA, IATA, CANSO	ANSP	20
1.3.2	Consider security of site facilities and personnel against unlawful interference	Environmental, physical and information security measures, employee vetting, and reference checks	• Relevant topics	Annex 17	30
1.3.3	Describe actions when suspecting a security breach.	E.g., Inform police, security agencies and mangers. Security manual and/or contingency plan	• Relevant topics	Annex 17	20

Sub-Topic 1.4: ATSEP Role

No	Objective	Main Points	Development Notes	Resource	Time
1.4.1	Describe the key responsibilities of an ATSEP		• Key roles and responsibilities of ATSEP at different levels in the organization	ICAO ANSP hand book	20

Sub-Topic 1.5: National/Regional/Worldwide Dimension

No	Objective	Main Points	Development Notes	Resource	Time
1.5.1	Explain the relationship between States and its relevance to ATM operations.	E.g. Harmonization, flow management, bilateral agreement, sharing of ATM relevant data, major studies, research programmes, and policy documents.	• Planning and implementation of regional groups – lateral agreements, OLDI / AIDC	ICAO ANSP	60
1.5.2	Define the regulatory framework of international and national ATM.	E.g. ICAO, regional and national concepts, responsibilities.	• Very brief overview of GANP, ASBU, GASP. ICAO functions. National civil aviation regulation.	ICAO ANSP	30
1.5.3	State the purpose of a range of international and regional bodies.	E.g., ICAO, EASA, RTCA, EUROCAE.	• Very brief overview of EASA, FAA, RTCA, EUROCAE, ITU, IEEE, AFCAC (as applicable to the state)	ICAO ANSP	30

Sub-Topic 1.6: International Standards and Recommended Practices

No	Objective	Main Points	Development Notes	Resource	Time
1.6.1	Explain how the regulatory environment of ICAO notifies and implements legislation.	ICAO Annexes	• ICAO provisions hierarchy (Convention, Annexures, DOCs, SUPPs, Manuals and circulars) Brief role of ANC on notification of ICAO provisions.	ICAO ANSP	20
1.6.2	State which major/key ATM engineering “standards” and “practices” are applicable.	E.g. ICAO Annex 10, ICAO Doc 8071, guidance material on reliability, maintainability and availability.	• List of important CNS related Annexures docs	ICAO ANSP	90

Sub-Topic 1.7: Quality Management

No	Objective	Main Points	Development Notes	Resource	Time
1.7.1	Explain quality management and the need for it.	E.g., ISO, EFQM (European Foundation for Quality Management)	• Briefly explain the QMS with the help of QMS cycle and highlight how QMS improves the process. • Briefly explain EFQM and its components and highlight how the model improves quality	ANSP Policies and Procedures	30
1.7.2	Explain the need for configuration management.	Importance for safe operations, e.g. S/E build state, software adaption/version.	• Correlate how the QMS implementation helps in configuration management of S/W and H/W of the CNS/ATM systems	ANSP Policies and Procedures	20

Sub-Topic 1.8: Safety Management System

No	Objective	Main Points	Development Notes	Resource	Time
1.8.1	Explain why there is a need for high-level safety requirements for aeronautical activities.	Safety policy and rules, system safety cases, system safety requirements.	• Explain the need of proactive high-level safety requirements, policies and rules	ANSP Policies and Procedures	30

Sub-Topic 1.9: Health and Safety

No	Objective	Main Points	Development Notes	Resource	Time
1.9.1	Explain personal safety responsibilities in the work environment.	Safety statement, first aid, rules about climbing.	• List job hazards		20
1.9.2	Explain potential hazards to health and safety generated by equipment	E.g. Health consequences of electric shock and static discharges, precautions with chemical	• Describe job hazards (Note: may require separate recognized training courses such as First Aid,	ISO45001 and	120

No	Objective	Main Points	Development Notes	Resource	Time
	or contained within the work environment.	products (batteries), mechanical hazards (rotating machinery/antennas), toxic materials (beryllium), biological hazards, faulty earthing.	Electrical Safety, Fall Arrest, Ladder Safety)	ILO-OSH 2001	
1.9.3	Describe fire safety and first-aid regulations and practices.	Requirements and rules, e.g. Standards.	• Overview of codes and regulations (Note: may require separate recognized training course)		30
1.9.4	State any applicable legal requirements and safety rules.	National, regional, international regulations, e.g. For working on power supply and/or air conditioning.	• Overview of codes	ISO45001 and ILO-OSH 2001	30
1.9.5	Describe the main features and uses of the different types of fire detectors and extinguishers.	E.g. VESDA, Type A, B, C, D extinguishers.	• (Note: may require separate recognized training course)		60

Subject 2: Air Traffic Familiarization

Sub-Topic 2.1: Air Traffic Management

No	Objective	Main Points	Development Notes	Resource	Time
2.1.1	Define Air Traffic Management	ICAO, regional regulations		ICAO	60
2.1.2	Describe operational ATM functions	ATFCM, ATS, ASM	• Air Traffic Separation • Flow Efficiency • Towers • Controllers • Centers • Airports • Flight Plan • Flight Rules • Meteorology • Communication • NOTAMs	ANSP	90
2.1.3	Describe ATM concepts and associated terminology.	E.g. Concepts: FUA, free flight, gate-to-gate, performance-based ATM operations (PBN, RCP), operational concepts (ICAO, SESAR, NextGen). Terminology: glossary.	• ATS basics • Concepts of control zones • Separation vertical/horizontal • Conflicts • VFR/IFR • Flight levels/altimeters • Flight altitudes • Airports, aprons, controlled surfaces • Lighting systems • Runway designators	ICAO ANSP	240
2.1.4	Explain the operational importance of technical services required for ATM.	e.g., Interoperability	• ATSEP roles and responsibilities • Certification Parameters • Periodic Maintenance • Restoration • Monitoring		30

No	Objective	Main Points	Development Notes	Resource	Time
			• Integrity • Availability		
2.1.5	State future developments in systems and/or ATM/ANS practices which may impact on services provided.	e.g. Data link, satellite-based navigation, gate-to gate (CDM), ATC tools, continuous approach, 4D trajectory, business trajectory, SWIM, NOP, (UDPP, modes of separation), ASAS.	• GPS/Glonass • SWIM • ADS-B • Datalink • WAAS-SBAS/GBAS • 4-D Trajectory, • RNAV • Virtualization	ICAO Industry	90
2.1.6	List the standard units of measurement used in aviation	Speed, distance, vertical distance, time, direction, pressure, temperature.	• Longitude and latitude • Nautical miles/Knots • GMT/Zulu • English • Celsius/Fahrenheit • Flight levels (feet) • Pascal • In. Hg • RF Frequencies • Pounds/Kilos	ICAO ANSP	20

Sub-Topic 2.2: Air Traffic Control

No	Objective	Main Points	Development Notes	Resource	Time
2.2.1	Define airspace organization.	ICAO Annex 11, e.g. additional regional regulations, FIR, UTA, TMA, CTR, ATS routes.	• Positive control • Advisory control • Uncontrolled • Airspace Classification • Military/Civil • Trans-Oceanic • Enroute/Terminal • SSR Codes	ICAO ANSP	60

No	Objective	Main Points	Development Notes	Resource	Time
2.2.2	Describe commonly used airspace terminologies and concepts.	E.g. Sectorization, identification of ATS routes, restricted airspace, significant points.	• Sectional charts • Call sign • Controller Handoff • Airways • RVSM • AIDC	ICAO ANSP	60
2.2.3	State the general organization of aerodromes	E.g. Obstacle limitation surfaces, different departure and arrival trajectories, approach and landing categories, operational status of radio navigation aids.	• Approach plates • Approach • Departure • Gates • Taxiways • RVR • Runway Safety Area • Ground Control • Surface Movement	ICAO ANSP	30
2.2.4	State the purpose of ATC.	ICAO Doc 4444.	• Separation • Conflict Resolution • Flow Efficiency • Emergency Assistance • Search and Rescue Coordination	ANSP	20
2.2.5	State the organization of ATC services.	ICAO Doc 4444, e.g. area, approach, aerodrome control services.	• Area • Enroute • TRACON • ARTCC • Approach • Terminal • Tower • Flow Management	ANSP	20

Sub-Topic 2.3: Ground Based Safety Nets

No	Objective	Main Points	Development Notes	Resource	Time
2.3.1	Describe the purpose of ground-based safety nets.	E.g. STCA, MSAW, APW, runway incursion alerts.	• Accident prevention • Controller awareness • Threat warning	ANSP	60

Sub-Topic 2.4: Air Traffic Control Tools and Monitoring Aids

No	Objective	Main Points	Development Notes	Resource	Time
2.4.1	Explain the main characteristics and use of ATC support and monitoring tools.	e.g. MTCD, sequencing and metering tools (AMAN, DMAN), A-SMGCS, CLAM, RAM, CORA	• Controller assistance for sequencing	ANSP	120

Sub-Topic 2.5: Familiarization

No	Objective	Main Points	Development Notes	Resource	Time
2.5.1	Take account of ATC tasks.	E.g. Simulation, role play, PC, Part Task Trainer, observations in the operational environment.	• Onsite overview of Operational environment • Controller specialization	ANSP ATC	120
2.5.2	Explain the need for good communication, coordination and cooperation between operational staff.	E.g. Handovers, MIL/CIV, planner/tactical, SV Tech (SMC) and SV ATCO, site visit(s) to ATC units.	• Onsite overview of Operational environment • Ground/departure handoff • Service interruptions	ANSP ATC	120
2.5.3	Consider the purpose, function and role of various operational stations in respect of ATM-related operations.	Site visit(s) to ATC units, e.g. MET Office, e.g. Meteorological providers, remote sites, airport operations.	• Onsite overview of Operational environment • Remote Towers • Briefing office • Flight plan filing	ANSP ATC	120

No	Objective	Main Points	Development Notes	Resource	Time

2.5.4	Define the phases of flight.	Take-off, climb, cruise, descent and initial approach, final approach and landing.	• Onsite overview of Operational environment
			• Pre-flight
			  ○ Flight Plan
			  ○ Weather Briefing
			  ○ NOTAMs
			• Taxing
			• Gate operations
				ANSP
				ATC
					120

2.5.5	Recognize the cockpit environment and associated equipment, in relation to ATC.	Relevant pilot HMI E.g. Familiarization flight or cockpit simulator training (where practicable), antenna.	• Transponder • Radio • ELT • Altimeter • GPS • FMS • Weather Radar	ANSP ATC	120
2.5.6	Define airborne collision avoidance systems.	ACAS, EGPWS, e.g. TCAS.	• Onsite overview of Operational environment	ANSP ATC	120

Subject 3: Aeronautical Information Services (AIS)

Sub-Topic 3.1: Aeronautical Information Services

No	Objective	Main Points	Development Notes	Resource	Time
3.1.1	State the organization of the AIS.			ANSP ATC	20
3.1.2	Define the AIP service.	E.g. Data contents of AIP, supplementary, AIC and types of publication: AIRAC, non-AIRAC, data collection and preparation, data format, distribution channels, supporting systems and tools.		ANSP ATC	90
3.1.3	Define the aeronautical charting service.	Types of aeronautical charts, operational use of charts, supporting systems and tools.	• Sectional Charts - VFR • World Area Charts – Route planners • Terminal Area Charts – Class B users • Approach Plates –IFR users	ANSP ATC	30
3.1.4	Define the NOTAM services.		• NOTAM Types • NOTAM Distribution – AFTN • NOTAM User • NOTAM Originators • NOTAM Format • NOTAM Duration	ANSP ATC	30
3.1.5	Define the ATS Reporting Office.	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.	• FF-ICE	ANSP ATC	60

No	Objective	Main Points	Development Notes	Resource	Time
3.1.6	Define the regional/national AIS database.	E.g. Paper/data, central single source, validated, redundancy.	• Airports • Obstructions • Approach • Mapping • NavAid Locations • Restricted/Prohibited Areas • Geographic Features • Temporary relocation of NavAids	ANSP ATC	30
3.1.7	Define procedures for providing Communications, Navigation, Surveillance (CNS) data to AIS.	Information of a permanent nature, information of a temporary nature, status report of NAVAIDs.		ANSP ATC	60

Subject 4: Meteorology

Sub-Topic 4.1: Introduction to Meteorology

No	Objective	Main Points	Development Notes	Resource	Time
4.1.1	State the relevance of meteorology in aviation.	Influence on the operation of aircraft, flying conditions, aerodrome conditions.	• Properties of atmosphere • Radiation process that occurs in the atmosphere • Seasonal variations • Horizontal pressure variations • Hazardous Cloud types • Radio communication interference • Volcanic ash • Flight rerouting • Flight delays • Icing • Turbulence • Lightning • Winds • Severe weather • Fog/low visibility	ANSP ICAO DOC 8896	90
4.1.2	State the weather prediction and measurement systems available.	Wind, visibility, temperature, pressure, humidity, cloud base.	• Weather information service providers • ASOS/AWOS • Satellite Imagery • Government providers • Commercial providers	ANSP	60

Sub-Topic 4.2: Impact on Aircraft and ATS Operation

No	Objective	Main Points	Development Notes	Resource	Time
4.2.1	State the meteorological conditions and their impact on aircraft operations.	E.g., Wind, visibility, temperature/humidity, clouds, precipitation, pressure, density.	• Role of temperature and moisture in atmospheric process • Rerouting • Delays • Fuel consumptions • Airport closures • Alternate airport requirements	ANSP	30
4.2.2	State the meteorological conditions hazardous to aircraft operations.	E.g., Turbulence, thunderstorms, icing, squall, macro bursts, wind shear, contaminated runway.	• Formation of air masses • Air mass modification • Air mass weather • Snow • Ice on runway • Jet Stream • Frontal boundaries	ANSP	30
4.2.3	Explain the impact of meteorological conditions and hazards on ATS operations.	Increased vertical and horizontal separation, low visibility procedures, anticipation of flights not adhering to tracks, diversions, missed approaches. E.g., effects on equipment performance.	• Weather variations that occur with frontal passage • Formation of frontal waves • Composition, formation, and dissipation of clouds • Composition and formation of precipitation • Composition and formation of fog	ANSP	30
4.2.4	Explain the effects of weather on propagation.	E.g. Anaprop, rain noise, sunspots.	• Effects of boundary layer of boundary layer on wind velocity • Local effects on wind velocity • Atmospheric lapse rate and adiabatic process • RF Interference • RF Reflections • RF Noise • RF Distortion • Propagation changes	ANSP	60

Sub-Topic 4.3: Meteorological Parameters and Information

No	Objective	Main Points	Development Notes	Resource	Time
4.3.1	List the main meteorological parameters.	Wind, visibility, temperature, pressure, humidity.	• Atmospheric pressure and associated units of measure • Wind Speed and Direction • Density Altitude • Clouds • Ceiling • Cloud coverage (scattered, broken, etc.)	ANSP	30
4.3.2	List the most common weather messages and broadcasts used in aviation.	Meteorology messages: TAF, METAR, SNOWTAM, SIGMET Broadcasts: ATIS/VOLMET	• ATIS messages and format • Sigmet	ANSP	20

Sub-Topic 4.4: Meteorological Systems

No	Objective	Main Points	Development Notes	Resource	Time
4.4.1	Explain the basic principles of the main meteorological systems in use.	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).	• Purpose and operation of sensors • LLWAS	ANSP	60

Subject 5: Communication

5.1: Introduction to communications

No	Objective	Main Points	Development Notes	Resource	Time
5.1.1	State the structure of the communication domain	Voice communication, data communication.	• ATC, Tower, airports, emergency services, etc.	ICA0 Annex 10 Vol III pt 1&2; ANSP; ICAO 10037	30
5.1.2	State major substructures of the communication domain.	Air-ground, ground-ground, air-air communications.	• Major components • Voice • Data	ACP WGC7/ WP28	10
5.1.3	State ATS requirements for safe communications.	Safety, reliability, availability, coverage, QoS, latency.	• Impact of communication	ICAO DOC 9694	30
5.1.4	State the aeronautical communication services.	Mobile, fixed.	• Aeronautical alphabet	ICAO ANNEX 10V II. Chp5 ICAO doc 9432	20

5.2: Introduction to Voice communication

No	Objective	Main Points	Development Notes	Resource	Time
5.2.1	Describe system Architecture		• VCCS • Radios • Hotlines		15
5.2.2	Explain the purpose, principles and role of voice communication systems in ATS.	e.g. Audio bandwidth, dynamic range, fidelity, routing, switching, lineside/deskside, coverage, communication chain between controller and pilot.	• HF, VHF, UHF, LORAN, Satellite, WAAS	ICA0 Annex 10 Vol III pt2; ITU Standards	30
5.2.3	Describe the way in which voice communication systems function.	VoIP VCS, analog/digital comparisons, distortion, harmonics.	• Functional blocs	ICA0 Annex 10 Vol III pt 1&2; ANSP, ICAO VOIP HNDBOOK	15
5.2.4	State methods used to route and switch voice communications.	e.g. Multichannel, multi-users, party lines, VHF/UHF linkage, HF, SELCAL.	• VCCS, VSAT, VHF, HF	ICA0 Annex 10 Vol III pt2; ANSP	30
5.2.5	State how systems interface to produce and integrated service for ATS		• VCCS, AMHS/AFTN/CIDIN		15

No	Objective	Main Points	Development Notes	Resource	Time
5.2.6	State radio spectrum and frequency allocation constraints and procedures.	Spectrum, interference sources, commercial allocations, world radio conference, ITU, common aviation position, efficient utilization of frequency bands, channel spacing.	• Civil Aviation Frequency Spectrum • Unlawful Interference • National Spectrum Allocation Officers and Frequency Allocation Plan	ICAO DOC 9718; ITU Standards; ICAO ACP-WGF-30; ICAO Annex 10	30
5.2.7	State voice recording systems in use.	e.g., Digital recording equipment	• Storage types/formats • Recorded Communication	ICAO Annex 11	15
5.2.8	State ICAO and local legal requirements regarding recording and retention of voice communications.	Regulatory requirements, incident recording and playback, recording equipment.	• Accident/Incident analysis • Storage Period		15
5.2.9	State the purpose of ATIS and VOLMET		• Contains weather information, active runways, available approaches and NOTAMs • D(C)VOR • Mobile phones • AIS • Meteorological Services		15

5.3: Air-Ground communication

No	Objective	Main Points	Development Notes	Resource	Time
5.3.1	State the functions and basic operation of routing and switching equipment in use in the ATS environment.	Voice switching.	• E.g. VCCS, PABX, IP-PABX		30

No	Objective	Main Points	Development Notes	Resource	Time
5.3.2	Describe the purpose and operation of the elements of a communication chain in use in the ATS environment.	Functionality, emergency systems, transmission/reception, CWP, on-board equipment e.g. channel spacing, antenna switching, CLIMAX, voting systems.	• Radio Frequency Theory		60
5.3.3	State ways of achieving quality of service.	e.g. Importance of coverage and redundancy of equipment, overlapping coverage, backup system, functional redundancy vs element redundancy.	• Backup Radios • Redundant routes • Coverage requirements	ANSP design engineers	30
5.3.4	Recognize the elements of the CWP that are used for air-ground communication.	Frequency selection, emergency, station selection, coupling, microphone, headset, loudspeaker, footswitch, push-to-talk.	• Demonstrate on Actual equipment if possible		30
5.3.5	List future developments and techniques which may have an impact on ATS voice communications.	e.g. CPDLC, VDL Mode 2.	• Discuss new and emerging technologies in ATS Voice Communication	Trade Magazines; Current News	10

5.4: Ground-Ground communication

No	Objective	Main Points	Development Notes	Resource	Time
5.4.1	State the functions and the basic operations of routing and switching equipment in use in ATS environment.	General architecture.	• Landlines, Telephony basic, analog, digital, voice over IP	Manufacturer Manuals	30

No	Objective	Main Points	Development Notes	Resource	Time
5.4.2	Describe how ground-ground systems interface to provide an integrated service to ATS environment.	International/national links, ACC interoperability, voice and data integration.	• Local/International radio • Handoff	ICAO Annex 11 – Section 6.2	30
5.4.3	Describe the functionality of the elements of ground-ground communication.	Main and emergency systems, interfaces to telecom providers e.g., MFC and ATS-Qsig, switching, local PABX equipment.	• Provide end to end overview of communications system including some peripheral equipment	Manufacturer Manuals; General Block Diagram	15
5.4.4	Recognize the elements of the CWP used for ground-ground communication.	Selection, emergency, loudspeaker, headset, microphone.	• Radio circuits • Hotlines • Telephone	Operator Manual	15
5.4.5	Describe developments in ground-ground technologies that may impact on ATS voice communication.	TCP/IP, VoIP. e.g., future development of protocols	• Discuss new technologies and their potential impact/change	Trade magazines; Internet search	15

5.5: Introduction to data communication

No	Objective	Main Points	Development Notes	Resource	Time
5.5.1	Explain the purpose, principles and role of data communication systems in ATS.	e.g. Terminology, principles and theory of networks, layering (e.g., OSI or TCP/IP), data links, LAN, WAN.	• Basic overview of network topology and terminology	CCNA or similar Training books	60

No	Objective	Main Points	Development Notes	Resource	Time
5.4.2	Define the concept of data transmission.	e.g. Packet switching, protocols, multiplexing, demultiplexing, error detection and correction, routing, switching, hops, cost, bandwidth/speed.	• Reliability vs Speed • Time sensitive or not		60
5.5.3	Describe the function of various elements of the data systems in use in the ATS environment.	Switch, router, gateways, end systems, redundancy.	• Purpose/function of various devices • Impact of failure		30
5.5.4	Define protocols in current use.	e.g., TCP/IP, frame relay, asynchronous transfer mode.	• Protocols used in specific systems • What is the function if the various protocols in data transfer	Networking Knowledge. Local ANS System knowledge	30

5.6: Networks

No	Objective	Main Points	Development Notes	Resource	Time
5.6.1	State ATS requirements for safe data and communication	Reliability, availability	• Data Accuracy • Importance of readback	ATS Manuals	20
5.6.2	Describe the different types of networks	LAN, WAN, ATN, national network for ATM e.g., satellite dedicated networks, AFTN	• Describe different types of networks and network domains and how data moves within and between them	Networking Knowledge; Local ANSP Block Diagram	20

No	Objective	Main Points	Development Notes	Resource	Time
5.6.3	State the function of a network management system	Priorities, rights, e.g., SNMP	• Provide Basic overview of Network Management • Provide example(s) of Network Management software	Networking Knowledge	20

5.7: Aviation Specific networks, applications, and ATM/ANS providers

No	Objective	Main Points	Development Notes	Resource	Time
5.7.1	Name a range of air-ground aviation related network concepts	ATN e.g., Subnetworks: ATN air-ground subnetwork, AMSS, VDL, HFDL Protocols: ACARS Communication service providers: ARINC, SITA	• Provide Basic overview of Concepts and Services and what they are used for	General ANSP Knowledge	10
5.7.2	Name a range of ground-ground aviation-related network concepts.	ATN, PENS e.g., Physical networks: PENS, AFTN, RAPNET. Communication protocols: IP, ASTERIX, FMTP. Communication service providers: SITA, ARINC, national carriers, ANSPs.	• Provide Basic overview of Concepts and Services and what they are used for	General ANSP Knowledge	10
5.7.3	Define SWIM.	SWIM institutional framework and applications. E.g., SWIM providers and users.		General ANSP Knowledge	10

Subject 6: Navigation

6.1: Purpose and use of navigation

No	Objective	Main Points	Development Notes	Resource	Time
6.1.1	Explain the need for navigation in aviation.	Positioning, guidance, planning.	• Discuss why it is needed and how it is used.	ICAO DOC 9613	15
6.1.2	Characterize navigation methods.	E.g. Historical overview, visual, celestial, electronic (on-board, radio, space-based and relative).	• E.g. Could discuss Pilotage, Dead Reckoning, NAVAIDS		15

6.2: Form of the Earth

No	Objective	Main Points	Development Notes	Resource	Time
6.2.1	State the shape of the Earth	Oblate spheroid. E.g., Diameter, gravity, rotation, axis, magnetic field.			15
6.2.2	Explain the Earth's properties and their effects.	Polar axis, direction of rotation.	• Explain true North vs magnetic north and its effect on bearings		10
6.2.3	State the accepted conventions for describing 2D position on a globe.	Meridians, parallels of latitude, equatorial plane.	• Discuss accuracy and precision • Discuss latitude and longitude • Discuss polar and azimuthal		10

6.3: Coordinate systems, directions, and distance

No	Objective	Main Points	Development Notes	Resource	Time
6.3.1	State the general principles of reference systems.	Geoid, reference ellipsoids, WGS 84 Latitude and longitude, undulation.	• Provide overview of Geopotential models		20
6.3.2	Explain why a global reference system is required for aviation.				10

6.4. Earth's Magnetism

No	Objective	Main Points	Development Notes	Resource	Time
6.4.1	State the general principles of Earth's magnetism.	True North, magnetic North e.g. Variation, declination, deviation, inclination.	• Discuss general principles of Earths magnetism and how they can affect navigation in aviation		15

6.5: Factors affecting electronic navigation performance

No	Objective	Main Points	Development Notes	Resource	Time
6.5.1	State how radio waves propagate.	Ground, sky, line of site.	• Discuss - reflection, refraction, diffraction, absorption, polarization, and scattering		15
6.5.2	State why the siting of a terrestrial navigation aid is important.	Multipath, blanking.	• Discuss Line of site, frequency range, interference, phase shifting • Discuss EMI and control signal used for blanking		10

6.6: Performance of navigation systems

No	Objective	Main Points	Development Notes	Resource	Time
6.6.1	State the performance of navigation systems	Coverage, accuracy, integrity, continuity of service, availability.	• Site/system Engineering design • Critical parameters • Backup power considerations • Monitoring / IDENT	ICAO DOC 9613	10
6.6.2	Explain the need for redundancy in navigation systems.	Ensuring continuity of service, maintainability, reliability.	• Discuss main/backup, Adjacent facilities, main/standby channels, different types of Navigational Aids		5

6.7: Means of Navigation

No	Objective	Main Points	Development Notes	Resource	Time
6.7.1	State the different means of navigation.	Sole, primary, supplementary.	• Discuss navigation with single or multiple Navaids		10

6.8: Terrestrial Navigation aids

No	Objective	Main Points	Development Notes	Resource	Time
6.8.1	Explain the basic working principles of electronic positioning.	Distance measurements (time and phase), angular measurements.	• Use chart or other relevant training material to depict how basic electronic positioning works		15
6.8.2	Describe ground-based navigation systems.	NDB, VOR, DME, ILS, DF e.g., TACAN, marker beacons.	• Give basic overview of purpose of each Navaid and describe functionality of each		30
6.8.3	Recognize how the navigation information is displayed on the relevant pilot HMI.		• Discuss or show examples of Pilot HMI for each system. E.g. Cockpit ILS Gauge		30
6.8.4	Explain the operational use of ground-based navigation systems in the different phases of flight.	NDB, VOR, DME, ILS, DF.	• Provide example of cross-country flight and discuss various Navaids used at each phase of the flight from takeoff > enroute >approach > landing		15

No	Objective	Main Points	Development Notes	Resource	Time
6.8.5	Recognize the frequency bands used by the ground-based navigation systems.		• Discuss or provide printout of frequency bands for the various Navaids		5
6.8.6	State the need for calibration.	Flight calibration, ground-based calibration and/or maintenance.	• Regulatory requirements • Accuracy/system integrity • Coverage		10

6.9: On-board navigation systems

No	Objective	Main Points	Development Notes	Resource	Time
6.9.1	State the use of on-board navigation systems.	E.g. Barometric altimetry, radio altimetry, INS/IRS, compass.	• Discuss the function of on-board navigation systems and redundancy to Terrestrial Navaids		5
6.9.2	State the use of an FMS.	Sensors, navigation database.	• FMS components		15

6.10: Space-based navigation systems

No	Objective	Main Points	Development Notes	Resource	Time
6.10.1	Explain the basic working principles of satellite positioning.	GNSS e.g., Galileo, GPS	• Provides geolocation and time information to a GPs Receiver • Requires line of sight to 4 + GPS satellites		10
6.10.2	Recognize the basic architecture of a core satellite positioning system.	GNSS e.g., Galileo, GPS	• Provide basic diagram or such showing basic overview of system and discuss		10
6.10.3	Recognize the frequency bands used by the space-based navigational systems.		• Discuss or provide printout of frequency bands for space-based navigation		5
6.10.4	State the benefits of satellite-based navigation	Global coverage, accuracy, time dissemination		Research latest info –	10

No	Objective	Main Points	Development Notes	Resource	Time
		E.g. Redundancy, interoperability, single set of avionics.		possibly WWW or Trade periodicals	
6.10.5	State the current limitations of space-based navigation systems	E.g. Single frequency, weak signal, ionospheric delay, institutional, military, multipath.		Research latest info – possibly WWW or Trade periodicals	10
6.10.6	Describe the basic working principles of satellite augmentation.	ABAS (RAIM, AAIM), SBAS (WAAS, EGNOS), GBAS	• Discuss improved Accuracy, Integrity and Availability		20
6.10.7	State the current implementations of satellite-based navigation systems.	Core Systems: GPS, GLONASS, GALILEO, BeiDou. Augmentation systems: RAIM, ASIM, EGNOS, WASS, GBAS	• State latest implementations and different relevant augmentation systems	Research latest info – possibly WWW or Trade periodicals	10

6.11: PBN

No	Objective	Main Points	Development Notes	Resource	Time
6.11.1	Describe the performance-based navigation (PBN) concept	ICAO Doc 6913	• Provide overview • Discuss advantages		10
6.11.2	List the navigation applications in use in the region.	E.g., B-RNAV-5 (B-RNAV), P-RNAV-1 (P-RNAV), RNP approaches.		Local ANSP / Aerodrome	10

6.12: Future Developments

No	Objective	Main Points	Development Notes	Resource	Time
6.12.1	State future navigation developments.	E.g., 4D-RNAV, free routes, rationalization plans, advanced RNP.	• Research Current Trends in Aviation Navigational Aids and present latest and upcoming Technology		20

Subject 7: Surveillance

7.1: Introduction to surveillance

No	Objective	Main Points	Development Notes	Resource	Time
7.1.1	Define surveillance in the context of ATM.	What positioning/identification) and why (maintain separation).	• Purpose of surveillance in ATM context. • Describe the different Aircraft separation standards based on radar sensing available and location of airspace. Different altitude standards based on location and calibration standards. • Describe separation standards when no external equipment able to verify other than pilot reports (procedural separation)	ANSP ATC	20
7.1.2	Define the various surveillance domains	Air-air, ground-air, ground-ground.	• Define the Air-Air domain, typically aircraft to aircraft (ADS-b, TCAS, ACAS, • Define the Ground to Air Domain, typically aircraft to some form of ATC (SSR, PSR, ADS-b, ADS-b Space based, MLAT, Camera or light spectrum sensing IR) • Define Ground to Ground domain, typically ATC to apron vehicles, ramp vehicles or any aircraft on movement surfaces (Airport surface detection, ADS-b, MLAT, SMR, Camera or light spectrum sensing IR)		30
7.1.3	List the surveillance techniques.	Non-cooperative, cooperative, dependent, independent techniques.	• Define the following terms: Cooperative Radar Target, those with some form of on-board equipment cooperating in the		30

No	Objective	Main Points	Development Notes	Resource	Time
			transfer of data. SSR, MLAT, ADS-b) • Define dependent with reference to RADAR, meaning the radar system is dependant on the aircraft to participate actively in the acquisition of the data. Cooperate to get the data, SSR, MLAT, ADS-b) • Define non-cooperative targets, these are aircraft that are not participating actively in the acquisition of location data, aircraft without SSR transponder, without ADS-b out. • State some techniques to identify independent or non-cooperative targets, such radars as PSR, SMR are designed to locate non-cooperative targets.		
7.1.4	Define the current and emerging surveillance systems in use in ATM.	Radar technology, ADS technology, multilateration, TIS.	• Define PSR, Primary Surveillance Radar basic principles • Define SSR, Secondary Surveillance Radar basic principles • Define MLAT, Multilateration basic principles • Define ADS-b, Automatic basic principles • Define SMR, Surface Movement Radar basic principles • Define ACAS- TCAS is a version or synonym of ACAS basic principles • Define Camera Tracking Surveillance Systems.		60

No	Objective	Main Points	Development Notes	Resource	Time
			• Define TIS-b, Traffic Information Service		
7.1.5	Explain the role and the current use of surveillance equipment by ATM.	Separation, vectoring, data acquisition, Detection and ranging, safety nets, e.g. Weather mapping.	• Describe Separation as it applies to all the different types of air space zones. • Define Vectoring • Define Detection and Ranging, see above, • Define what additional safety systems are provided to enhance aircraft target safety, one example, weather Maps, lightning maps	ICAO ANNEX 10 section IV	20
7.1.6	State ICAO and any local legal requirements	E.g. ICAO SARPS, Annex 10 Vol. IV.	• Define the role of ICAO as it pertains to Radar Sensing Equipment. ICAO ANNEX 10 section IV defines many aspects of operation for in broad terms SSR. SSR is the basis for MLAT, MODE S, ADS-b and TIS-b. ICAO defines frequencies and their standards, interrogation and reply message formats and the tolerances associated with the data transfer.	ICAO ANNEX 10 section IV	10
7.1.7	List the main users of surveillance data.	HMI, safety nets, FDPS, air defense systems, flow management.	• Define Human Machine interface and how it pertains to Radar targets. • Define the additional safety redundancy as it pertains to Radar Data, redundant PSR SSR channels at site, Overlap of Radar Coverage areas (service Volumes) redundancy with respect to Flight Data Processing Systems.		30

No	Objective	Main Points	Development Notes	Resource	Time
			• Define how the Civil aviation system is integrated into the local air defense system and vice-versa. • Define how flight data is used within the Flow Managements systems • State the safety, economic and environmental advantages, of a flow management system.		

7.2: Avionics

No	Objective	Main Points	Development Notes	Resource	Time
7.2.1	State the avionics used for the surveillance in ATM and their interdependencies	Transponder, GNSS, data link equipment, ACAS, ATC control panel, e.g. FMS.	• State the purpose and general operation of the following Aircraft Equipment. ○ Transponder, depending on type can be used with Mode A/C or Mode A/C and S SSR, can be used with ADS-b out and ADS-b in, MLAT can also use this transponder. ○ ACAS (TCAS) uses the data from the Transponder to create a Virtual 3D bubble around the aircraft, the aircraft locations and tracking are processed using algorithms to determine RA (recommended Actions) or TA (traffic advisories). ○ ACAS, depending on the type of ACAS the conflicted aircraft can		20

No	Objective	Main Points	Development Notes	Resource	Time
			ensure these RAs completement each other.		
7.2.2	Define the role of TCAS as a safety net.	E.g. FMS.	• Describe the objective of ACAS (Airborne Collision Avoidance System) ○ To provide advice to pilots for the purpose of avoiding potential collisions. This is achieved through resolution advisories (RAs), which recommend actions (including manoeuvres), and through traffic advisories (TAs), which are intended to prompt visual acquisition and to act as a precursor to RAs. ACAS has been designed to provide a back-up collision avoidance service for the existing conventional air traffic control system while minimizing unwanted alarms in encounters for which the collision risk does not warrant escape manoeuvres. The operation of ACAS is not dependent upon any ground-based systems		20

7.3: Primary Radar

No	Objective	Main Points	Development Notes	Resource	Time
7.3.1	Describe the need for and the use of primary radar in ATC.	Non-cooperative detection, improvement of detection and tracking e.g. Types of PSR (en-route, terminal, SMR, weather).	• Primary Surveillance Radar is required to detect aircraft that do not have any cooperative target equipment on board or the equipment is unserviceable due to failure in flight, SSR Transponder, ADS-b etc. The Primary Radar will see all aircraft regardless. Primary Radar will be able to see aircraft as it enters a control zone even if by error and alert or vector other traffic away from the offending aircraft. • Describe a Terminal PSR- this type of Primary is located at or near an airport to track all non-cooperative targets within the defined range, typically 50-80 miles. • Describe an en-route PSR- this type of PSR is designed to track non-cooperative targets along prescribe air routes or corridors, these systems generally have a greater range. • Describe an SMR, Surface Movement Radar, these PSR systems are designed to see non-cooperative targets on the maneuvering surface of Airports. Therefore, they will see aircraft, baggage carts, mules, security vehicles, maintenance vehicles etc. This style of PSR operates with different characteristics that		60

No	Objective	Main Points	Development Notes	Resource	Time
			reduce the range to within the airport area but allow the resolution to be much greater compared to a terminal PSR. • Describe a Weather PSR, some En-route and terminal PSR have to capability to detect weather, however these radars are designed to see metal objects not water droplets or water vapour. These radars will typically only see or detect severe weather events.		
7.3.2	Explain the principles of operation, basic elements and overall architecture of a primary radar.	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.	• Explain how a typical PSR detects a target • Describe how PSR determines Range- the PSR can determine the Slant range of a target by measuring the time from the transmission to the time the reflection is received. • Describe how a PSR will determine Azimuth. Most Radar systems will have a rotating antenna that is calibrated to true north or Magnetic north. As the antenna rotates its azimuth is being disclosed to the rest of the system. • Define Clutter- Clutter is a term used for unwanted echoes in electronic systems. • PSR Doppler shift is only used to determine if a target is moving or not, it is not used to calculate the speed of a target. • Describe a basic PSR Antenna • Define a circulator		90

No	Objective	Main Points	Development Notes	Resource	Time
			• Define how a target is processed through the PSR.		
7.3.3	State the limitations of primary radar.	Line of sight, environmental, clutter, no identification of the target, no height information (in case of 2D radar).	• Typically, any RF signal over 30 MHz will operate line of sight, PSR frequency range is typically 1.2 GHz to 17 GHz. This is well within line of sight criteria. A Radar antenna at approx. 100 ft above sea level with no other obstructions can only see target above 5000 feet 100 nautical miles away. • Define Environmental limitations- the PSR is affected by other environmental issues, heavy rain, weather inversions or fronts. • Define a Solo PSR target		30

7.4: Secondary radars

No	Objective	Main Points	Development Notes	Resource	Time
7.4.1	Describe need for and the use of secondary radars in ATC.	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.	• Describe Secondary Detection Radar- most Secondary detection Systems operate using SSR standards, Mode A, mode C and Moe S. • Describe BDS- Binary Data Store		30

No	Objective	Main Points	Development Notes	Resource	Time
7.4.2	Explain the principles of operation, basic elements and overall architecture of a secondary radar.	SSR, MSSR, Mode S antenna, TX/RX, extractor, tracking processor e.g. Use of the parameters of the radar equations	• Describe MSSR- Monopulse Secondary Surveillance Radar is a method to calculate Accurate Azimuth.		20
7.4.3	State the limitations of secondary radar.	FRUIT, garbling, ghost reply, code shortage, cooperation by the aircraft needed.	• Define FRUIT- False Reply unsynchronized in time • Define SSR Ghost • Define Code Shortage- SSR codes are limited to a 4-digit 0-7 format that leaves at total of 4096 codes available to all aircraft in each control zone or area.		30

7.5: Surveillance data message format

No	Objective	Main Points	Development Notes	Resource	Time
7.5.1	State the need for harmonization	Surveillance data sharing, interoperability.	• Define Sharing Radar Data- most states share data within their borders and will when required share data across borders to help with the safe flow of air traffic. Some states will share data with military defense systems and vice versa.		10
7.5.2	State the techniques used for transmission of surveillance data.	E.g. Point-to-point, network, microwave, satellite.	• Describe data transfer mechanisms used to transmit radar data from source to client. • Describe Point-to Point – some cases when the radar site is in very close proximity to the client simple serial data tools are used.		20
7.5.3	State main formats in use.	E.g. ASTERIX.	• Radar data transmission formats, • ASTERIX-All-purpose structured EUROCONTROL surveillance information exchange		10

7.6: Automatic dependent surveillance (ADS)

No	Objective	Main Points	Development Notes	Resource	Time
7.6.1	State surveillance-related FANS concepts and their impact on ATM.	Sources of aircraft parameters (e.g. FMS outputs), communication mediums. Application within oceanic and other non-radar airspace, ATC requirements.	• The FANS concept was developed to improve the safety and efficiency of airplanes operating under procedural control. This method uses time-based procedures to keep aircraft separated.		10
7.6.2	Explain the principles of operation, basic elements and overall architecture of ADS-C and ADS-B and the differences between them.	Advantages/disadvantages, standards, data update rates.	• ADS-addressed (ADS-A), also known as ADS-Contract (ADS-C) • ADS-broadcast (ADS-B)		20
7.6.3	State the data link technologies proposed and the current situation of deployment.	Extended squitter 1 090 MHz, e.g. VDL 4, HFDL, UAT, AMSS.	• Describe UAT- ADS-B is short for Automatic Dependent Surveillance Broadcast and is used to help track aircraft • UAT is short for Universal Access Transceiver and is transmit at 978 MHz Like ADS-B it is used to keep track of aircraft, however UAT is only available in the USA and only for aircraft that fly below 18,000ft. • Define Extended Squitter-The “extended squitter” ES format is capable of carrying much more data than the basic “short squirt” Mode S version. • Define VDL4 - The ICAO standard for VDL Mode 4 specifies a protocol enabling		30

No	Objective	Main Points	Development Notes	Resource	Time
			aircraft to exchange data with ground stations and other aircraft. VDL Mode 4 uses a protocol that allows it to be self-organizing, meaning no master ground station is required. • Define AMSS- Aeronautical mobile-satellite (R) service (AMS(R)S). - An aeronautical mobile-satellite service reserved for communications relating to safety and regularity of flights, primarily along national or international civil air routes.		

7.7: Weather radar

No	Objective	Main Points	Development Notes	Resource	Time
7.7.1	Define the use of weather radar in ATM.	e.g. Role in adverse weather in dense airspace, antenna, coverage, polarization, multi elevation scanning, frequency band.			20

7.8: Integration of surveillance information

No	Objective	Main Points	Development Notes	Resource	Time
7.8.1	Describe complementary use of different sensors				10

7.9: Multilateration

No	Objective	Main Points	Development Notes	Resource	Time
7.9.1	State the use of MLAT in ATC.	LAM and WAM	• MLAT provides surveillance for modes A/C, mode S and ADS-B. There are two types of MLAT systems, LAM (local area multilateration) and WAM, which basically differ on the sensors coverage area. LAM is more appropriate to airplanes and vehicles surveillance at the airport area, while WAM has a wide area system, i.e., the sensors are widely spread in order to ensure the coverage area. They also differ in the number of antennas necessary to install and their location, which are consequences of the difference in the size of the coverage areas. Since the SSR has a wide coverage area, the most suitable choice to replace this one is the WAM system.		30
7.9.2	Explain the principles of operation, basic elements and overall architecture of MLAT.	TDOA principle, hyperbolic positioning, accuracy, transmissions used.	• Multilateration is a proven technology that has been in use for many decades, using a method known as Time Difference of Arrival (TDOA). • Multilateration requires no additional avionics equipment, as it uses replies from Mode A, C and S transponders, as well as military IFF and ADS-B transponders.		30

7.10: Airport surface surveillance

No	Objective	Main Points	Development Notes	Resource	Time
7.10.1	State typical ATC requirements.	e.g. Safety (aircraft and mobiles), clear runway, low visibility, collision warnings, displays, mapping, data merging, aircraft identification, ground mobiles.			20
7.10.2	State the current technologies for airport surface surveillance.	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).			20

7.11: Display of surveillance information

No	Objective	Main Points	Development Notes	Resource	Time
7.11.1	Recognize surveillance information on a display	e.g. PSR and MSSR tracks, position identification, FL, speed vector, RDP and FDP information.			20

7.12: Analysis tools

No	Objective	Main Points	Development Notes	Resource	Time
7.12.1	State analysis tools.	E.g. SASS-C.			20

Subject 8: Data Processing/Automation

8.1: Introduction to data processing

No	Objective	Main Points	Development Notes	Resource	Time
8.1.1	Describe the functions and generic architecture of the systems.	Generic FDP and SDP overall functional block diagrams.	• Describe data flow through block diagram • Describe components of block diagram and their functions	Functional block diagram	60
8.1.2	Describe how the systems interface with other systems.	Surveillance sensors, displays, flight plan distribution systems, recording, international ATM networks. e.g. Safety nets, military interfaces.	• Describe peripherals of system, their function, and how data is shared between each peripheral	Functional block diagram	120
8.1.3	Define basic software functions/applications	FDP (route processing, code/call sign correlation, code allocation, strip distribution, track labelling) SDP (coordinate conversion, plot and track processing, MRP, safety nets, track labelling).	• Provide brief overview of Flight Data Processing • Provide brief overview of Surveillance Data Processing	ANSP System Manuals	60
8.1.4	State the legal aspects for data processing in ATM.	Traceability and recording of data and actions, configuration control.	• Define the methods and tools used for recording (Data, voice) and the regulations which require it	ICAO regulations Local regulations	15
8.1.5	State current developments and future possibilities.	e.g. Coflight, iTEC, SESAR, NextGen, multisensor tracking.	• Briefly describe the current and future state of ATM systems	Trade publications ANSP Design engineers	15

8.2: System software and hardware principles

No	Objective	Main Points	Development Notes	Resource	Time
8.2.1	Describe the current hardware configurations used in ATM.	Redundancy and backup E.g. Driver, interfaces, hardware platforms, fault tolerant systems.	• Describe fault tolerance and redundancy used in ATM (Servers, routers, switches, data, hot-standby, etc.)	Local ANSP design	30
8.2.2	Describe the current software platforms, used in ATM.	Operating systems.	• Provide brief overview of the different operating systems and applications used by ATM	Local ANSP design	30
8.2.3	Describe concepts of virtualization in ATM	Virtual center (remote CWP-SESAR). E.g., Display virtualization (remote display unit (RDU)), server virtualization (server consolidation).		Local ANSP design	30

8.3: Surveillance data processing (SDP)

No	Objective	Main Points	Development Notes	Resource	Time
8.3.1	State ATC requirements	QoS, mandatory data recording, dependability	• Describe system availability • Describe response times • Describe data recording • Discuss redundancy requirements, overlapping coverage, etc.	Local ANSP requirements	15
8.3.2	Explain the principles of SDP.	E.g. Single, multi, plot, track.	• Explain Single RADAR vs Multi RADAR coverage • Describe Tile Sets • Explain data flow from RADAR to ATCO display • Explain differences between SDP for PSR and SSR	RADAR Training Manual	45

No	Objective	Main Points	Development Notes	Resource	Time
8.3.3	Describe the functions of SDP	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.	• Describe process of taking input from various sources, processing the data, and outputting to various end users/systems • Describe process of subscribing to data across WAN • Describe process of monitoring data for accuracy • Describe seamless integration of data	SDP Training Manual	60
8.3.4	Describe radar data inputs/outputs	Tracks, plots, messages, code/call sign, time, control and monitoring, conflict alerts, FDP interface, maps, adaptation	• Describe Interconnectivity to RADAR display system • Describe how information relating to flight plans is processed • Describe how call sign, departure/arrival airports, type of aircraft is processed	SDP Training Manual	60
8.3.5	Describe the surveillance data-based monitoring functions.	Safety nets, ATC tools e.g. Safety nets: STCA, MSAW, APW, runway incursion alerts ATC Tools: MTCD, AMAN, DMAN, A-SMGCS.	• Describe adaptation and what parts are used for accuracy, warnings, conflict alert, etc. • Describe functions of GUI	Engineering Release Notes; Training Manuals	30

8.4: Flight data processing (FDP)

No	Objective	Main Points	Development Notes	Resource	Time
8.4.1	State ATC requirements	QoS, unambiguous, accurate, error free, timely.	• Describe error checking • Describe PARROTs • Describe permanent Echo's	FDP Training Manual	20
8.4.2	Explain the functions of FDP.	Flight strip production, flight plan data updates, code/call sign correlation, flight progress	• Describe how FDP produces flight strips and how they are updated • Describe how call sign is processed to display	FDP Training Manual	20

No	Objective	Main Points	Development Notes	Resource	Time
		monitoring, coordination and transfer E.g. CIV/MIL coordination.	• Describe data transfer between Flight Information Regions		
8.4.3	Define inputs and outputs.	Flow control flight strips/data displays, MRT, environmental data, static data, airspace adaptation.	• Describe Interconnectivity to RADAR display system • Describe how information relating to flight plans is processed • Describe Flight Supplement data	FDP Training Manual	30
8.4.4	Describe the basic software functions/applications.	FDP (route processing, code/call sign correlation, code allocation, strip distribution, track labelling).	• Describe FDP data flow and the software used to process/display it	FDP Training Manual	30
8.4.5	Describe the FPL data update process	Automatic and manual update.	• Describe how FDP produces flight strips and how they are updated	FDP Training Manual	20

8.5: Human machine interface systems

No	Objective	Main Points	Development Notes	Resource	Time
8.5.1	Describe the different display technologies.	Common graphic display interface, LCD, TFT, touch input device, video interfaces, extenders. DVI, HDMI, DisplayPort, Thunderbolt, video and USB signal extenders, video splitters and video frame rate encoders.	• Describe the types of displays and human interactions with systems in the ATCO and ATM environment	Local ANSP topology	30
8.5.2	Recognize what information is normally displayed on the ATCO and ATSEP HMI.		• Describe Software, Layouts, Availability of different data sets	Local ANSP topology	30

8.6: Miscellaneous information

No	Objective	Main Points	Development Notes	Resource	Time
8.6.1	State the additional data used by ATM system	E.g., MET, AIM (NOTAMs), CDM, aircraft data.			20

Subject 9: System Monitoring and Control

Sub-Topic 9.1: Overview of SMC Function

No	Objective	Main Points	Development Notes	Resource	Time
9.1.1	Describe the principles and purpose of the operational management of the technical services.	Service requirements, interfaces, boundaries of tactical responsibility e.g. Hierarchy of authority for the technical and ATC structures.	• FIR structure (jurisdiction) and map(s) • Compare/Contrast Enroute ATC, Tower ATC • Explore ATC org chart • Explore Technical / Engineering org. Chart • Overview ATSEP-staffed and remote sites within jurisdiction		60

9.1.2	Describe the technical system architecture of the SMC function and its subordinate systems.	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.
			• Air navigation systems equipment Monitoring and Control interface or workstation (HMI)
			• Compare/contrast ATM/CNS architecture
			• ATM Interoperability diagram
			  ○ by system/subsystem
			  ○ by service to ATC/airmen
			• CNS architecture as a backup to RNAV/GPS navigation
					60

9.1.3	Describe the transfer of responsibility for a service.	Operational and technical responsibility, configuration and monitoring access and responsibility.	• Service removal advisory • NOTAM issuance • Service restoral handoff back to Air Traffic Services		20

Sub-Topic 9.2: System configuration

No	Objective	Main Points	Development Notes	Resource	Time
9.2.1	Describe the range of configurations that can be used.	Equipment or channel switching, parameter settings.	• Single channel ops / loss of redundancy (e.g. ILS transmitter failure) • Full redundancy ops (e.g. Dual server flight data processing system) • Degraded service/subordinate component failure (e.g. Primary Surveillance RADAR failure, with co located Secondary Surveillance RADAR operational)		20
9.2.2	Describe the general techniques that are employed to make configuration changes.	e.g. Physical switching.	• HMI / Air Navigation systems monitoring and control interface manipulations • In situ manipulations		15
9.2.3	State procedures required to implement a planned major system change.	e.g. Safety requirement, authorization, 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.	• Identifying and early advising of major stakeholders • Identifying any subordinate stakeholders (e.g. remote towers) • Keeping track of outage time window / overruns		20

Sub-Topic 9.3: Monitoring and control functions

No	Objective	Main Points	Development Notes	Resource	Time
9.3.1	State the monitoring functions that are available	E.g. BITE, status, parameters, software and hardware watchdogs.	• Self-reporting systems (ex. NAVAIDS, Surveillance, flight data and weather data servers) • User-reporting / complaint-based systems (ex. DF, EM interference, unmonitored radios, emergency / backup systems/facilities)		30
9.3.2	State the control functions that are available	e.g. Switching, parameters, set configurations	• HMI / Air Navigation systems monitoring and control interface manipulations • in situ manipulations		20
9.3.3	Explain the importance of SMC management and coordination of maintenance activities.		• Constant ANS equipment integrity assurance • User (ATC) support • First-level response / immediacy of response/restoration for remote/unstaffed equipment • Assignment of corrective duties to appropriate authority • Emergency contact for FIR • Proper equipment shutdown and advisory (ex. Third-party activities affecting NAVAIDS such as snow clearing/vegetation control). • Technical authority on premises • Alternating (vulgarizing or elevating) use of language to suit ATSEP or ATC as needed		40
9.3.4	State analysis tools associated with SMC.	e.g. Possible malfunctions (SASS-C track and noise monitoring tools).	• HMI / Air Navigation systems monitoring and control interface manipulations		20

Sub-Topic 9.4: Coordination and reporting

No	Objective	Main Points	Development Notes	Resource	Time

9.4.1	State why coordination and reporting are required and how it is achieved.	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.
			• Single point of contact for all-FIR
			• Consistency of execution of fault restoration or escalation
			• Keeping dependant parties apprised (ex. Adjacent FIR or SMC center).
			• Computer assisted log keeping
			• Robust databases:
			  ○ FIR/SMC jurisdiction schematics and equipment inventory
			  ○ ATSEP contacts
			  ○ Site Contacts
			  ○ TELCO circuits connecting jurisdiction equipment
			  ○ procedures
					40

Sub-Topic 9.5: Emergency coordination

No	Objective	Main Points	Development Notes	Resource	Time
9.5.1	Describe situations where coordination and reporting will be necessary.	E.g. Hijack, mayday, r/t fail, loss of aircraft, MIL action, fire, flood, security, terrorist threat or action, medical.	• Robust procedures • Frequent review and practice of emergency scenarios • First Aid and first responder training as deemed necessary		20

No	Objective	Main Points	Development Notes	Resource	Time
9.5.2	State which parties may be involved in the coordination and reporting of emergency situations	E.g. ATC supervisors (local and remote), ATSEP supervisors (local and remote), management, police, MIL, medical, accident investigation branch.	• Law enforcement (local/federal) ○ may require logbooks and voice recordings • Radio Frequency spectrum management authority may investigate interference • military search and rescue may require information		15
9.5.3	Explain the responsibilities and/or duties of SMC members during an emergency situation by using an example scenario.		• Close collaboration with ACC / FIR management		15
9.5.4	State the succession of authorities and responsibilities in the event that the nominated person or function is not available	Hierarchy of responsibility			15

Sub-Topic 9.6: Equipment operating

No	Objective	Main Points	Development Notes	Resource	Time
9.6.1	Define the principles and ergonomics of the HMI of the SMC central system and its subordinate systems.	Permissions, control tokens, ergonomic conventions (e.g. Green is good or safe, red is fail or unsafe).	• Understanding significance of indications for the end-user (ATC, FSS, pilot). Ex. Red could mean loss of service (noticeable) or loss of redundancy (unnoticed).		30

No	Objective	Main Points	Development Notes	Resource	Time
9.6.2	State the routine tasks required and the criticality of their completion and any legal requirements.	e.g. Audio circuit voice checking, audio recording checking, archive media changing and storage, VOLMET.	• Advising appropriate stakeholders (ATC/FSS, pilots via NOTAM) of scheduled AND unscheduled failures. • Issuing NOTAMS in timely fashion for known releases • Shift brief for next SMC • apprising ATC management of ongoing outages • Monitoring scheduled release time windows		30

Subject 10: Maintenance Procedures

10.1: Maintenance Procedures

No	Objective	Main Points	Development Notes	Resource	Time
10.1.1	Explain handling precautions to be taken to ensure equipment protection.	Isolation, protection devices, electrostatic sensitive devices, power supplies, heavy loads, high voltage		Policy and procedures of Member State/ANSP	90
10.1.2	Explain the classifications of maintenance	e.g. preventative, corrective, service configuration			20
10.1.3	Explain the maintenance strategy and rules.	Organization and planning of maintenance, rules controlling deviation from planned maintenance, intervention tracking, return to service	• Policy and procedures of Member State/ANSP	Policy and procedures of Member State/ANSP	30
10.1.4	State the scope or responsibility of an S/E rated person.	e.g. tracing maintenance actions and objectives, liability of maintenance personnel actions, safety of service, safety of equipment	• Policy and procedures of Member State/ANSP	Policy and procedures of Member State/ANSP	20

Subject 11: Infrastructure

11.1: Power Supplies

No	Objective	Main Points	Development Notes	Resource	Time
11.1.1	Define the performance for power supply systems in the operational environment.	Availability, quality, Continuity of Service	• Explain the importance of the uninterrupted service of power source.		30
11.1.2	Define the main features of current power supply systems	e.g., UPS systems, batteries and emergency generators, high voltage, earthing techniques, power provider(s).	• Briefly explain local power source: commercial power, battery, UPS, generators		120
11.1.3	Describe the power distribution system at an example operational site.	e.g., power distribution redundancy, input, output, protections, measurements and monitoring, block schematic.	• Briefly explain local system power source: local ILS, Radar, air traffic tower		120

11.2: Air Conditioning

No	Objective	Main Points	Development Notes	Resource	Time
11.2.1	State the function, appropriate terminology and performance of current air conditioning systems in use.	e.g. air conditioning, water cooling, humidity control, air filtering system, visit to stations	• Briefly explain local air conditioning system and operational performance.		90
11.2.2	State the importance and criticality of maintaining a controlled environment	Short- and long-term effect on people and equipment	• Explain the importance of the uninterrupted service to air conditioning systems to equipment and personnel.		30

Subject 12: Safety

12.1: Policy and Principles

No	Objective	Main Points	Development Notes	Resource	Time
12.1.1	Explain the underlying need for safety management policy and principles.	ICAO Annex 19, lessons learnt from events, evolving environment, requirements	• safety is the state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management. • Reference ICAO Annex-19/ICAO SMM Doc 9859	ICAO Annex-19/ICAO SMM Doc 9859	60
12.1.2	State the safety management policy	ICAO Annex 19, priority of safety, the safety objective of ATM, roles and responsibilities	• Reference ICAO Annex-19/ICAO SMM Doc 9859 • Policy and procedures of Member State/ANSP	Policy and procedures of Member State/ANSP	30
12.1.3	Explain safety management principles.	ICAO Annex 19, safety achievement, safety assurance, safety promotion	The four components of SMS • Safety Policy • Safety Risk Management • Safety Assurance • Safety Promotion	ICAO Annex-19/ICAO SMM Doc 9859	30
12.1.4	Appreciate the reactive and proactive nature of safety management policy and principle	e.g., ICAO Annex 19. nature of events, Swiss cheese model (J. Reason), events investigation, safety assessment	• Describe Reason's Model • Briefly describe the need for an affective safety management program	ICAO Annex-19/ICAO SMM Doc 9859	30
12.1.5	Explain the link between safety management principles and the life cycle of an ATM system.	ICAO Annex 19, safety occurrences, setting of safety levels, system safety assessment, safety surveys, safety monitoring, system safety assessment			60

No	Objective	Main Points	Development Notes	Resource	Time
		documentation, lesson dissemination, safety improvement, use of safety data to assist in decommissioning or replacement of system			
12.1.6	Appreciate the ATSEP role and responsibilities to safety management.	Competency, occurrence reporting e.g. 'just culture' (ref.: EAM2 GUI6), risk assessment	• Reference ICAO Annex-19/ICAO SMM Doc 9859 • Policy and procedures of Member State/ANSP	Policy and procedures of Member State/ANSP	20
12.1.7	State the role and content of a typical SMS within an ANSP.	ICAO Annex 19	• Policy and procedures of Member State/ANSP	Policy and procedures of Member State/ANSP	20
12.1.8	Explain the "just culture" concept.	Benefits, prerequisites, constraints e.g. EAM2 GUI6	• Key item to a SMS program is the nonpunitive, positive safety culture which empowers all employees to have a role in safety.	ICAO Annex-19/ICAO SMM Doc 9859	20

12.2: Concept of Risk and Principles of Risk Assessment

No	Objective	Main Points	Development Notes	Resource	Time
12.2.1	Describe the concept of risk	Types of risk, components of risk, risk contributors (people, procedure, organizations and equipment)	• Safety risk is the projected likelihood and severity of the consequence or outcome from an existing hazard or situation. • Safety risks are conceptually assessed as acceptable, tolerable or intolerable.	ICAO Annex-19/ICAO SMM Doc 9859	20
12.2.2	State ways of assessing risk.	Risk comparisons, risk analysis	• Safety risk probability and severity assessment process can be used to derive a safety risk index.	ICAO Annex-19/ICAO SMM Doc 9859	20

No	Objective	Main Points	Development Notes	Resource	Time
			• The respective severity/probability combinations are presented in the safety risk assessment matrix.		
12.2.3	Describe the concept of risk tolerability.	Risk assessment and mitigation, ALARP Principle e.g. risk perception, risk management	• Safety risk management encompasses the assessment and mitigation of safety risks. • Safety risks are conceptually assessed as acceptable, tolerable or intolerable. • Safety risks assessed in the tolerable region are acceptable provided that appropriate mitigation strategies are implemented by the organization • Safety risks assessed as initially falling in the acceptable region are acceptable as they currently stand and require no action to bring or keep the probability and/or severity of the consequences of hazards under organizational control.	ICAO Annex-19/ICAO SMM Doc 9859	30

12.3: Safety Assessment Process

No	Objective	Main Points	Development Notes	Resource	Time
12.3.1	Explain the methods for the assessment of hazards and possible failures	e.g. Failure and hazard brainstorm session, Fault tree analysis	• Hazards exist at all levels in the organization and are detectable through use of reporting systems, inspections or audits. • Hazards can also be identified from the review or study of investigation reports, especially	ICAO Annex-19/ICAO SMM Doc 9859	60

No	Objective	Main Points	Development Notes	Resource	Time
			those hazards which are deemed to be indirect contributing factors, and which may not have been adequately addressed by corrective actions resulting from the investigation process • Three methodologies for identifying hazards are: 1. Reactive 2. Proactive 3. Predictive		
12.3.2	Appreciate the importance of adopting a total system approach covering human, procedure, organization and equipment elements	ATM system description (including scope definition and limitation), end-to-end integrity of safety assessment e.g. Concept of TRM			20
12.3.3	Describe the overall safety assessment process and its relationships with risk assessment during the total life cycle of ANS system.	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)	Safety/risk assessment 1. Identify the hazard 2. Decide who might be harmed and how 3. Evaluate the risks and decide on precautions 4. Record significant findings 5. Review/monitor assessment and update as needed		30

12.4: Air Navigation Safety Risk Classification Scheme

No	Objective	Main Points	Development Notes	Resource	Time
12.4.1	Describe the ATM system risk classification scheme.	e.g. Scenario of failure of air navigation system (incident chain), component of a risk classification scheme, severity classes, probability classes (qualitative and quantitative)	• Risk classification Scheme contains a severity classification for the identification of the effects of ATM/CNS related hazards on the safety of aircraft, but without quantitative rates being applied.		30

12.5: Safety Regulation

No	Objective	Main Points	Development Notes	Resource	Time
12.5.1	Describe the role of safety regulation.	The purpose of national regulations and international standards, , objective of the national regulator	• The safety management SARPs are intended to assist States in managing aviation safety risks, in coordination with their Service Providers	ICAO Annex-19/ICAO	20
12.5.2	Explain the relationship between the safety regulation documents.	ICAO SARPS, regional regulations, national regulations	• ICAO SARPS are recommended practices • Discuss local policy and procedures of Member State/ANSP	ICAO Annex-19/ICAO	20
12.5.3	Explain how the safety regulation documents affect ATM service provision	ICAO documentation (SARPS), regional Regulations, AMCs and GM, national regulation	• Safety regulation documents create a standard to increase aviation safety		20
12.5.4	Explain the interface between the safety regulator and the ANSP.	Information to be provided to regulator by ANSP and vice versa, importance of incident reporting	• Discuss local policy and procedures of Member State/ANSP	Policy and procedures of Member State/ ANSP	20

Subject 13: Health and Safety

13.1: Hazard Awareness

No	Objective	Main Points	Development Notes	Resource	Time
13.1.1	Consider potential hazards to health and safety generated by equipment used in CNS/ATM.	e.g. COM/SUR/SMC: mechanical hazards, electrical hazards (LV, HV, EMI), chemical hazards NAV: includes RF energy DP: none	• Discuss local and state Occupational Safety and Health Program	Policy and procedures of Member State/ ANSP	60

13.2: Regulations and Procedures

No	Objective	Main Points	Development Notes	Resource	Time
13.2.1	State applicable international requirements.		• Discuss local policy and procedures of Member State/ANSP	Policy and procedures of Member State/ ANSP	30
13.2.2	State any applicable national requirement		• Discuss local and state Occupational Safety and Health Program • Discuss local policy and procedures of Member State/ANSP	Policy and procedures of Member State/ ANSP	30
13.2.3	Describe safety procedure for the persons working on or near relevant equipment	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,	• Discuss local and state Occupational Safety and Health Program • Discuss local policy and procedures of Member State/ANSP	Policy and procedures of Member State/ ANSP	60

No	Objective	Main Points	Development Notes	Resource	Time
		earthing, direct or indirect contact with HV			

13.3: Handling of Hazardous Material

No	Objective	Main Points	Development Notes	Resource	Time
13.3.1	State regional and local regulations for electronic device disposal	Protection of environment e.g. Disposal/recycling	• Brief local Policy and procedures of Member State/ANSP	Policy and procedures of Member State/ ANSP	20

Subject 14: Functional Safety

14.1: Safety Attitude

No	Objective	Main Points	Development Notes	Resource	Time
14.1.1	State the role of ATSEP in safety management routines and in reporting processes.	Safety assessment documentation related to navigation, communication and surveillance systems; safety reports and occurrences; safety monitoring.	• SMS in ATM	ICAO ANSP	30

14.2 Functional Safety

No	Objective	Main Points	Development Notes	Resource	Time
14.2.1	Describe the implications of functional failures in terms of exposure time, environment, effect on controller and effect on pilot.	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).	• Safety policy reviews • Case study reviews	ANSP	20
14.2.2	Explain the need for NOTAMSs.	e.g., for PBN and GNSS	• Types of NOTAMS	ICAO ANSP	30

Subject 15: Human Factors

15.1: Introduction

No	Objective	Main Points	Development Notes	Resource	Time
15.1.1	Explain why human factors are particularly important in the ATM environment.	Historical background, safety impact on ATM, incidents.	• Human performance is cited as a caused factor in the majority of aircraft accidents. • Throughout the years, some three. out of four accidents have resulted from less than optimum human performance. • If the accident rate is to be decreased, Human Factors issues in aviation must be better understood and Human Factors knowledge more broadly and proactively applied • Resolution 826-9 (ICAO Assembly 1986) provides background on Flight Safety and Human Performance	ICAO Doc 9683 (Resolution 826-9 (ICAO Assembly 1986)	60
15.1.2	Define human factors.	e.g. ICAO Human Factors Training Manual	• Human Factors as a term has to be clearly defined because when these words are used in the vernacular, they are often applied to any factor related to humans. • The human element is the most flexible. adapt- able and valuable part of the aviation system. but it is also the most vulnerable to influences which can adversely affect its performance	ICAO Doc 9683	30
15.1.3	Explain the concept of systems and its relevance in the ATM environment.	People, procedures, equipment.	• Including environment • Illustrate the effect of Human Factors issues on aviation safety	ICAO Doc 9683	20

No	Objective	Main Points	Development Notes	Resource	Time
			through an example of an accident. • Illustrate how these main points are interlinked and impact on Human Factors		
15.1.4	Explain the use of the SHELL model.	e.g., ICAO Doc 9683, visits to OPS and technical rooms	• Define concept	ICAO Doc 9683	30
15.1.5	State the factors which can affect personal and team performance.	e.g. Psychological, medical, physiological, social, organizational, communication, stress, human error, working knowledge and skills.	• Physical Factors • Physiological factors • Psychological Factors • Psychosocial Factors • Hardware Factors • Task Factors • Environmental Factors		10

15.2: ATSEP Knowledge, Skills, Competence

No	Objective	Main Points	Development Notes	Resource	Time
15.2.1	Explain the importance of maintaining and updating professional knowledge and skills	Ensuring safety	• Continuation training ensure the ATSEP maintains up-to-date operational competence in all required topics.	ICAO 10057 doc	10
15.2.2	Explain the importance of maintaining nontechnical skills and professional competence.	e.g. communication, human relationship, knowledge of environment, human limit awareness	• Communications assures efficiency and safety • Leadership • Team building		10
15.2.3	State the available means to maintain professional knowledge and skills.	e.g. practice, personal study, briefing, seminars, courses, technical periodicals, technical books, OJT, simulation, CBT, e-learning, visits, feedback, TRM	• Discuss the various means of maintaining ATSEP skills • Including factory/manufacturer training		10

15.3: Cognition

No	Objective	Main Points	Development Notes	Resource	Time
15.3.1	Describe major aspects of human information processing.	Attention, memory, situational awareness (perception, comprehension, projection), decision-making, action, feedback, environment.	Briefly discuss information processes which include: • Perception • Recognition, • Imagining, • Remembering, • Thinking, judging, • Reasoning • Problem solving, • Conceptualizing • Planning • Awareness		20
15.3.2	Describe the factors which influence information processing.	e.g. stress and strain, experience, knowledge, distraction, interpersonal relations, working environment, risk perception, attitude, workload, fatigue, confidence, job security	• Briefly discuss some factors that interrupt information processing and lead to human error		20
15.3.3	Appreciate factors which influence information processing.	e.g. case study, simulation, role playing			10

15.4: Fatigue

No	Objective	Main Points	Development Notes	Resource	Time
15.4.1	Describe the effect of fatigue on human performance.	Physiological, cognitive and relational effects e.g. lack of concentration, irritability, frustration	Discuss: • Fatigue • Body rhythm disturbance • Sleep deprivation	ICAO Doc 9683	20
15.4.2	Recognize the signs of fatigue in oneself and in others.	e.g. making frequent mistakes, unable to concentrate, lack of normal	Describe: • Acute fatigue • Chronic fatigue • Mental fatigue		20

No	Objective	Main Points	Development Notes	Resource	Time
		humor, sleeping and/or eating disorders			
15.4.3	Explain how to respond to indications of fatigue in an appropriate manner.	Take time off, rest for short periods of time, seek professional help	• Discuss appropriate measures to combat fatigue		20

15.5: Fitness

No	Objective	Main Points	Development Notes	Resource	Time
15.5.1	Describe signs of lack of personal fitness		Lack personal fitness will make your bones very weak, accumulates excess body weight, causes malfunction of organs or failure and heart issues. Additionally: • high blood pressure • Diabetes • Depression • Cardiovascular disease • Anxiety • Obesity • Fatigue		20
15.5.2	Describe actions to prevent or resolve lack of personal fitness.	Healthy lifestyle e.g. healthy diet, sleeping, physical and mental activities	• Regularly exercise • Healthy Diet • Proper rest Adequate sleeping		10
15.5.3	Explain the influence of psychoactive substances on human performance.	e.g. nervous system, medication, smoking, alcohol, habitual and occasional use of psychoactive substances	• Discuss the effect of substance abuse on human performance and health		10

15.6: Work Environment

No	Objective	Main Points	Development Notes	Resource	Time
15.6.1	Describe the influence of the work environment on human performance	Ergonomics, effects of noise, electromagnetic waves, temperature, working circumstances	• Workplace environment impacts employee morale, productivity and engagement both positively and negatively. • Quality of the employee's workplace environment that most impacts on their level of motivation and subsequent performance.		20

15.7: Basic Needs of People at Work

No	Objective	Main Points	Development Notes	Resource	Time
15.7.1	Explain basic needs of people at work.	e.g. balance between individual ability and workload, working time and rest periods; adequate working conditions, positive working environment	• Discuss quality of work life, home life and the balance of the two		10
15.7.2	Characterize the factors of work satisfaction.	e.g. money, motivation, achievement, recognition, advancement, challenge	• Including right tools		10

15.8: Team Resource Management (TRM)

No	Objective	Main Points	Development Notes	Resource	Time
15.8.1	State the objectives of TRM	Experience sharing, feedback, improved interpersonal relations, indirect increase in safety	• Feeling of fulfillment • Increased job satisfaction • Development of communication skills • Personal and team recognition		20

15.9: Teamwork and Team Roles

No	Objective	Main Points	Development Notes	Resource	Time
15.9.1	Describe the differences between social human relations and professional interactions.				10
15.9.2	Take account of reasons for loss of team effectiveness and actions to prevent it and prevent repetition.	e.g., roles poorly defined, goals poorly identified, bad planning, too many leaders or not enough, respect for others, divergence in values, misunderstandings	• Too many leaders will cause distraction • Complacency • Peer pressure		10
15.9.3	Describe the principles of teamwork	e.g. team membership, group dynamics, advantages/disadvantages of teamwork	• Sense of belonging • Strength of team is defined by the weakest link		10
15.9.4	Appreciate reasons for conflict.		• Inconsistent recognition • Unhealthy competition • Feelings of inadequacy/superiority • Differences of opinion		30
15.9.5	Describe actions to prevent human conflicts		• Communication • Equitable treatment • Conflict avoidance training		10
15.9.6	Describe strategies to cope with human conflicts	e.g. in your team	• Negotiations • Diversity		20

15.10: Written Report

No	Objective	Main Points	Development Notes	Resource	Time
15.10.1	Appreciate the importance of recording information by writing effectively.	ATSEP technical report, logs, system degradation reports, specification, system manager report	• Better enables self or others to follow up or learn from provided information • Enables better communication to colleagues at shift changeover		10

No	Objective	Main Points	Development Notes	Resource	Time
15.10.2	Use appropriate terminology to communicate effectively in writing.	Be concise, clear; common technical terms; convey key points	• Better enables understanding among all stakeholders		10

15.11: Verbal and Non-Verbal Communication

No	Objective	Main Points	Development Notes	Resource	Time
15.11.1	Describe the human communication process.				10
15.11.2	Characterize the factors which affect verbal communication.	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	• Phraseology • Recognition of target audience • Linguistic barriers		20
15.11.3	Describe factors which affect non-verbal communication.	e.g. touch, noise, interruption, body language	• Distractions • Empathy or lack thereof • Facial expressions		10
15.11.4	Use appropriate vocabulary to communicate effectively on technical matters	Technical 'jargon', language differences, standard words/phrases	• Standard acronyms		10
15.11.5	Use appropriate language for professional communication with non-ATSEP.	Term sharing, translation, being concise, simple words, selection of information and detail level according to the receiver	• Enables others to better understand message		10

15.12: Stress

No	Objective	Main Points	Development Notes	Resource	Time
15.12.1	Explain the process of stress.	Causes, stress mechanism, consequences in different work situations (e.g. online intervention, maintenance, training)		Study or published paper	20
15.12.2	State the symptoms of stress.	e.g. frustration, anger, irritability, aggressive and/or irrational behavior, helplessness		Study or published paper	10

15.13: Stress Management

No	Objective	Main Points	Development Notes	Resource	Time
15.13.1	Explain how to relieve or minimize stress in self and/or others.	The effect of personality in coping with stress, benefits of active stress management			10
15.13.2	Appreciate how assistance is obtained in stressful situations.	Benefits of asking, offering and accepting help in stressful situations e.g., CISM			10
15.13.3	Recognize the effects of shocking and stressful situations.	For oneself and for others, abnormal situations			10
15.13.4	Consider the benefits of critical incident stress management.				10

15.14: Human Error

No	Objective	Main Points	Development Notes	Resource	Time
15.14.1	Describe human error.				10
15.14.2	Explain the relationship between human error and safety.	Mechanism, error-prone conditions, consequences e.g., Swiss cheese model, feedback			20
15.14.3	State different types of errors using an appropriate model.	e.g. Rasmussen model, Gagne model			10
15.14.4	Differentiate between errors and violation				10
15.14.5	Explain how to detect errors.	e.g. individual and collective strategy, event report, procedure			10
15.14.6	Explain, in general terms, how errors are mitigated.				10
15.14.7	Appreciate two significant ATM incidents/accidents involving ATSEP/engineering contributory factors.				30

Subject 16: Information System Security

16.1: Purpose and principles

No	Objective	Main Points	Development Notes	Resource	Time
16.1.1	Define information security and relevant terminology.	e.g., Information security, cybersecurity, network security, physical security.	• Principles of information security		10
16.1.2	Define regulatory framework.	ICAO, regional regulations, NIS Directive.	• Ref. ICSO Cyber Security Strategy/Action Plan	ICAO Annex 17 ANSP	10
16.1.3	List the concepts governing a security policy.	Security objectives, business continuity. E.g., Resilience, recovery plan.	• accountability framework and oversight to ensure that risks are adequately mitigated • ensures that controls are implemented to mitigate risks. • security strategies ensure that security strategies are aligned with business objectives and consistent with regulations.	Various	10
16.1.4	List the relevant security managerial personnel.		• Site specific	ANSP	10
16.1.5	Explain the importance of ATM security.		• Current systems used in ATM are a patchwork of evolving, interconnected systems, comprising legacy systems and more recent commercial off-the-shelf (COTS) systems, connected by a variety of interfaces utilizing a combination of national, international and proprietary standards. The diversity of systems has significant implications for cybersecurity.	Various	
16.1.6	Describe the security of operational data.	Secure, restricted access by authorized personnel.		ANSP	

No	Objective	Main Points	Development Notes	Resource	Time
16.1.7	Appreciate the security risk management system in an ANSP's organization	Risk based approach, risk assessment, threats, vulnerabilities, residual risks, impact, likelihood, risk treatment.	• Hazard identification • Safety risk assessment and mitigation	ICAO Annex19 ANSP	20
16.1.8	Explain information security frameworks.	e.g., ISO, NIST	• Documented, policies, procedures, and processes that define how information is managed in a business	ISO 27000	30
16.1.9	Explain the confidentiality, integrity and availability (CIA) concept		• Confidentiality is a set of rules that limits access to information, Integrity is the assurance that the information is trustworthy and accurate, and Availability is a guarantee of reliable access to the information by authorized people.	Various	20
16.1.10	Appreciate the security threats faced by the functional system	ATM/ANS	• Remote worker endpoint security • Cloud Jacking • AI enhanced cyberthreats Etc.	Various	20
16.1.11	Explain different network and physical attacks.	DoS, DDoS, port scanning network sniffing, spoofing, MITM, APT (advanced persistent threat), e.g., tailgating, crypto jacking.	• Passive and active attacks	Various	45
16.1.12	Explain social engineering techniques.	Social networking, human flaws, phishing, spear phishing.	• Malicious activities accomplished through human interactions • Psychological manipulation to trick users into making security mistakes or giving away sensitive information.	Various	20
16.1.13	Explain the different types of malware.	Viruses, worms, spyware, ransomware.		Various	20
16.1.14	Identify the different phases of a security attack.	e.g., Cyber kill chain, Swiss cheese model.	• Reconnaissance • Intrusion • Exploitation • Privilege Escalation	Various	20ho

No	Objective	Main Points	Development Notes	Resource	Time
			• Lateral Movement • Obfuscation • Denial of Service • Exfiltration		
16.1.15	Appreciate how to detect and stop security attacks.	e.g., Cyber kill chain	• Employee training • Updated software • Firewalls • Physical access/secure access • Etc.	Various	20
16.1.16	Appreciate a holistic security architecture.	Application security, network security, operating systems security, role of SOC/CERT, system of systems, e.g., firewalls, proxies, routers, switches, network data flow, PKIs, DMZ, IDS/IPS.	• Integration of self-care, well-being, digital security, and information security into traditional security management practices.	Various	30
16.1.17	Explain security policies and practices for information and data.	Backup, storing, hacking, confidentiality, copyright.		ANSP	10
16.1.18	Describe the possible external interventions that may interrupt or corrupt ATM services.	Introduction of software viruses, illegal broadcasts, jamming, spoofing.		ANSP Various	20

END