AMC1 Appendix I — Basic Knowledge Requirements

(except for category L licence) Section 2

MODULARISATION

MODULE 1 — MATHEMATICS

MODULE 1 — MATHEMATICS	Level		Ant. Spm.	
		B1 B2		B1 B2
Total number for the module:				32
1.1 Arithmetic Arithmetical terms and signs, methods of multiplication and division, fractions and decimals, factors and multiples, weights, measures and conversion factors, ratio and proportion, averages and percentages, areas and volumes, squares, cubes, square and cube roots.		2		6
1.2 Algebra (a) Evaluating simple algebraic expressions, addition, subtraction, multiplication anddivision, use of brackets, simple algebraic fractions;.		2		4
(b) Linear equations and their solutions; Indices and powers, negative and fractional indices; Binary and other applicable numbering systems; Simultaneous equations and second-degree equations with one unknown; Logarithms		1		12
1.3 Geometry 2				
(a) Simple geometrical constructions		1		3
(b) Graphical representation: nature and uses of graphs, graphs ofequations/functions;		2		4
(c) Simple trigonometry: trigonometrical relationships, use of tables and rectangularand polar coordinates		2		3

MODULE 2 — PHYSICS

MODULE 2 — PHYSICS	Level		Ant. Spm.	
		B1 B2 B2L		B1 B2 B2L
Total number for the module:				52
2.1 Matter Nature of matter: the chemical elements, structure of atoms, molecules; Chemical compounds; States: solid, liquid, and gaseous; Changes between states.		2		5
2.2 Mechanics				
2.2.1 Statics Forces, moments and couples, representation as vectors; Centre of gravity; Elements of theory of stress, strain, and elasticity: tension, compression, shear, and torsion; Nature and properties of solid, fluid, and gas matter; Pressure and buoyancy in liquids (barometers).		2		7
2.2.2 Kinetics Linear movement: uniform motion in a straight line, motion under constant acceleration (motion under gravity); Rotational movement: uniform circular motion (centrifugal/centripetal forces); Periodic motion: pendular movement; Simple theory of vibration, harmonics, and resonance; Velocity ratio, mechanical advantage, and efficiency.		2		7
2.2.3 Dynamics				
(a) Mass; Force, inertia, work, power, energy (potential, kinetic and total energy), heat,efficiency;		2		5
(b) Momentum, conservation of momentum; Impulse; Gyroscopic principles; Friction: nature and effects, coefficient of friction (rolling resistance).		2		4
2.2.4 Fluid dynamics				
(a) Specific gravity and density;		2		2
(b) Viscosity, fluid resistance, effects of streamlining; Effects of compressibility on fluids;Static, dynamic, and total pressure: Bernoulli's Theorem, venturi.		2		3
2.3 Thermodynamics				
(a) Temperature: thermometers and temperature scales (Celsius, Fahrenheit andKelvin); definition of heat;		2		2
(b) Heat capacity, specific heat; Heat transfer: convection, radiation and conduction; Volumetric expansion; First and second law of thermodynamics; Gases: ideal gases laws; specific heat at constant volume and constant pressure, workdone by expanding gas; Isothermal, adiabatic expansion and compression, engine cycles, constant volumeand constant pressure, refrigerators and heat pumps; Latent heats of fusion and evaporation, thermal energy, heat of combustion.		2		8
2.4 Optics (Light) Nature of light; speed of light; Laws of reflection and refraction: reflection at plane surfaces, reflection by spherical mirrors, refraction, lenses; Fibre optics.		2		5
2.5 Wave motion and sound Wave motion: mechanical waves, sinusoidal wave motion, interference phenomena, standing waves; Sound: speed of sound, production of sound, intensity, pitch and quality, Doppler effect.		2		4

MODULE 3 — ELECTRICS FUNDAMENTALS

MODULE 3 — ELECTRICS FUNDAMENTALS	Level		Ant. Spm.	
		B1 B2		B1 B2
Total number for the module:				52
3.1 Electron theory Structure and distribution of electrical charges within atoms, molecules, ions, and compounds; Molecular structure of conductors, semiconductors, and insulators.		1		2
3.2 Static electricity and conduction Static electricity and distribution of electrostatic charges; Electrostatic laws of attraction and repulsion; Units of charge, Coulomb's law; Conduction of electricity in solids, liquids, gases and in vacuum.		2		3
3.3 *Electrical terminology* The following terms, their units and factors affecting them: potential difference, electromotive force, voltage, current, resistance, conductance, charge, conventional current flow, electron flow.		2		2
3.4 Generation of electricity Production of electricity by the following methods: light, heat, friction, pressure, chemical reaction, magnetism, and motion.		1		2
3.5 *Sources of DC electricity* Construction and basic chemical reaction of primary cells, secondary cells, lead acid cells, nickel cadmium cells, lithium cells, nickel cells and other alkaline cells; Cells connected in series and in parallel; Internal resistance and its effect on a battery; Construction, materials, and operation of thermocouples; Operation of photocells.		2		3
3.6 DC circuits Ohm's law, Kirchhoff's voltage, and current laws; Calculations using the above laws to find resistance, voltage, and current; Significance of the internal resistance of a supply.		2		2
3.7 *Resistance/Resistor*				
(a) Resistance Specific resistance; Calculation of total resistance using series, parallel and series–parallelcombinations; Operation and use of potentiometers and rheostats; Operation of Wheatstone Bridge.		2		3
(b) Resistor Positive and negative temperature coefficient conductance; Resistor colour code, values and tolerances, preferred values, wattage ratings; Resistors in series and in parallel; Fixed resistors, stability, tolerance and limitations, methods of construction; Variable resistors, thermistors, voltage-dependent resistors; Construction of potentiometers and rheostats; Construction of Wheatstone Bridge.		1		2
3.8 Power Power, work, and energy (kinetic and potential); Dissipation of power by a resistor; Power formula; Calculations involving power, work, and energy.		2		3
3.9 *Capacitance/Capacitor* Operation and function of a capacitor;		2		4

Factors that affect the capacitance area of plates, distance between plates, number of plates, dielectric and dielectric constant, working voltage, voltage rating; Capacitor types, construction, and function; Capacitor colour-coding; Calculations of capacitance and voltage in series and in parallel circuits; Exponential charge and discharge of a capacitor, time constants; Testing of capacitors.				
3.10 Magnetism				
(a) Theory of magnetism; Properties of a magnet; Action of a magnet suspended in the Earth's magnetic field; Magnetisation and demagnetisation; Magnetic shielding; Various types of magnetic material; Electromagnet construction and principles of operation; Handclasp rules to determine magnetic field around current-carrying conductor.		2		3
(b) Magnetomotive force, field strength, magnetic flux density, permeability,hysteresis loop, retentivity, coercive force reluctance, saturation point, eddycurrents; Precautions for care and storage of magnets.		2		1
3.11 ***Inductance/Inductor*** Faraday's law; Action of inducing a voltage in a conductor that moves in a magnetic field; Induction principles; Effects of the following on the magnitude of an induced voltage: magnetic field strength, rate of change of flux, number of conductor turns; Mutual induction; The effect that the rates of change of primary current and mutual inductance have on induced voltage; Factors that affect mutual inductance: number of turns in the coil, physical size of the coil, permeability of the coil, position of coils with respect to each other; Lenz's law and polarity determining rules; Back EMF, self-induction; Saturation point; Principal uses of inductors.		2		4
3.12 ***DC motor/generator theory*** Basic motor and generator theory; Construction and purpose of components in a DC generator; Operation of and factors that affect the output and direction of the current in DC generators; Operation of and factors that affect the output power, torque, speed, and direction of rotation of DC motors; Series-wound, shunt-wound and compound motors; Starter generator construction.		2		3
3.13 AC theory Sinusoidal waveform: phase, period, frequency, cycle; Instantaneous, average, root mean square, peak, peak-to-peak current values and calculations of these values in relation to voltage, current and power; Triangular/Square waves; Single-phase/Three-phase principles.		2		3
3.14 ***Resistive (R), capacitive (C) and inductive (L) circuits*** Phase the relationship of voltage and current in L, C and R circuits, parallel, series and series–parallel; Power dissipation in L, C and R circuits; Impedance, phase angle, power factor and current calculations; True power, apparent power, and reactive power calculations.		2		3
3.15 Transformers Transformer construction principles and operation; Transformer losses and methods for overcoming them;		2		3

Transformer action under load and no-load conditions; Power transfer, efficiency, polarity markings; Line and phase voltages and currents; Power in a three-phase system; Primary and secondary current, voltage, turn ratio, power, efficiency; Auto-transformers.				
3.16 Filters Operation, application, and uses of the following filters: low pass, high pass, band pass, band stop.		1		1
3.17 AC generators Rotation of loop in a magnetic field and waveform produced; Operation and construction of revolving armature and revolving field type AC generators; Single-phase, two-phase, and three-phase alternators; Three-phase star and delta connection advantages, and uses; Permanent magnet generators.		2		3
3.18 AC motors 3 Construction, principles of operation and characteristics of: AC synchronous and induction motors both single-phase and polyphase; Methods of speed control and direction of rotation; Methods of producing a rotating field: capacitor, shaded or split pole.		2		2

MODULE 4 — ELECTRONICS FUNDAMENTALS

MODULE 4 — ELECTRONICS FUNDAMENTALS	Level		Ant. Spm.	
	B1 B3	B2 B2L	B1 B3	B2 B2L
Total number for the module:			20	40
4.1 Semiconductors				
4.1.1 Diodes				
(a) Description and characteristics Diode symbols; Diode characteristics and properties; Diodes in series and in parallel; Materials, electron configuration, electrical properties; P and N type materials: effects of impurities on conduction, majority and minority characters; P–N junction in a semiconductor, development of a potential across a P–N junction in unbiased, forward-biased and reverse-biased conditions; Diode parameters: peak inverse voltage, maximum forward current, temperature, frequency, leakage current, power dissipation; Main characteristics and use of silicon-controlled rectifiers (thyristors), light-emitting diodes (LEDs), photo-conductive diodes, rectifier diodes.	2	2	8	8
(b) Operation and function Operation and function of diodes in the following circuits: clippers, clampers,full- and half-wave rectifiers, bridge rectifiers, voltage doublers and triplers; Detailed operation and characteristics of the following devices: silicon-controlled rectifier (thyristor), light-emitting diode (LED), Schottky diode,photo-conductive diode, varactor diode, varistor, rectifier diodes, Zenerdiode. Functional testing of diodes	-	2	-	7
4.1.2 Transistors				
(a) Description and characteristics Transistor symbols; Component description and orientation; Transistor characteristics and properties.	1	2	4	4
(b) Construction and operation Construction and operation of PNP and NPN transistors; Base, collector and emitter configurations; Testing of transistors; Basic appreciation of other transistor types, including types of FET and theiruses; Application of transistors: amplifier classes (A, B, C); Simple circuits including bias, decoupling, feedback and stabilisation; Multistage circuit principles: cascades, push–pull, oscillators, multivibrators,flip-flop circuits; Operation and amplifier stages connecting methods: resistive, capacitive,direct, inverting, non-inverting and adding.	-	2	-	7
4.1.3 *Integrated circuits*				
(a) Description and operation of logic circuits and linear circuits/operationalamplifiers;	1	2	3	2
(b) Introduction to the operation and function of an operational amplifier usedas: an integrator, a differentiator, a voltage follower, a comparator; Advantages and disadvantages of positive and negative feedback.	-	2	-	4
4.2 *Printed circuit boards* Description and use of printed circuit boards.	1	2	2	3
4.3 Servomechanisms				
(a) Principles Understanding of the following principles: open- and closed-loop systems,servomechanism, feedback, follow-up, null, overshoot, damping,	1	2	3	2

deadband,hunting, proximity switches, analogue transducers, synchro systems andcomponents, digital tachometers and encoders, inductance, and capacitancetransmitters;				
(b) Construction operation and use of the following synchro-system components:resolvers, differential, control and torque, E and I transformers, inductancetransmitters, capacitance transmitters, synchronous transmitters; Construction, operation and use of servomechanism and PID controller; Fault-finding of servo defects, reversal of synchro leads, hunting.	-	2	-	3

MODULE 5 — DIGITAL TECHNIQUES / ELECTRONIC INSTRUMENT SYSTEMS

MODULE 5 — DIGITAL TECHNIQUES / ELECTRONIC INSTRUMENT SYSTEMS	Level		Ant. Spm.	
	B1	B2 B2L	B1	B2 B2L
Total number for the module:			40	72
5.1 *Electronic instrument systems* Typical arrangements of systems and cockpit layout of electronic instrument systems.	1	1	4	4
5.2 *Numbering systems* Numbering systems: binary, octal, and hexadecimal; Demonstration of conversions between the decimal and binary systems, octal and hexadecimal systems and vice versa.	1	2	3	5
5.3 Data conversion Analogue data, Digital data; Operation and application of analogue-to-digital and digital-to-analogue converters, inputs and outputs, limitations of various types.	1	2	3	4
5.4 Data buses Operation of data buses in aircraft systems, including knowledge of ARINC and other specifications. Aircraft network/Ethernet.	2	2	3	5
5.5 *Logic circuits*				
(a) Identification of common logic gate symbols, tables and equivalentcircuits; Applications used for aircraft systems, schematic diagrams.	2	2	3	4
(b) Interpretation of logic diagrams.	-	2	-	4
5.6 Basic computer structure				
(a) Computer terminology (including bit, byte, software, hardware, CPU,IC, and various memory devices such as RAM, ROM, PROM); Computer technology (as applied in aircraft systems).	2	2	4	2
(b) Computer operation, layout, and interface of the major components ina microcomputer, including their associated bus systems; Information contained in single- and multi-address instruction words; Memory-associated terms; Operation of typical memory devices; Operation, advantages, and disadvantages of the various data storagesystems.	-	2	-	6
5.7 Microprocessors Functions performed and overall operation of a microprocessor; Basic operation of each of the following microprocessor elements: control and processing unit, clock, register, arithmetic logic unit.	-	2	-	4
5.8 Integrated circuits Operation and use of encoders and decoders; Function of encoder types.	-	2	-	5
5.9 Multiplexing Operation, application and identification in logic diagrams of multiplexers and demultiplexers.	-	2	-	4
5.10 Fibre optics Advantages and disadvantages of fibre optic data transmission over electrical wire propagation; Fibre optic data bus; Fibre-optic-related terms; Terminations; Couplers, control terminals, remote terminals; Application of fibre optics in aircraft systems.	1	2	3	3
5.11 *Electronic displays* Principles of operation of common types of displays used in modern aircraft, including cathode-ray tubes (CRTs), light-emitting diodes (LEDs) and liquid crystal displays (LCDs).	2	2	2	4
5.12 *Electrostatic-sensitive devices* Special handling of components sensitive to electrostatic discharges;	2	2	4	5

Awareness of risks and possible damage, component, and personnel antistatic protection devices.				
5.13 ***Software management control*** Awareness of restrictions, airworthiness requirements and possible catastrophic effects of unapproved changes to software programs.	2	2	3	3
5.14 ***Electromagnetic environment*** Influence of the following phenomena on maintenance practices for electronic systems: EMC — Electromagnetic Compatibility, EMI — Electromagnetic Interference, HIRF — High-Intensity Radiated Field, Lightning / lightning protection.	2	2	3	4
5.15 ***Typical electronic/digital aircraft systems*** General arrangement of typical electronic/digital aircraft systems and associated BITE (Built-In Test Equipment), such as: **(a)** ACARS — ARINC Communication and Addressing and Reporting System, FBW — Fly-by-Wire, FMS — flight management system, IRS — inertial reference system; **(b)** ECAM — electronic centralised aircraft monitoring, EICAS — engine indication and crew alerting system, EFIS — electronic flight instrument system, GNSS — global navigation satellite system, TCAS — traffic alert collision avoidance system, Integrated Modular Avionics, Cabin Systems, Information Systems.	1	1	5	6

MODULE 6 — MATERIALS AND HARDWARE

MODULE 6 — MATERIALS AND HARDWARE	Level		Ant. Spm.	
	B1 B3	B2 B2L	B1 B3	B2 B2L
Total number for the module:			80	60
6.1 ***Aircraft materials — ferrous***				
(a) Characteristics, properties and identification of common alloy steels used inaircraft; Heat treatment and application of alloy steels.	2	1	3	3
(b) Testing of ferrous materials for hardness, tensile strength, fatigue strength andimpact resistance.	1	1	2	1
(c) Repair and inspection procedures for ferrous materials, structures, andairframes	2	1	2	1
6.2 Aircraft materials — non-ferrous:				
(a) Characteristics; properties and identification of common non-ferrousmaterials used in aircraft; Heat treatment and application of non-ferrous materials.	2	1	4	3
(b) Testing of non-ferrous materials; for hardness, tensile strength, fatigue strengthand impact resistance.	1	1	3	2
(c) Repair and inspection procedures. for non-ferrous materials, structures, andairframes.	2	1	2	1
6.3 Aircraft materials — composite and non-metallic				
6.3.1 Composite and non-metallic other than wood and fabric:				
(a) Characteristics; properties and identification of common composite andnon-metallic materials, other than wood, used in aircraft; Sealant and bonding agents.	2	2	4	3
(b) Detection of defects/deterioration in composite and non-metallicmaterials	2	-	4	—
(c) Repairs and inspection procedures for composite and non-metallicmaterials, structures, and airframes.	2	1	2	2
6.3.2 Wooden structures Construction methods of wooden airframe structures; Characteristics, properties and types of wood and glue used in aeroplanes; Preservation and maintenance of wooden structures; Types of defects in wood material and wooden structures; Detection of defects in wooden structures; Repair of wooden structures.	1		4	—
6.3.3 Fabric covering Characteristics, properties and types of fabrics used in aeroplanes; Inspection methods for fabrics; Types of defects in fabrics; Repair of fabric covering.	1		4	—
6.4 Corrosion:				
(a) Chemical fundamentals; Formation by galvanic action process, microbiological contamination,mechanical stress.	1	1	3	3
(b) Types of corrosion and their identification; Causes of corrosion; Material types, and their susceptibility to corrosion.	3	2	5	3
6.5 Fasteners				
6.5.1 Screw threads Screw nomenclature; Thread forms, dimensions and tolerances for standard threads used in aircraft; Measuring screw threads	2	2	4	3
6.5.2 Bolts, studs, and screws Bolt types: specification, identification and marking of aircraft bolts, international standards;	2	2	6	5

Nuts: self-locking, anchor, standard types; Machine screws: aircraft specifications; Studs: types and uses, insertion, and removal; Self-tapping screws, dowels.				
6.5.3 Locking devices Tab and spring washers, locking plates, split pins, pal-nuts, wire locking, quick-release fasteners, keys, circlips, cotter pins.	2	2	2	2
6.5.4 Aircraft rivets Types of solid and blind rivets: specifications and identification, heat treatment	2	1	3	2
6.6 Pipes and unions:				
(a) Identification; and types of rigid and flexible pipes and their connectors used inaircraft;	2	2	1	1
(b) Standard unions for aircraft hydraulic, fuel, oil, pneumatic and air systempipes.	2	1	2	2
6.7 Springs Types of springs, materials, characteristics, and applications	2	1	1	1
6.8 Bearings Purpose of bearings, loads, material, construction; Types of bearings and their application.	2	2	4	3
6.9 Transmissions Gear types and their application; Gear ratios, reduction and multiplication gear systems, driven and driving gears, idler gears, mesh patterns; Belts and pulleys, chains and sprockets.	2	2	4	4
6.10 Control cables Types of cables; End fittings, turnbuckles and compensation devices; Pulleys and cable system components; Bowden cables; Aircraft flexible control systems.	2	1	5	4
6.11 Electrical cables and connectors Cable types, construction and characteristics; High-tension and coaxial cables; Crimping; Connector types, pins, plugs, sockets, insulators, current and voltage rating, coupling, identification codes	2	2	6	11

MODULE 7 — MAINTENANCE PRACTICES

MODULE 7 — MAINTENANCE PRACTICES	Level		Ant. Spm.	
	B1	B2 B2L	B1	B2 B2L
Total number for the module:			80	60
7.1 Safety precautions — aircraft and workshop Aspects of safe working practices including precautions to be taken when working with electricity, gases (especially oxygen), oils, and chemicals. Fuel tank safety and fuel tank entry procedures and precautions. Awareness and precautions regarding aircraft equipped with ballistic recovery systems. Also, instructions for the remedial action to be taken in the event of a fire or another accident with one or more of these hazards, including information on fire-extinguishing agents.	3	3	4	4
7.2 Workshop practices Care of tools, control of tools, use of workshop materials; Dimensions, allowances and tolerances, workmanship standards; Calibration of tools and equipment, calibration standards.	3	3	4	4
7.3 Tools Common hand-tool types; Common power-tool types; Operation and use of precision-measuring tools; Lubrication equipment and methods; Operation, function, and use of electrical general test equipment.	3	3	6	6
7.4 (Reserved)			—	—
7.5 Engineering drawings, diagrams, and standards Drawing types and diagrams, their symbols, dimensions, tolerances and projections; Identification of title block information; Microfilm, microfiche, and computerised presentations; Specification 100 of the Air Transport Association (ATA) of America; Aeronautical and other applicable standards including ISO, AN, MS, NAS and MIL; Wiring diagrams and schematic diagrams.	2	2	6	6
7.6 Fits and clearances Drill sizes for bolt holes, classes of fits; Common system for fits and clearances; Schedule of fits and clearances for aircraft and engines; Limits for bow, twist and wear; Standard methods for checking shafts, bearings, and other parts.	2	1	5	5
7.7 Electrical wiring interconnection system (EWIS) Continuity, insulation and bonding techniques and testing; Use of crimp tools: hand and hydraulic operated; Testing of crimp joints; Connector pin removal and insertion; Coaxial cables: testing and installation precautions; Identification of wire types, their inspection criteria and damage tolerance; Wiring protection techniques: cable looming and loom support, cable clamps, protective sleeving techniques including heat shrink wrapping, shielding; High-Intensity Radiated Fields (HIRF) and protection principles; Soldering of electrical wires, EWIS installations, inspection, repair, maintenance, and cleanliness standards.	3	3	4	8
7.8 Riveting Riveted joints, rivet spacing and pitch; Tools used for riveting and dimpling; Inspection of riveted joints.	2	-	3	—
7.9 Pipes and hoses Bending and belling/flaring aircraft pipes;	2	-	3	—

Inspection and testing of aircraft pipes and hoses; Installation and clamping of pipes.				
7.10 Springs Inspection and testing of springs.	2	-	1	—
7.11 Bearings Testing, cleaning and inspection of bearings; Lubrication requirements for bearings; Defects in bearings and their causes.	2	-	3	—
7.12 Transmissions Inspection of gears, backlash; Inspection of belts and pulleys, chains and sprockets; Inspection of screw jacks, lever devices, push–pull rod systems.	2	-	3	—
7.13 Control cables Swaging of end fittings; Inspection and testing of control cables; Bowden cables; aircraft flexible control systems.	2	-	3	—
7.14 Material handling				
7.14.1 Sheet metal Marking out and calculation of bend allowance; Sheet metal working, including bending and forming; Inspection of sheet metal work.	2	-	2	—
7.14.2 Composite and non-metallic Bonding practices; Environmental conditions; Inspection methods.	2	-	2	—
7.14.3 Additive manufacturing Common additive manufacturing techniques and their influence on the mechanical properties of the finished part; Inspection of additive manufactured parts and common production failures.	1	1	4	2
7.15 (Reserved)			—	—
7.16 Aircraft weight and balance:				
(a) Calculation of centre-of-gravity / balance limits: use of relevant documents.	2	2	2	2
(b) Aircraft weighing. Preparation of aircraft for weighing; Aircraft weighing.	2	-	1	—
7.17 Aircraft handling and storage Aircraft taxiing/towing and associated safety precautions; Aircraft jacking, chocking, securing and associated safety precautions; Aircraft storage methods; Refuelling/defuelling procedures; De-icing/anti-icing procedures; Electrical, hydraulic, and pneumatic ground supplies; Effects of environmental conditions on aircraft handling and operation.	2	2	5	6
7.18 Disassembly, inspection, repair, and assembly techniques:				
(a) Types of defects and visual inspection techniques; Corrosion removal, assessment and reprotection;	3	3	2	2
(b) General repair methods — structural repair manual; Ageing, fatigue, and corrosion control programmes;	2	-	2	—
(c) Non-destructive inspection techniques; including penetrant, radiographic,eddy current, magnetic particle, ultrasonic and borescope inspections;including practical training in colour contrast penetrant inspection;	2	1	1	1
(d) Disassembly and reassembly techniques;	2	2	1	1
(e) Troubleshooting techniques.	2	2	1	1
7.19 Abnormal events:				
(a) Inspections following lightning strikes and HIRF penetration;	2	2	1	2
(b) Inspections following abnormal events such as heavy landing and flightthrough turbulence.	2	-	1	—
7.20 Maintenance procedures	2	2	6	6

Maintenance planning; Modification procedures; Stores procedures; Certification/release procedures; Interface with aircraft operation; Maintenance Inspection / Quality Control / Quality Assurance; Additional maintenance procedures; Control of life-limited components.				
7.21 Documentation and communication Documentation: elements and criteria for writing work reports, troubleshooting reports, and shift handover instructions. Communication: clear, comprehensive, and concise.	2	2	4	4

MODULE 8 — BASIC AERODYNAMICS

MODULE 8 — BASIC AERODYNAMICS	**Level**		**Ant. Spm.**	
	B1 B2 B2L		B1 B2 B2L	
Total number for the module:			24	
8.1 Physics of the atmosphere International Standard Atmosphere (ISA), application to aerodynamics.	2		2	
8.2 Aerodynamics Airflow around a body; Boundary layer, laminar and turbulent flow, free stream flow, relative airflow, upwash and downwash, vortices, stagnation; The terms: camber, chord, mean aerodynamic chord, profile (parasite) drag, induced drag, centre of pressure, angle of attack, wash-in and wash-out, fineness ratio, wing shape and aspect ratio; Thrust, weight, aerodynamic resultant; Generation of lift and drag angle of attack, lift coefficient, drag coefficient, polar curve, stall; Aerofoil contamination including ice, snow, and frost.	2		9	
8.3 Theory of flight Relationship between lift, weight, thrust and drag; Glide ratio; Steady-state flights, performance; Theory of the turn; Influence of load factor: stall, flight envelope, and structural limitations; Lift augmentation.	2		7	
8.4 High-speed airflow Speed of sound, subsonic flight, transonic flight, supersonic flight, Mach number, critical Mach number, compressibility buffet, shock wave, aerodynamic heating, area rule; Factors that affect airflow in engine intakes of high-speed aircraft; Effects of sweepback on critical Mach number.	2		4	
8.5 Flight stability and dynamics Longitudinal, lateral, and directional stability (active and passive).	2		2	

MODULE 9 — HUMAN FACTORS

MODULE 9 — HUMAN FACTORS	**Level**		**Ant. Spm.**	
	All		All	
Total number for the module:			28	
9.1 General The need to take human factors into account when performing maintenance; Incidents attributable to human factors/human error; Murphy's law.	2		3	
9.2 Human performance and limitations Vision; Hearing; Information processing; Attention and perception; Memory; Claustrophobia and physical access.	2		3	
9.3 Social psychology Accountability and responsibility: individual and group; Motivation and demotivation; Peer pressure; Cultural issues; Teamwork; Management, supervision, and leadership.	1		2	
9.4 Factors that affect human performance Fitness/health; Stress: domestic and work related; Time pressure and deadlines; Workload: overload, underload, and workload management; Sleep and fatigue, shift work; Alcohol, medication, drug abuse; Lack of manpower.	2		3	
9.5 Physical environment Noise and fumes; Illumination; Climate and temperature; Motion and vibration; Working environment; Situational awareness.	1		2	
9.6 Tasks Physical work; Repetitive tasks, complacency; Visual inspection; Complex systems; Critical maintenance tasks and error-capturing methods; Technical documentation: access, use, and quality.	1		2	
9.7 Communication Within and between teams; Work logging and recording; Shift handover; Keeping up to date, currency; Dissemination of information.	2		3	
9.8 Human error Error models and theories Types of error in maintenance tasks; Implications of errors (e.g. accidents); Organisational errors;	2		4	

Avoiding and managing errors.				
9.9 Safety management Risk management; Occurrence reporting; Safety culture Just culture; Identifying, avoiding, and reporting hazards; Organisational human-factors programme: professionalism and integrity, error-provoking behaviour, reporting errors, disciplinary policy, error investigation, action to address problems, feedback, assertiveness; Dealing with emergencies.	2		2	
9.10 The 'Dirty Dozen' and risk-mitigation The 'Dirty Dozen': the twelve most common human-factors errors in maintenance: Lack of communication, Lack of teamwork, Lack of assertiveness, Complacency, Fatigue, Stress, Lack of knowledge, Lack of resources, Lack of awareness, Distraction, Pressure, Norms. Risk-mitigation methods.	2		4	

MODULE 10 — AVIATION LEGISLATION

Reg. (EU) 2023_989 corrections ***MODULE 10 — AVIATION LEGISLATION***	**Level**		**Ant. Spm.**	
	B1 B2		**B1 B2**	
Total number for the module:			44	
10.1 Regulatory framework Role of: — the International Civil Aviation Organization (ICAO); — the European Commission (EC); — the European Union Aviation Safety Agency (EASA); — the European Union Member States and national aviation authorities; — the bilateral agreements concluded by the European Commission; — Regulation (EU) 2018/1139 (the Basic Regulation) and its implementing acts: Regulations (EU) No 748/2012 (Initial Airworthiness) and (EU) No 1321/2014 (Continuing Airworthiness); — the relationship between regulations (hard law) and AMC, GM and CSs (soft law); — occurrence reporting according to Regulation (EU) No 376/2014; — the relationship between the various annexes (parts) relating to Initial and Continuing Airworthiness (such as Part 21, Part-M, Part-145, Part-66, Part-147, Part-T, Part-ML, Part-CAMO, and Part-CAO) and Regulations (EU) No 965/2012 (the Air Operations Regulation) and (EU) No 1178/2011 (the Air Crew Regulation).	1		5	
10.2 Certifying staff — maintenance Deep understanding of Part-66 maintenance licences with the associated privileges and authorisations, and how to exercise them properly for the different aircraft categories	2		7	
10.3 Approved maintenance organisations General understanding of Part-145 and Part-CAO	2		6	
10.4 Independent certifying staff Privileges, responsibilities, record-keeping, limitations, and oversight according to Part-M, Part-66 and Part-ML.	3		4	
10.5 Air operations General understanding of Regulation (EU) No 965/2012 (the Air Operations Regulation); Differences between commercial and non-commercial air operations, and their influence on aircraft maintenance; Air Operator Certificates (AOCs) and self-declaration authorisations; Air operator responsibilities, in particular regarding continuing airworthiness and maintenance; Specialised operations / specific approvals: ETOPS, CAT I/II/III, and BRNAV. Minimum Equipment List (MEL) and Configuration Deviation List (CDL); Aircraft placarding and markings; Documents to be carried on board: — Certificate of Airworthiness / Restricted Certificate of Airworthiness; — Airworthiness Review Certificate; — Permit to Fly; — Certificate of Registration; — Noise Certificate; — Weight and Balance report; — Radio Station Licence.	1		4	
10.6 Certification of aircraft, parts, and appliances Basic understanding of Part 21 and of the following EASA certification specifications: CS-22, CS-23, CS-25, CS-27, CS-29, and CS-STAN.	2		4	
10.7 Continuing airworthiness General understanding of the Part 21 requirements on continuing airworthiness; General understanding of Part-M, Part-ML, Part-CAO and Part-CAMO;	2		7	

Aircraft Maintenance Programme.				
10.8 Oversight principles in continuing airworthiness	1		3	
10.9 Maintenance and certification beyond the current EU regulations (if not superseded by EU requirements) Maintenance of European Union aircraft that are not within the scope of Regulation (EU) 2018/1139 (Annex I aircraft); European military airworthiness requirement (EMAR) 66 licence; Applicable national and international requirements for component maintenance, welding, painting, NDT, etc. (if not superseded by EU requirements).	1		3	
10.10 ***Cybersecurity in aviation maintenance*** Regulation on the introduction of organisation requirements for the management of information security risks related to aeronautical information systems used in civil aviation.	1		1	

MODULE 11 — AEROPLANE AERODYNAMICS, STRUCTURES ANatinD SYSTEMS

Reg. (EU) 2023_989 corrections ***MODULE 11 — AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS***	**Level**		**Ant. Spm.**	
	B1.1	B1.2	B1.1	B1.2
Total number for the module:			140	100
11.1 Theory of flight:				
(a) Aeroplane aerodynamics and flight controls; Operation and effect of: — roll control: ailerons and spoilers; — pitch control: elevators, stabilators, variable incidence stabilisers and canards; — yaw control, rudder limiters; — elevons, ruddervators; — high-lift devices, slots, slats, flaps, flaperons; — drag-inducing devices, spoilers, lift dumpers, speed brakes; — trim tabs, servo tabs, control surface bias.	2	2	2	2
(b) Aeroplane, other aerodynamic devices. Operation and effect of: — balance and antibalance (leading) tabs; — spring tabs — mass balance, aerodynamic balance panels; — effects of wing fences, saw tooth leading edges; — boundary layer control using vortex generators, stallwedges or leading-edge devices.	2	2	2	2
11.2 Airframe structures (ATA 51):				
(a) General concepts; — Zonal and station identification systems; — Electrical bonding; — Lightning strike protection provisions.	2	2	4	3
(b) Airworthiness requirements for structural strength; — Structural classification: primary, secondary, and tertiary; — Fail-safe, safe-life, damage-tolerance concepts; — Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue; — Drains and ventilation provisions;	2	2	3	3
(c) Construction methods. — Stressed skin fuselage, formers, stringers, longerons,bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement, skinning, anticorrosive protection, wing, empennage and engine attachments; — Structure assembly techniques: riveting, bolting, bonding; — Methods of surface protection, such as chromating, anodising, painting; — Surface cleaning; — Airframe symmetry: methods of alignment and symmetry checks.	2	2	3	2
11.3 Airframe structures — aeroplanes				
11.3.1 Fuselage, doors, windows (ATA 52/53/56):				
(a) Construction principles; — Construction and pressurisation sealing; — Wing, stabiliser, pylon, and undercarriage attachments; — Seat installation —Construction, mechanisms,operation — Windows and windscreen construction and mechanisms.	2	2	2	2
(b) Airborne towing devices;	1	1	1	1

(glider, banner, target).				
(c) Doors — Doors and emergency exits: safety devices; — Cargo loading system.	2	1	1	1
11.3.2 Wings (ATA 57) Construction; Fuel storage; Landing gear, pylon, control surface and high lift/drag attachments.	2	2	3	3
11.3.3 Stabilisers (ATA 55) Construction; Control surface attachment.	2	2	2	2
11.3.4 Flight control surfaces (ATA 55/57) Construction and attachments; Balancing — mass and aerodynamics.	2	2	2	2
11.3.5 Nacelles/pylons (ATA 54) Nacelles/Pylons: — Construction, — Firewalls, — Engine mounts.	2	2	2	2
11.4 Air conditioning and cabin pressurisation (ATA 21):				
(a) Pressurisation Pressurisation systems; Cabin pressure controllers, control, and safety valves; Control and indication.	3	3	3	1
(b) Air supply; Sources of air supply including engine bleed, APU and ground cart; Distribution systems.	3	-	3	—
(c) Air conditioning; Air-conditioning systems; Air cycle and vapour cycle machines; Flow, temperature and humidity control system; Control and indication control valves.	3	-	3	—
(d) Safety and warning devices; *Protection and warning devices.*	3	3	2	2
(e) **Heating and ventilation system.e**	-	3	—	2
11.5 Instruments / avionics systems				
11.5.1 Instrument systems (ATA 31) Pitot-static: Airspeed indicators, Vertical speed indicators, Altimeters; Gyroscopic: Gyroscopic principles, Artificial horizons, Attitude directors, Direction indicators, Horizontal situation indicators (HSI), Slip indicators, Turn indicators, Turn coordinators; Compass systems: systems, direct reading, remote reading, Stall-warning systems and angle-of-attack indicating systems, Glass cockpit, Indications of other aircraft systems.	2	2	4	4
11.5.2 Avionics systems Fundamentals of system layouts and operation of: — Autoflight **(ATA 22)**; — Communications **(ATA 23)**; — Very High Frequency (VHF) communications,	1	1	5	4

— High Frequency (HF) communications, — Satellite Communications (SATCOM), — Controller–pilot data link communications (CPDLC), — Audio systems, — Emergency Locator Transmitters (ELTs), — Cockpit Voice Recorder (CVR); — Navigation systems **(ATA 34)**. — Very high frequency omnidirectional range (VOR), — Automatic direction finder (ADF), — Instrument landing system (ILS), — Microwave landing system (MLS), — Flight director systems (FDSs), distance-measuring equipment (DME), — Area navigation (RNAV) systems, — Flight management systems (FMSs), — Satellite navigation systems, — Air traffic control transponder, secondary surveillance radar, — Traffic alert and collision avoidance system (TCAS), — Weather avoidance radar, — Radio altimeter, — Inertial navigation system (INS), — ARINC (Aeronautical Radio Incorporated) communication and reporting. Types and uses of avionics general test equipment.				
11.6 Electrical power (ATA 24) — Installation and operation of batteries; — DC power generation; — AC power generation; — Emergency power generation; — Voltage regulation; — Power distribution; — Inverters, transformers, rectifiers; — Circuit protection; — External/ground power.	3	3	5	5
11.7 Equipment and furnishings (ATA 25)				
(a) Emergency equipment; Emergency equipment requirements.	2	2	4	3
(b) Cabin and cargo layout. — Seats, harnesses, and belts; — Cabin layout; — Equipment layout; — Cabin furnishing installation; — Galley installation; — Cargo handling and retention equipment; — Airstairs.	1	1	3	3
11.8 Fire protection (ATA 26)				
(a) Fire and smoke detection system and fire-extinguishing systems; — Fire and smoke detection and warning systems; — Fire-extinguishing systems; — System tests.	3	3	4	3
***(b)* Portable fire extinguisher.**	1	1	1	1
11.9 Flight controls (ATA 27)				
(a) Primary and secondary flight controls; — Primary controls: aileron, elevator, rudder, spoiler; — Trim control, trim tabs; — High-lift devices; — System operation: manual; — Gust locks and gust lock systems; — Artificial feel, yaw damper, Mach trim, rudder limiter;	3	3	4	4

— Stall-warning systems.				
(b) Actuation and protection; — Active load control; — Lift dump, speed brakes; — Hydraulic, pneumatic systems; — Stall-protection systems.	3	-	3	-
(c) System operation; Electrical systems, fly-by-wire systems.	3	-	3	-
***(d)* Balancing and rigging.**	3	3	3	3
11.10 Fuel systems (ATA 28/47)				
(a) Systems: — Systems layout — Fuel tanks; — Supply systems.	3	3	3	3
(b) Fuel handling; — Cross-feed and transfer; — Refuelling and defuelling.	3	3	2	2
(c) Indications and warnings;	3	3	2	2
(d) aSpecial systems; — Dumping, venting, and draining; — Inert gas systems.	3	-	1	—
(e) Balancing. Longitudinal balance fuel systems.	3	-	2	—
11.11 Hydraulic power (ATA 29)				
(a) System description; System layout; Hydraulic fluids; Hydraulic reservoirs and accumulators; Filters; Power distribution.	3	3	3	3
(b) System operation (1); Pressure generation: electric and mechanical; Pressure control; Indication and warning systems; Servicing.	3	3	3	2
(c) System operation (2). Pressure generation: pneumatic; Emergency pressure generation; Interface with other systems.	3	-	2	—
11.12 Ice and rain protection (ATA 30)				
(a) Principles; Ice formation, classification, and detection.	3	3	2	2
(b) De-icing; De-icing systems: electrical, hot-air, pneumatic, chemical; Probe and drain heating.	3	3	2	2
(c) Anti-icing; Anti-icing systems: electrical, hot-air, chemical.	3	-	2	—
(d) Wipers; Wiper systems.	3	3	2	2
(e) Rain-repellent systems.	3	-	2	—
11.13 Landing gear (ATA 32)				
(a) Description; Construction, shock absorbing; Tyres.	3	3	4	3
(b) System operation; Extension and retraction systems: normal and emergency; Indications and warnings; Wheels, brakes, antiskid, and autobraking;	3	3	4	2

Steering.				
(c) Air–ground sensing;	3	-	1	—
(d) Tail protection. Skids.	3	3	1	1
11.14 Lights (ATA 33) External: navigation, anticollision, landing, taxiing, ice; Internal: cabin, cockpit, cargo; Emergency.	3	3	3	3
11.15 Oxygen (ATA 35) System layout: cockpit, cabin; Sources, storage, charging and distribution; Supply regulation; Indications and warnings.	3	3	4	4
11.16 Pneumatic/vacuum (ATA 36)				
(a) ***Systems;*** System layout; Sources: engine / APU (Auxiliary Power Unit), compressors,reservoirs, ground supply; Pressure control; Distribution; Indications and warnings; Interface with other systems.	3	3	3	3
(b) ***Pumps.*** Pressure and vacuum pumps.	3	3	3	3
11.17 Water/waste (ATA 38)				
(a) ***Systems;*** Water system layout, supply, distribution, servicing and draining; Toilet system layout, flushing and servicing.	3	3	2	2
(b) ***Corrosion.*** Corrosion aspects.	3	3	1	1
11.18 Onboard maintenance systems (ATA 45) Central maintenance computers; Data-loading system; Electronic library system; Printing systems; Structure monitoring (damage-tolerance monitoring).	2	-	3	—
11.19 Integrated modular avionics (IMA) (ATA 42)				
(a) Overall system description and theory; Core system; network components; Functions that may be typically integrated in the integratedmodular avionics (IMA) modules are, among others: Bleed management, air pressure control, air ventilation and control, avionics and cockpit ventilation control, temperature control, air traffic communication, avionics communication router, electrical load management, circuit breaker monitoring, electrical system BITE, fuel management, braking control, steering control, landing gear extension and retraction, tyre pressure indication, oleo pressure indication, brake temperature monitoring, etc.	2	-	1	—
(b) Typical system layouts.	2	-	1	—
11.20 Cabin systems (ATA 44) System architecture, operation, and control of systems for: — passenger in-flight entertainment; — communication within the aircraft (Cabin intercommunication data system (CIDS); — communication between the aircraft cabin and ground stations; — including voice, data, music, and video transmission. CIDS interface between cockpit/cabin crew and cabin systems. Data exchange between the different related line replaceable units (LRUs). Flight attendant panels (FAPs). Cabin network server (CNS) and interfaces with the following systems:	2	-	2	—

— Data/radio communication; — Cabin core system (CCS); — In-flight entertainment system (IFES); — External communication system (ECS); — Cabin mass memory system (CMMS); — Cabin monitoring system (CMS); — Miscellaneous cabin systems (MCSs); and — Other systems. Cabin network server (CNS) hosting functions: — Access to predeparture/departure reports; — Email/intranet/internet access; passenger database; — In-flight entertainment system; — External communication system; — Cabin mass memory system; — Cabin monitoring system; — Miscellaneous cabin system.				
11.21 Information systems (ATA 46) System architecture, operation, and control of: — Storage and electronic library; — Updating; — Retrieving of digital information; — Air traffic and information management systems (ATIMS) and network server systems; — Aircraft general information system; — Flight deck information system; — Maintenance information system; — Passenger cabin information system; — Miscellaneous information systems; — Other linked systems.	2	-	2	—

MODULE 12 — HELICOPTER AERODYNAMICS, STRUCTURES AND SYSTEMS

MODULE 12 — HELICOPTER AERODYNAMICS, STRUCTURES AND SYSTEMS	**Level**		**Ant. Spm.**	
	B1.3 B1.4		**B1.3** B1.4	
Total number for the module:			128	
12.1 Theory of flight — rotary wing aerodynamics Terminology; Effects of gyroscopic precession; Torque reaction and directional control; Dissymmetry of lift, blade tip stall; Translating tendency and its correction; Coriolis effect and compensation; Vortex ring state, power setting, overpitching; Auto-rotation; Ground effect.	2		9	
12.2 Flight control systems (ATA 67) Cyclic control; Collective control; Swashplate; Yaw control: antitorque control, tail rotor, bleed air; Main-rotor head: design and operation features; Blade dampers: function and construction; Rotor blades: main- and tail-rotor blade construction and attachment; Trim control, fixed and adjustable stabilisers; System operation: manual, hydraulic, electrical, fly-by-wire; Artificial feel; Balancing and rigging.	3		9	
12.3 Blade tracking and vibration analysis (ATA 18) Rotor alignment; Main-rotor and tail-rotor tracking; Static and dynamic balancing; Vibration types, and vibration reduction methods; Ground resonance.	3		9	
12.4 Transmission Gear boxes, main and tail rotors; Clutches, free wheel units and rotor brake; Tail-rotor drive shafts, flexible couplings, bearings, vibration dampers and bearing hangers.	3		6	
12.5 Airframe structures (ATA 51)				
(a) General concept; Airworthiness requirements for structural strength; Structural classification: primary, secondary, tertiary; Fail-safe, safe-life, damage-tolerance concepts; Zonal and station identification systems; Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue; Drains and ventilation provisions; System installation provisions; Lightning strike protection provisions.	2		6	
(b) Construction methods of the principal elements. Stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers,struts, ties, beams, floor structures, reinforcement, skinning and anticorrosiveprotection; Pylon, stabiliser and undercarriage attachments; Seat installation; Doors: construction, mechanisms, operation, and safety devices; Windows and windscreen construction; Fuel storage;	2		7	

Firewalls; Engine mounts; Structure assembly techniques: riveting, bolting, bonding; Methods for surface protection, such as chromating, anodising, painting; Surface cleaning; Airframe symmetry: methods for alignment and symmetry checks.				
12.6 Air conditioning (ATA 21)			—	
12.6.1 Air supply Sources of air supply, including engine bleed and ground cart.	2		2	
12.6.2 Air conditioning Air-conditioning systems; Distribution systems; Flow and temperature control systems; Protection and warning devices.	3		5	
12.7 Instruments / avionics systems				
12.7.1 Instrument systems (ATA 31) Pitot-static: altimeter, airspeed indicator, vertical speed indicator; Gyroscopic: artificial horizon, attitude director, direction indicator, horizontal situation indicator, turn and slip indicator, turn coordinator; Compasses: direct reading, remote reading; Vibration indicating systems / health and usage monitoring systems (HUMSs); Glass cockpit; Indications of other aircraft systems.	2		9	
12.7.2 Avionics systems Fundamentals of system layouts and operation of: **— Autoflight (ATA 22);** **— Communications (ATA 23);** — Very high frequency (VHF) communications, — High-frequency (HF) communications, — Satellite communications (SATCOM), — Controller–pilot data link communications (CPDLC), — Audio systems, — Emergency locator transmitters (ELTs), — Cockpit voice recorder (CVR); **— Navigation systems (ATA 34).** — Very high frequency omnidirectional range (VOR), — Automatic direction finding (ADF), — Instrument landing system (ILS), — Microwave landing system (MLS), — Flight director systems (FDSs), distance-measuring equipment (DME), — Area navigation (RNAV) systems, — Flight management systems (FMSs), — Satellite navigation systems, — Inertial navigation system (INS), — Air traffic control transponder, secondary surveillance radar, — Traffic alert and collision avoidance system (TCAS), — Weather avoidance radar, — Radio altimeter, — ARINC communication and reporting. Types and uses of general test equipment for avionics.	1		7	
12.8 Electrical power (ATA 24) Installation and operation of batteries; DC power generation, AC power generation; Emergency power generation; Voltage regulation, circuit protection; Power distribution; Inverters, transformers, rectifiers;	3		10	

External/Ground power.				
12.9 Equipment and furnishings (ATA 25)				
(a) Emergency equipment: Seats, harnesses, and belts; Lifting systems.	2		3	
(b) Emergency flotation systems: Cabin layout, cargo retention; Equipment layout; Cabin furnishing installation.	1		3	
12.10 Fire protection (ATA 26) **(a) Fire and smoke detection systems and fire-extinguishing systems;** Fire-extinguishing systems; System tests.	3		4	
(b) Portable fire extinguishers.	1		1	
12.11 Fuel systems (ATA 28) System layout; Fuel tanks; Supply systems; Dumping, venting, and draining; Cross-feed and transfer; Indications and warnings; Refuelling and defuelling.	3		8	
12.12 Hydraulic power (ATA 29) System layout; Hydraulic fluids; Hydraulic reservoirs and accumulators; Pressure generation: electric, mechanical, pneumatic; Emergency pressure generation; Filters; Pressure control; Power distribution; Indication and warning systems; Interface with other systems; Servicing.	3		8	
12.13 Ice and rain protection (ATA 30) Ice formation, classification, and detection; Anti-icing and de-icing systems: electrical, hot-air, and chemical; Rain repellent and removal; Probe and drain heating; Wiper system.	3		4	
12.14 Landing gear (ATA 32)				
(a) System description and operation; Construction, shock absorbing; Extension and retraction systems: normal and emergency; Wheels, tyres, brakes; Steering; Skids, floats.	3		4	
(b) Sensors. Indications and warning; Air–ground sensing.	3		3	
12.15 Lights (ATA 33) External: navigation, landing, taxiing; Internal: cabin, cockpit, cargo; Emergency.	3		4	
12.16 (Reserved)				
12.17 Integrated modular avionics (IMA) (ATA 42)				
(a) Overall system description and theory;	2		1	

Functions that may be typically integrated in the integrated modular avionics (IMA)modules: Bleed management, air pressure control, air ventilation and control, avionics andcockpit ventilation control, temperature control, air traffic communication, avionicscommunication router, electrical load management, circuit breaker monitoring,electrical system BITE, fuel management, steering control, landing gear extensionand retraction, tyre pressure indication, oleo pressure indication, braketemperature monitoring, etc.; Core System; Network Components				
(b) Typical system layouts.	2		1	
12.18 Onboard maintenance systems (ATA 45) Central maintenance computers; Data-loading system; Electronic library system.	2		3	
12.19 Information systems (ATA 46) The units and components which furnish a means of storing, updating, and retrieving digital information traditionally provided on paper, microfilm or microfiche. They include units that are dedicated to the information storage and retrieval function, such as the electronic library mass storage and controller. They do not include units or components installed for other uses and shared with other systems, such as flight deck printer or general-use display. Typical examples include air traffic and information management systems and network server systems. Aircraft general information system. Flight deck information system. Maintenance information system. Miscellaneous information system.	2		2	

MODULE 13 — AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS

C/N: Communication and Navigation; **Ins.**: instruments; **A/F**: Autoflight; **Sur.**: Surveillance; **A/S**: Airframe and Systems

Reg. (EU) 2023_989 corrections MODULE 13 — AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS	**Level**		**Ant. Spm.**	
	B2		**B2**	
Total number for the module:			188	
13.1 Theory of flight				
(a) Aeroplane aerodynamics and flight controls; Operation and effect of: — roll control: ailerons and spoilers; — pitch control: elevators, stabilators, variableincidence stabilisers and canards; and — yaw control: rudder limiters; — control using elevons, ruddervators; — high-lift devices: slots, slats, flaps; — drag-inducing devices: spoilers, lift dumpers, speed brakes; — trim tabs, servo tabs, and control surface bias.	1		3	
(b) Rotary wing aerodynamics. Terminology; Operation and effect of cyclic, collective, andantitorque controls.	1		1	
13.2 Structures — general concepts (ATA 51)				
(a) General concepts; Zonal and station identification systems; Electrical bonding; Lightning strike protection provisions.	2		4	
***(b)* Fundamentals of structural systems.**	1		4	
13.3 Autoflight (ATA 22)				
(a) *Fundamentals of automatic flight control;* — Working principles and current terminology; — Command signal processing; — Modes of operation: roll, pitch, and yawchannels; — Yaw dampers; — Stability augmentation system in helicopters; — Automatic trim control; — Autopilot navigation aids interface.	3		16	
(b) *Autothrottle systems and automatic landingsystems.* — Principles and categories; — Modes of operation; — Approach; — Glideslope; — Land, go-around; — System monitors and failure conditions.	3		8	
13.4 Communication/navigation (ATA 23/34)				
(a) *Fundamentals of communication andnavigation systems;* — Radio wave propagation, antennas, transmissionlines, communication, receiver, and transmitter; Working principles of the following systems: — Very high frequency (VHF) communications; — High-frequency (HF) communications; — Satellite communications (SATCOM); — Controller–pilot data link communications (CPDLC); — Audio systems; — Emergency locator transmitters (ELTs); — Cockpit voice recorder (CVR); — Very high frequency omnidirectional range (VOR);	3		24	

— Automatic direction finding (ADF); — Instrument landing system (ILS); — Microwave landing system (MLS), — Flight director systems (FDSs), distance-measuring equipment (DME); — Area navigation (RNAV) systems; — Flight management systems (FMSs); — Global navigation satellite systems (GNSSs), Global Positioning System (GPS), ground-based augmentation system (GBAS), satellite-based augmentation system (SBAS) such as the European geostationary navigation overlay service (EGNOS) and the wide area augmentation system (WAAS); — Data link and two-way data link.				
(b) *Fundamentals of aircraft surveillance systems.* — Air traffic control transponder, secondarysurveillance radar; — Traffic alert and collision avoidance system (TCAS); — Weather avoidance radar; — Radio altimeter; — Automatic dependent surveillance — broadcast (ADS-B) and its other associated services such as FIS-B, TIS-B and multilink; — Inertial navigation system (INS); — ARINC (Aeronautical Radio Incorporated) communication and reporting.	3		3	
13.5 Electrical power (ATA 24) — Installation and operation of batteries; — DC power generation; — AC power generation; — Emergency power generation; — Voltage regulation; — Power distribution; — Inverters, transformers, rectifiers; — Circuit protection; — External/ground power.	3		13	
13.6 Equipment and furnishings (ATA 25) Electronic emergency equipment requirements.	3		5	
13.7 Flight controls				
(a) Primary and secondary flight controls (ATA 27); — Primary controls: aileron, elevator, rudder,spoiler; — Trim control: trim tabs; — High-lift devices; — System operation: manual; — Gust locks and gust lock systems; — Artificial feel, yaw damper, Mach trim, rudder limiter; — Stall-warning systems.	2		4	
(b) Actuation and protection; — Active load control; — Lift dump, speed brakes; — Hydraulic, pneumatic systems; — Stall-protection systems.	2		4	
(c) System operation; — System operation: electrical, fly-by-wire.	3		2	
(d) Rotorcraft flight controls (ATA 67). Rotorcraft controls: cyclic control, collective control,swashplate, yaw control.	2		2	
13.8 Instruments (ATA 31) — Classification; — Atmosphere; — Terminology; — Pressure-measuring devices and systems; — Pitot-static systems; — Altimeters; — Vertical speed indicators; — Airspeed indicators;	3		20	

— Machmeters; — Altitude-reporting/-alerting systems; — Air-data computers; — Instrument pneumatic systems; — Direct-reading pressure and temperature gauges; — Temperature-indicating systems; — Gyroscopic principles; — Artificial horizons; — Slip indicators; — Directional gyros; — Ground proximity warning systems (GPWSs); — Compass systems; — Flight data recording systems (FDRSs); — Electronic flight instrument systems (EFISs) — typical system arrangements and cockpit layout; — Instrument warning systems, including master warning systems and centralised warning panels; — Stall-warning systems and angle-of-attack indicating systems; — Vibration measurement and indication; — Glass cockpit; — Types and uses of general test equipment for avionics.				
13.9 Lights (ATA 33) External: navigation, anticollision, landing, taxiing, ice; Internal: cabin, cockpit, cargo; Emergency.	3		7	
13.10 Onboard maintenance systems (ATA 45) Central maintenance computers; Data-loading system; Electronic library system; Printing system; Structure monitoring system (damage-tolerance monitoring).	3		5	
13.11 Air conditioning and cabin pressurisation (ATA 21)				
(a) Pressurisation; — Pressurisation systems; — Cabin pressure controllers, control and safetyvalves; — Control and indication.	3		2	
(b) Air supply; Sources of air supply including engine bleed, APUand ground cart; Distribution systems.	1		2	
(c) Air conditioning;	2		2	
(d) Safety and warning devices.	3		2	
13.12 Fire protection (ATA 26)				
(a) Fire and smoke detection system and fire-extinguishing systems; — Fire and smoke detection and warning systems; — Fire-extinguishing systems; — System tests.	3		2	
(b) Portable fire extinguisher.	1		1	
13.13 Fuel systems (ATA 28, ATA 47)				
(a) System layout; System layout; Fuel tanks; Supply systems.	1		2	
(b) Fuel handling; Cross-feed and transfer; Refuelling and defuelling.	2		2	
(c) Indications and warnings;	3		2	
(d) Special systems; Dumping, venting and draining;	1		2	

Inert gas systems.				
(e) Balancing. Longitudinal balance fuel systems.	3		1	
13.14 Hydraulic power (ATA 29)				
(a) System layout; System layout; Hydraulic fluids; Hydraulic reservoirs and accumulators; Filters; Power distribution.	1		1	
(b) System operation (1); Pressure generation: electric and mechanical; Pressure control; Indication and warning systems; Servicing.	3		5	
(c) System operation (2). Pressure generation: pneumatic; Emergency pressure generation; Interface with other systems.	3		5	
13.15 Ice and rain protection (ATA 30)				
(a) Principles; Ice formation, classification, and detection.	2		1	
(b) De-icing; De-icing systems: electrical, hot-air, pneumatic, andchemical; Probe and drain heating.	3		2	
(c) Anti-icing; Anti-icing systems: electrical, hot-air, and chemical.	2		1	
(d) (d) Wiper systems;	1		1	
(e) (e) Rain repellent.	1		1	
13.16 Landing gear (ATA 32)				
(a) Description; Construction, shock absorbing; Tyres.	1		1	
(b) System; Extension and retraction systems: normal and emergency; Indications and warnings; Wheels, brakes, antiskid, and autobraking; Steering.	3		3	
(c) Air–ground sensing.	3		3	
13.17 Oxygen (ATA 35) System layout: cockpit, cabin; Sources, storage, charging, and distribution; Supply regulation; Indications and warnings.	3		2	
13.18 Pneumatic/vacuum (ATA 36) — System layout; — Sources: engine/APU, compressors, reservoirs, ground supply; — Pressure control; — Distribution; — Indications and warnings; — Interfaces with other systems.	2		6	
13.19 Water/waste (ATA 38) — Water system layout, supply, distribution, servicing, and draining; — Toilet system layout, flushing and servicing.	2		2	
13.20 Integrated modular avionics (IMA) (ATA 42)				
(a) Overall system description and theory; Core system; Network components.	3		2	

Note: Functions that may be typically integrated intothe integrated modular avionics (IMA) modules are,among others: — Bleed management; — Air pressure control; — Air ventilation and control; — Avionics and cockpit ventilation control,temperature control; — Air traffic communication; — Avionics communication router; — Electrical load management; — Circuit breaker monitoring; — Electrical system built-in test equipment (BITE); — Fuel management; — Braking control; — Steering control; — Landing gear extension and retraction; — Tyre pressure indication; — Oleo pressure indication; — Brake temperature monitoring.				
(b) Typical system layouts.	3		1	
13.21 Cabin systems (ATA 44) System architecture, operation and control of systems for: — passenger in-flight entertainment; — communication within the aircraft (cabin intercommunication data system (CIDS); — communication between the aircraft cabin and ground stations, including voice, data, music and video transmission. CIDS interface between cockpit/cabin crew and cabin systems; Data exchange between the different related line replaceable units (LRUs); Flight attendant panels (FAPs). CNS server and interfaces with the following systems: — Data/radio communication system; — Cabin core system (CCS); — In-flight entertainment system (IFES); — External communication system (ECS); — Cabin mass memory system (CMMS); — Cabin monitoring system (CMS); — Miscellaneous cabin systems (MCSs). The CNS may host functions such as: — access to predeparture/departure reports; — email/intranet/internet access; — passenger database.	3		3	
13.22 Information systems (ATA 46) The units and components which furnish a means of storing, updating, and retrieving digital information traditionally provided on paper, microfilm or microfiche. They include units that are dedicated to the information storage and retrieval function, such as the electronic library mass storage and controller, but they do not include units or components installed for other uses and shared with other systems, such as flight deck printer or general-use display. Typical examples include: — air traffic and information management systems and network server systems; — aircraft general information system; — flight deck information system; — maintenance information system; — passenger cabin information system; — miscellaneous information systems; — other linked systems.	3		3	

MODULE 14 — PROPULSION

MODULE 14 — PROPULSION	**Level**		**Ant. Spm.**	
	B2 B2L		**B2 B2L**	
Total number for the module:			32	
14.1 Engines				
(a) Turbine engines; Constructional arrangement and operation of turbojet, turbofan,turboshaft, and turboprop engines.	1		3	
(b) Auxiliary power units (APUs); Constructional arrangement and operation of auxiliary power units (APUs).	1		4	
(c) Piston engines; Constructional arrangement and operation of piston engines.	1		2	
(d) Electric and hybrid engines; Constructional arrangement and operation of electric and hybrid engines,their electric energy storage and control systems.	2		4	
(e) **Engine control.** Electronic engine control and fuel-metering systems (full authority digitalengine control (FADEC)).	2		3	
14.2 Electric/electronic engine indication systems — Exhaust gas temperature / interstage turbine temperature systems; — Cylinder head temperature, engine coolant temperature, engine speed; — Engine thrust indication: engine pressure ratio, engine turbine discharge pressure or jet pipe pressure systems; — Vibration measurement systems; — Oil pressure and temperature; — Fuel pressure, temperature, and flow; — Manifold pressure; — Engine torque.	2		10	
14.3 Propeller systems — Propeller speed indication; — Speed control and pitch change methods — electrical/electronic; — Synchronising and synchrophasing equipment; — Electrical anti-icing/de-icing equipment.	2		2	
14.4 Starting and ignition systems — Operation of engine start systems and components; — Ignition systems and components; — Maintenance safety requirements.	2		4	

MODULE 15 — GAS-TURBINE ENGINE

MODULE 15 — GAS-TURBINE ENGINE	**Level**		**Ant. Spm.**	
	B1.1 B1.3		**B1.1 B1.3**	
Total number for the module:			92	
15.1 Fundamentals — Potential energy, kinetic energy, Newton's laws of motion, Brayton cycle; — The relationship between force, work, power, energy, velocity, and acceleration; — Constructional arrangement and operation of turbojet, turbofan, turboshaft, turboprop, and geared turbofan engines.	2		4	
15.2 Engine performance — Gross thrust, net thrust, choked nozzle thrust, thrust distribution, resultant thrust, thrust horsepower, equivalent shaft horsepower, specific fuel consumption; — Engine efficiencies; — By-pass ratio and engine pressure ratio; — Pressure, temperature, and velocity of the gas flow; — Engine ratings, static thrust, influence of speed, altitude and hot climate, flat rating, limitations.	2		6	
15.3 Inlet — Compressor inlet ducts; — Effects of various inlet configurations; — Ice protection.	2		4	
15.4 Compressors — Axial and centrifugal types; — Constructional features, operating principles, and applications; — Fan balancing; — Operation: -Causes and effects of compressor stall and surge; -Methods of air-flow control: bleed valves, variable inlet guide vanes, variablestator vanes, rotating stator blades; -Compressor ratio.	2		7	
15.5 Combustion section Constructional features and principles of operation.	2		3	
15.6 Turbine section — Operation and characteristics of different turbine blade types; — Blade-to-disk attachment; — Nozzle guide vanes; — Causes and effects of turbine blade stress and creep.	2		5	
15.7 Exhaust — Constructional features and principles of operation; — Convergent, divergent, and variable area nozzles; — Engine noise reduction; — Thrust reversers.	2		4	
15.8 Bearings and seals Constructional features and principles of operation.	2		3	
15.9 Lubricants and fuels — Properties and specifications of standard, alternate, and drop-in fuel; — Properties and specifications of lubricants; — Fuel additives; — Safety precautions.	2		4	
15.10 Lubrication systems System operation/layout and components.	2		4	
15.11 Fuel systems	2		5	

— Operation of engine control and fuel-metering systems, including electronic engine control (full authority digital engine control (FADEC)) and electronic power augmentation; — System layout and components.				
15.12 Air systems Operation of engine air distribution and anti-icing control systems, including internal cooling and sealing, and external air services.	2		3	
15.13 Starting and ignition systems — Operation of engine start systems and components; — Ignition systems and components; — Maintenance safety requirements.	2		4	
15.14 Engine indication systems — Exhaust gas temperature / interstage turbine temperature; — Engine thrust indication: engine pressure ratio, engine turbine discharge pressure or jet pipe pressure systems; — Oil pressure and temperature; — Fuel pressure and flow; — Engine speed; — Vibration measurement and indication; — Torque; — Power.	2		7	
15.15 Alternate turbine constructions — Geared turbofan (GTF); — Variable fan blades; — Open rotor/propfan; — Hybrid turbine-electric concepts and electric power augmentation; — Future trends and developments.	1		2	
15.16 Turboprop engines — Gas-coupled/free-turbine and gear-coupled turbines; — Reduction gears; — Integrated engine and propeller controls; — Overspeed safety devices.	2		5	
15.17 Turboshaft engines Arrangements, drive systems, reduction gearing, couplings, control systems.	2		3	
15.18 Auxiliary power units (APUs) Purpose, operation, protective systems.	2		3	
15.19 Power plant installation Configuration of firewalls, cowlings, acoustic panels, engine mounts, antivibration mounts, hoses, pipes, feeders, connectors, wiring looms, control cables and rods, lifting points and drains.	2		3	
15.20 Fire protection systems Operation of fire-detection and fire-extinguishing systems.	2		3	
15.21 Engine monitoring and ground operation — Procedures for starting and ground run-up; — Interpretation of engine power output and parameters; — Trend (including oil analysis, vibration and borescope) monitoring; — Inspection of engine and components to criteria, tolerances and data specified by the engine manufacturer; — Compressor washing/cleaning; — Foreign object damage (FOD).	3		7	
15.22 Engine storage and preservation Preservation and depreservation for the engine and its accessories/systems.	2		3	

MODULE 16 — PISTON ENGINE

MODULE 16 — PISTON ENGINE	**Level**		**Ant. Spm.**	
	B1.2 B1.4 B3		**B1.2 B1.4 B3**	
Total number for the module:			76	
16.1 Fundamentals of piston engines Mechanical, thermal, and volumetric efficiencies; — Operating principles: 2-stroke, 4-stroke, Otto, diesel, and rotary (Wankel); — Piston displacement and compression ratio; — Engine configuration and firing order.	2		5	
16.2 Engine performance — Power calculation and measurement; — Factors that affect engine power; — Mixtures/leaning, pre-ignition.	2		5	
16.3 Engine construction — Crank case, crank shaft, cam shafts, sumps; — Accessory gearbox; — Cylinder and piston assemblies; — Connecting rods, inlet and exhaust manifolds; — Valve mechanisms; — Propeller reduction gearboxes.	2		8	
16.4 Engine fuel systems			—	
16.4.1 Carburettors — Types, construction, and principles of operation; — Icing and heating.	2		4	
16.4.2 Fuel injection systems Types, construction, and principles of operation.	2		4	
16.4.3 Electronic engine control — Operation of engine control and fuel-metering systems including electronic engine control (full authority digital engine control (FADEC)); — System layout and components.	2		4	
16.5 Starting and ignition systems — Starting systems, preheat systems; — Magneto types, construction, and principles of operation; — Ignition harnesses, spark plugs; — Low- and high-tension systems.	2		5	
16.6 Induction, exhaust, and cooling systems — Construction and operation of induction systems, including alternate air systems; — Exhaust systems, engine cooling systems — air and liquid.	2		4	
16.7 Supercharging/turbocharging — Principles and purpose of supercharging and its effects on engine parameters; — Construction and operation of supercharging/turbocharging systems; — System terminology; — Control systems; — System protection.	2		6	
16.8 Lubricants and fuels — Properties and specifications of standard, alternate, and drop-in fuel; — Properties and specifications of lubricants; — Fuel additives; — Safety precautions.	2		5	
16.9 Lubrication systems System operation/layout and components.	2		4	
16.10 Engine indication systems — Engine speed;	2		7	

— Cylinder head temperature; — Coolant temperature; — Oil pressure and temperature; — Exhaust gas temperature; — Fuel pressure and flow; — Manifold pressure.				
16.11 Power plant installation Configuration of firewalls, cowlings, acoustic panels, engine mounts, antivibration mounts, hoses, pipes, feeders, connectors, wiring looms, control cables and rods, lifting points and drains.	2		3	
16.12 Engine monitoring and ground operation — Procedures for starting and ground run-up; — Interpretation of engine power output and parameters; — Inspection of engine and components: criteria, tolerances, and data specified by the engine manufacturer.	3		5	
16.13 Engine storage and preservation Preservation and depreservation for the engine and its accessories/systems.	2		3	
16.14 Alternative piston-engine constructions Hybrid piston–electric concepts and electric power augmentation.	1		4	

MODULE 17 — PROPELLER

MODULE 17 — PROPELLER	**Level**		**Ant. Spm.**	
	B1.1 **B1.2** B3		**B1.1** **B1.2** **B3**	
Total number for the module:			32	
17.1 Fundamentals of propellers — Blade element theory; — High/low blade angle, reverse angle, angle of attack, rotational speed; — Propeller slip; — Aerodynamic, centrifugal, and thrust forces; — Torque; — Relative airflow on blade angle of attack; — Vibration and resonance.	2		8	
17.2 Propeller construction — Construction methods and materials used in wooden, composite and metal propellers; — Blade station, blade face, blade shank, blade back / thrust face and hub assembly; — Fixed pitch, controllable pitch, constant speeding propeller; — Propeller/spinner installation.	2		5	
17.3 Propeller pitch control peed control and pitch change methods — mechanical and electrical/electronic; — Feathering and reverse pitch; — Overspeed protection.	2		6	
17.4 Propeller synchronising Synchronising and synchrophasing equipment.	2		2	
17.5 Propeller ice protection Fluid and electrical de-icing equipment.	2		3	
17.6 Propeller maintenance — Static and dynamic balancing; — Blade tracking; — Assessment of blade damage, erosion, corrosion, impact damage, delamination; — Propeller treatment/repair schemes; — Propeller engine running.	3		6	
17.7 Propeller storage and preservation Propeller preservation and depreservation.	2		2	