

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

**Subject 022 - Aircraft General knowledge: Instrumentation**

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
022 00 00 00		AIRCRAFT GENERAL KNOWLEDGE								
022 00 00 00		AIRCRAFT GENERAL KNOWLEDGE — INSTRUMENTATION								
022 01 00 00		SENSORS AND INSTRUMENTS								
022 01 01 00		Pressure gauge								
022 01 01 01		Units for pressure, sensor types, measurements								
(01)	X	Define 'pressure', 'absolute pressure' and 'differential pressure'.	X	X	X	X	X			
(02)	X	List the following units used for pressure measurements: — Pascal;	X	X	X	X	X			

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			ATPL	CPL	ATPL/IR	ATPL	CPL			
		<ul style="list-style-type: none"> <li>— bar;</li> <li>— inches of mercury (in Hg);</li> <li>— pounds per square inch (psi).</li> </ul>								
(03)	X	State the relationship between the different units.	X	X	X	X	X			
(04)		List and describe the following different types of sensors used according to the pressure to be measured <ul style="list-style-type: none"> <li>— aneroid capsules;</li> <li>— bellows;</li> <li>— diaphragms;</li> <li>— bourdon tube.</li> </ul>	X	X	X	X	X			
(05)		Identify pressure measurements that are applicable to an aircraft: <ul style="list-style-type: none"> <li>— liquid-pressure measurement (fuel, oil, hydraulic);</li> <li>— air-pressure measurement (bleed-air systems, air-conditioning systems);</li> <li>— engine-pressure measurement manifold pressure (MAP), engine pressure ratio (EPR)</li> </ul>	X	X	X	X	X			
(06)		Identify and read pressure measurement indications both for engine indications and other systems.	X	X	X	X	X			
(07)		Explain the implications of the following pressure measurement errors both for engine indications and other systems: <ul style="list-style-type: none"> <li>— loss of pressure sensing;</li> <li>— incorrect pressure indications.</li> </ul>	X	X	X	X	X			
022 01 02 00		Temperature sensing								
022 01 02 01		Units for temperature, measurements								

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			ATPL	CPL	ATPL/IR	ATPL	CPL			
(01)	X	Explain temperature.	X	X	X	X	X			
(02)	X	List the following units that can be used for temperature measurement: — Kelvin; — Celsius; — Fahrenheit.	X	X	X	X	X			
(03)	X	State the relationship between these units and convert between them.	X	X	X	X	X			
(04)		Identify temperature measurements that are applicable to an aircraft: — gas temperature measurement (ambient air, bleed-air systems, air-conditioning systems, air inlet, exhaust gas, gas turbine outlets); — liquid-temperature measurement (fuel, oil, hydraulic); — component-temperature measurement (generator, transformer rectifier unit (TRU), pumps (fuel, hydraulic), power transfer unit (PTU).	X	X	X	X	X			
(05)		Identify and read temperature measurement indications for both engine indications and other systems.	X	X	X	X	X			
022 01 03 00		Fuel gauge								
022 01 03 01		Units for fuel, measurements, fuel gauges								
(01)		State that the quantity of fuel can be measured by volume or mass.	X	X	X	X	X			
(02)		List the following units used for fuel quantity: — kilogramme; — pound; — litres; — gallons (US and	X	X	X	X	X			

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			ATPL	CPL	ATPL/IR	ATPL	CPL			
		imperial).								
(03)		Convert between the various units.	X	X	X	X	X			
(04)		Explain the parameters that can affect the measurement of the volume or mass of the fuel in a fuel tank: <ul style="list-style-type: none"> <li>— temperature;</li> <li>— aircraft accelerations and attitudes;</li> <li>— and explain how the fuel-gauge system design compensates for these changes.</li> </ul>	X	X	X	X	X			
(05)		Describe and explain the operating principles of the following types of fuel gauges: <ul style="list-style-type: none"> <li>— float system;</li> <li>— capacitance-type of fuel-gauge system.</li> <li>— ultrasound-type of fuel-gauge system: to be introduced at a later date.</li> </ul>	X	X	X	X	X			
(06)		Describe and complete a typical post-refuelling procedure for a pilot: <ul style="list-style-type: none"> <li>— recording the volume that was filled;</li> <li>— converting to the appropriate unit used by the aircraft fuel gauge(s) to compare the actual indicated fuel content to the calculated fuel content;</li> <li>— assess appropriate action if the numbers does not compare.</li> </ul>	X	X	X	X	X			
022 01 04 00		Fuel flowmeters								
022 01 04 01		Fuel flow, units for fuel flow, total fuel consumption								
(01)		Define 'fuel flow' and where it is measured.	X	X	X	X	X			
(02)		State that fuel flow may be measured by volume or mass per unit of time.	X	X	X	X	X			

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			ATPL	CPL	ATPL/IR	ATPL	CPL			
(03)		List the following units used for fuel flow when measured by mass per hour: kilogrammes/hour; pounds/hour.	X	X	X	X	X			
(04)		List the following units used for fuel flow when measured by volume per hour: — litres/hour; — imperial gallons/hour; — US gallons/hour.	X	X	X	X	X			
(05)		Explain how total fuel consumption is obtained.	X	X	X	X	X			
022 01 05 00		Tachometer								
022 01 05 01		Types, operating principles, units for engine speed								
(01)	X	List the following types of tachometers, describe their basic operating principle and give examples of use:  mechanical (rotating magnet);  electrical (three-phase tachogenerator);  electronic (impulse measurement with speed probe and phonic wheel);  and describe the operating principle of each type.	X	X	X	X	X			
(02)		Explain the typical units for engine speed: — rpm for piston-engine aircraft; — percentage for turbine-engine aircraft.	X	X	X	X	X			
(03)		Explain that some types of rpm indicators require electrical power to provide an indication.	X	X	X	X	X			
022 01 06 00		Thrust measurement								
022 01 06 01		Parameters, operating principle								
(01)		List and describe the following two parameters used to	X	X						

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			ATPL CPL		ATPL/IR	ATPL CPL				
		represent thrust: — N1; — EPR.								
(02)		Explain the operating principle of using an engine with EPR indication and explain the consequences of incorrect or missing EPR to the operation of the engine, including reverting to N1 mode.	X	X						
(03)		Give examples of display for N1 and EPR.	X	X						
022 01 07 00		Engine torquemeter								
022 01 07 01		Torque, torquemeters								
(01)		Define 'torque'.	X	X	X	X	X			
(02)		Explain the relationship between power, torque and rpm.	X	X	X	X	X			
(03)		List the following units used for torque: — Newton meters; — inch or foot pounds.	X	X	X	X	X			
(04)		State that engine torque can be displayed as a percentage	X	X	X	X	X			
(05)	X	List and describe the following different types of torquemeters, and explain their operating principles: — mechanical; — electronic.	X	X	X	X	X			
(06)	X	Compare the two systems with regard to design and weight.	X	X	X	X	X			
(07)		Give examples of display.	X	X	X	X	X			
022 01 08 00		Synchroscope								
022 01 08 01		Purpose, operating principle, display								
(01)		State the purpose of a synchroscope.	X	X						
(02)	X	Explain the operating principle of a synchroscope.	X	X						
(03)		Give examples of display.	X	X						
022 01 09 00		Engine-vibration monitoring								
022 01 09		Purpose, operating principle of a								

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			ATPL	CPL	ATPL/IR	ATPL	CPL			
01		vibration-monitoring system, display								
(01)		State the purpose of a vibration-monitoring system for a jet engine.	X	X						
(02)	X	Describe the operating principle of a vibration-monitoring system using the following two types of sensors: piezoelectric crystal; magnet.	X	X						
(03)		Explain that there is no specific unit for vibration monitoring, i.e. it is determined by specified numeric threshold values.	X	X						
(04)		Give examples of display.	X	X						
022 01 10 00		Time measurement								
022 01 10 01		On-board clock								
(01)		Explain that the on-board aircraft clock provides a time reference for several of the on-board systems including aircraft communications addressing and reporting system (ACARS) and engine and systems maintenance.	X	X	X	X	X			
022 02 00 00		MEASUREMENT OF AIR-DATA PARAMETERS								
022 02 01 00		Pressure measurement								
022 02 01 01		Definitions								
(01)		Define the following pressure measurements and state the relationship between them: — static pressure; — dynamic pressure; — total pressure.	X	X	X	X	X	X		
022 02 01 02		Pitot/static system: design and errors								
(01)		Describe the design and the operating principle of a: — static port/source; — pitot tube; — combined pitot/static	X	X	X	X	X	X	X	

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			ATPL	CPL	ATPL/IR	ATPL	CPL			
		probe.								
(02)		For each of these indicate the various locations and describe the following associated errors and how to correct, minimise the effect of or compensate for them: — position errors; — instrument errors; — errors due to a non-longitudinal axial flow (including manoeuvre-induced errors).	X	X	X	X	X	X	X	
(03)		Describe a typical pitot/static system and list the possible outputs.	X	X	X	X	X	X		
(04)		Explain the redundancy and the interconnections that typically exist in complex pitot/static systems found in large aircraft.	X	X	X	X	X	X		
(05)		Explain the purpose of pitot/static system heating.	X	X	X	X	X	X	X	
(06)		Describe alternate static sources and their effects when used, particularly in unpressurised aircraft.	X	X	X	X	X	X	X	
(07)		Describe a modern pitot static system using solid-state sensors near the pitot probe or static port converting the air data to numerical data (electrical signals) before being sent to the air-data computer(s).	X	X	X	X	X	X		
022 02 02 00		Temperature measurement								
022 02 02 01		Definitions								
(01)		Define the following and explain the relationship between them: — outside air temperature (OAT); — total air temperature (TAT); — static air temperature (SAT).	X	X	X	X	X	X	X	
(02)		Explain the term 'ram rise' and convert TAT to SAT.	X					X		

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(03)		Explain why TAT is often displayed and that TAT is the temperature input to the air-data computer.	X	X	X	X	X	X	X	
022 02 02 02		Design and operation								
(01)		Indicate typical locations for both direct-reading and remote-reading temperature probes, and describe the following errors: — position error; — instrument error.	X	X	X	X	X	X		
(02)		Explain the purpose of temperature probe heating and interpret the effect of heating on sensed temperature unless automatically compensated for.	X	X	X	X	X	X		
022 02 03 00		Angle-of-attack (AoA) measurement								
022 02 03 01		Sensor types, operating principles, ice protection, displays incorrect indications								
(01)		Describe the following two types of AoA sensors: — null-seeking (slotted) probe; — vane detector.	X	X						
(02)		For each type, explain the operating principles.	X	X						
(03)		Explain how both types are protected against ice.	X	X						
(04)		Give examples of systems that use the AoA as an input, such as: — air-data computer; — stall warning systems; — flight-envelope protection systems.	X	X						
(05)		Give examples of and interpret different types of AoA displays: — simple light arrays of green, amber and red lights; — gauges showing a numerical scale.	X	X						
(06)		Explain the implications for the	X	X						

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		pilot if the AoA indication becomes incorrect but still provides data, e.g. if the sensor is frozen in a fixed position.								
(07)		Explain how an incorrect AoA measurement can affect the controllability of an aircraft with flight-envelope protection.	X	X						
022 02 04 00		Altimeter								
022 02 04 01		Units, terms, types, operating principles, displays, errors, corrections								
(01)		List the following two units used for altimeters and state the relationship between them: — feet; — metres.	X	X	X	X	X	X		
(02)	X	Define the following terms: — height, altitude; — indicated altitude, true altitude; — pressure altitude, density altitude.	X	X	X	X	X	X	X	
(03)	X	Define the following barometric references: 'QNH', 'QFE', '1013,25'.	X	X	X	X	X	X	X	
(04)		Explain the operating principles of an altimeter.	X	X	X	X	X	X	X	
(05)	X	Describe and compare the following three types of altimeters and reason(s) why particular designs may be required in certain airspace: — simple altimeter (single capsule); — sensitive altimeter (multi-capsule); — servo-assisted altimeter.	X	X	X	X	X	X	X	
(06)	X	Give examples of associated displays: pointer, multi-pointer, drum, vertical straight scale.	X	X	X	X	X	X	X	
(07)		Describe the following errors: — static system error;	X	X	X	X	X	X	X	

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			ATPL	CPL	ATPL/IR	ATPL	CPL			
		<ul style="list-style-type: none"> <li>— instrument error;</li> <li>— barometric error;</li> <li>— temperature error (air column not at ISA conditions);</li> <li>— lag (altimeter response to change of height).</li> </ul>								
(08)		Demonstrate the use of an altimeter correction table for the following errors: <ul style="list-style-type: none"> <li>— temperature corrections;</li> <li>— aircraft position errors.</li> </ul>	X	X	X	X	X	X	X	
(09)		Describe the effects of a blockage or a leakage on the static pressure line.	X	X	X	X	X	X	X	
(10)		Describe the use of GPS altitude as an alternative means of checking erroneous altimeter indications, and highlight the limitations of the GPS altitude indication.	X	X	X	X	X	X	X	
022 02 05 00		Vertical speed indicator (VSI)								
022 02 05 01		VSI and instantaneous vertical speed indicator (IVSI)								
(01)		List the two units used for VSIs and state the relationship between them: <ul style="list-style-type: none"> <li>— metres per second;</li> <li>— feet per minute.</li> </ul>	X	X	X	X	X	X	X	
(02)		Explain the operating principles of a VSI and an IVSI.	X	X	X	X	X	X	X	
(03)		Describe and compare the following types of VSIs: <ul style="list-style-type: none"> <li>— barometric type (VSI);</li> <li>— instantaneous barometric type (IVSI);</li> <li>— inertial type (inertial information provided by an inertial reference unit).</li> </ul>	X	X	X	X	X	X	X	
(04)		Describe the following VSI errors: <ul style="list-style-type: none"> <li>— static system errors;</li> <li>— instrument errors;</li> </ul>	X	X	X	X	X	X	X	

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			ATPL	CPL	ATPL/IR	ATPL	CPL			
		— time lag.								
(05)		Describe the effects on a VSI of a blockage or a leakage on the static pressure line.	X	X	X	X	X	X	X	
(06)		Give examples of a VSI display.	X	X	X	X	X	X		
(07)		Compare the indications of a VSI and an IVSI during flight in turbulence and appropriate pilot technique during manoeuvring using either type.	X	X	X	X	X	X		
022 02 06 00		Airspeed indicator (ASI)								
022 02 06 01		Units, errors, operating principles, displays, position errors, unreliable airspeed indications								
(01)		List the following three units used for airspeed and state the relationship between them: — nautical miles/hour (kt); — statute miles/hour (mph); — kilometres/hour (km/h).	X	X	X	X	X	X		
(02)		Describe the following ASI errors and state when they must be considered: — pitot/static system errors; — instrument errors; — position errors; — compressibility errors; — density errors.	X	X	X	X	X	X	X	
(03)		Explain the operating principles of an ASI (as appropriate to aeroplanes or helicopters).	X	X	X	X	X	X	X	
(04)		Give examples of an ASI display: pointer, vertical straight scale, and digital (HUD display).	X	X	X	X	X	X		
(05)		Demonstrate the use of an ASI correction table for position error.	X	X	X	X	X	X		
(06)		Define and explain the following colour codes that can be used on an ASI: — white arc (flap operating speed range);	X	X						

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		<ul style="list-style-type: none"> <li>— green arc (normal operating speed range);</li> <li>— yellow arc (caution speed range);</li> <li>— red line (VNE) or barber's pole (<math>V_{MO}</math>);</li> <li>— blue line (best rate of climb speed, one-engine-out for multi-engine piston light aeroplanes).</li> </ul>								
(07)		Define and explain the following colour codes that can be used on an ASI: <ul style="list-style-type: none"> <li>— green arc (normal operating speed range);</li> <li>— red line (VNE);</li> <li>— blue line (maximum airspeed during autorotation).</li> </ul>			X	X	X			
(08)		Describe the effects on an ASI of a blockage or a leakage in the static or total pressure line(s).	X	X	X	X	X	X	X	
(09)		Define the term 'unreliable airspeed' and describe the means by which it can be recognised such as: <ul style="list-style-type: none"> <li>— different airspeed indications between ASIs;</li> </ul>	X	X	X	X	X	X	X	
		<ul style="list-style-type: none"> <li>— unexpected aircraft behaviour;</li> <li>— buffeting;</li> <li>— aircraft systems warning;</li> <li>— aircraft attitude.</li> </ul>								
(10)		Describe the appropriate procedures available to the pilot in the event of unreliable airspeed indications: <ul style="list-style-type: none"> <li>— combination of a pitch attitude and power setting;</li> <li>— ambient wind noise inside the aircraft;</li> <li>— use of GPS speed indications and the associated limitations.</li> </ul>	X	X	X	X	X	X	X	

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			ATPL	CPL	ATPL/IR	ATPL	CPL			
022 02 07 00		Machmeter								
022 02 07 01		Operating principle, display, CAS, TAS and Mach number								
(01)		Define 'Mach number' and 'local speed sound' (LSS). Calculate between LSS, TAS and Mach number.	X							
(02)	X	Describe the operating principle of a Machmeter.	X							
(03)	X	Explain why a Machmeter does not suffer from compressibility error.	X							
(04)		Give examples of a Machmeter display: pointer, drum, vertical straight scale, digital.	X							
(05)		Describe the effects on a Machmeter of a blockage or a leakage in the static or total pressure line(s).	X							
(06)		Explain the relationship between CAS, TAS and Mach number. Explain how CAS, TAS and Mach number vary in relation to each other during a climb, a descent, or in level flight in different temperature conditions.	X							
(07)		State the existence of maximum operating limit speed ( $V_{MO}$ ) and maximum operating Mach number ( $M_{MO}$ ).	X							
(08)		Describe typical indications of MMO and VMO on analogue and digital instruments.	X							
(09)		Describe the relationship between $M_{MO}$ and $V_{MO}$ with change in altitude and the implications of climbing at constant IAS and descending at constant Mach number with respect to the margin to $M_{MO}$ and $V_{MO}$ .	X							
(10)		Describe the implications of climbing or descending at constant Mach number or constant IAS with respect to the margin to the stall speed or maximum speed.	X							

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			ATPL CPL		ATPL/IR ATPL CPL					
022 02 08 00		Air-data computer (ADC)								
022 02 08 01		Operating principle, data, errors, air-data inertial reference unit								
(01)		<p>Explain the operating principle of an ADC.</p> <p>List the following possible input data:</p> <ul style="list-style-type: none"> <li>— TAT;</li> <li>— static pressure;</li> <li>— total pressure;</li> </ul>	X	X	X	X	X	X		
(02)	X	<ul style="list-style-type: none"> <li>— measured temperature;</li> <li>— AoA;</li> <li>— flaps position;</li> <li>— landing gear position;</li> <li>— stored aircraft data.</li> </ul>	X	X	X	X	X	X		
(03)	X	<p>List the following possible output data, as applicable to aeroplanes or helicopters:</p> <ul style="list-style-type: none"> <li>— IAS;</li> <li>— TAS;</li> <li>— SAT;</li> <li>— TAT;</li> <li>— Mach number;</li> <li>— AoA;</li> <li>— altitude;</li> <li>— vertical speed;</li> <li>— <math>V_{MO}/M_{MO}</math> pointer.</li> </ul>	X	X	X	X	X	X		
(04)		Explain how position, instrument, compressibility and density errors can be compensated/corrected to achieve a TAS calculation.	X	X	X	X	X	X		
(05)		Give examples of instruments or systems which may use ADC output data.	X	X	X	X	X	X		
(06)		Explain that an air-data inertial reference unit (ADIRU) is an ADC integrated with an inertial	X	X	X	X	X	X		

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			ATPL CPL		ATPL/IR	ATPL CPL				
		reference unit (IRU), that there will be separate controls for the ADC part and inertial reference (IR) part, and that incorrect selection during failure scenarios may lead to unintended and potentially irreversible consequences.								
(07)	X	Explain the ADC architecture for air-data measurement including sensors, processing units and displays, as opposed to stand-alone air-data measurement instruments.	X	X	X	X	X	X		
(08)		Describe the consequences of the loss of an ADC compared to the failure of individual instruments.	X	X	X	X	X	X		
022 03 00 00		MAGNETISM — DIRECT-READING COMPASS AND FLUX VALVE								
022 03 01 00		Earth's magnetic field								
022 03 01 01		Magnetic field, variation, dip								
(01)		Describe the magnetic field of the Earth.	X	X	X	X	X	X		
(02)	X	Explain the properties of a magnet.	X	X	X	X	X	X		
(03)		Define the following terms: — magnetic variation; — magnetic dip (inclination).	X	X	X	X	X	X		
(04)		Describe that a magnetic compass will align itself to both the horizontal (azimuth) and vertical (dip) components of the Earth's magnetic field, thus will not function in the vicinity of the magnetic poles.	X	X	X	X	X	X		
(05)		Demonstrate the use of variation values (given as East/West (E/W) or +/-) to calculate: — true heading to magnetic heading;	X	X	X	X	X	X		
		— magnetic heading to true heading.								

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			ATPL	CPL	ATPL/IR	ATPL	CPL			
022 03 02 00		Aircraft magnetic field								
022 03 02 01		Permanent magnetism, electromagnetism, deviation								
(01)	X	Explain the following differences between permanent magnetism and electromagnetism: — when they are present; — what affects their magnitude.	X	X	X	X	X	X		
(02)	X	Explain the principles of and the reasons for: — compass swinging (determination of initial deviations); — compass compensation (correction of deviations found); — compass calibration (determination of residual deviations).	X	X	X	X	X	X		
(03)		Explain how permanent magnetism within the aircraft structure and electromagnetism from the aircraft systems affect the accuracy of a compass.	X	X	X	X	X	X		
(04)		Describe the purpose and the use of a deviation correction card.	X	X	X	X	X	X		
(05)		Demonstrate the use of deviation values (either given as E/W or +/-) from a compass deviation card to calculate: — compass heading to magnetic heading; — magnetic heading to compass heading.	X	X	X	X	X	X	X	
022 03 03 00		Direct-reading magnetic compass								
022 03 03 01		Purpose, errors, timed turns, serviceability								
(01)		Explain the purpose of a direct-reading magnetic compass.	X	X	X	X	X	X		

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
(02)		Describe how the direct-reading magnetic compass will only show correct indications during straight, level and unaccelerated flight, and that an error will occur during the following flight manoeuvres (no numerical examples):	X	X	X	X	X	X		
		— acceleration and deceleration; — turning; — during pitch-up or pitch-down manoeuvres.								
(03)		Explain how the use of timed turns eliminates the problem of the turning errors of a direct-reading magnetic compass, and calculate the duration of a rate-1 turn for a given change of heading.	X	X	X	X	X	X		
(04)		Describe the serviceability check for a direct-reading magnetic compass prior to flight, such as: — the physical appearance of the device; — comparing the indication to another known direction such as a different compass or runway direction.	X	X	X	X	X	X	X	
022 03 04 00		Flux valve								
022 03 04 01		Purpose, operating principle, location, errors								
(01)		Explain the purpose of a flux valve.	X	X	X	X	X	X		
(02)	X	Explain its operating principle.	X	X	X	X	X	X		
(03)		Indicate typical locations of the flux valve(s).	X	X	X	X	X	X		
(04)		Give the remote-reading compass system as example of application for a flux valve.	X	X	X	X	X	X		
(05)		Explain that deviation is compensated for and, therefore, eliminates the need for a deviation correction card.	X	X	X	X	X	X		
(06)		Explain that a flux valve does not suffer from the same magnitude	X	X	X	X	X	X		

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		of errors as a direct-reading magnetic compass when turning, accelerating or decelerating and during pitch-up or pitch-down manoeuvres.								
022 04 00 00		GYROSCOPIC INSTRUMENTS								
022 04 01 00		Gyroscope: basic principles								
022 04 01 01		Gyroscopic forces, degrees of freedom, gyro wander, driving gyroscopes								
(01)	X	Define a 'gyro'.	X	X	X	X	X	X	X	
(02)	X	Explain the fundamentals of the theory of gyroscopic forces.	X	X	X	X	X	X	X	
(03)	X	Define the 'degrees of freedom' of a gyro.  Remark: As a convention, the degrees of freedom of a gyroscope do not include its own axis of rotation (the spin axis).	X	X	X	X	X	X	X	
(04)	X	Explain the following terms: — rigidity; — precession; — wander (drift/topple).	X	X	X	X	X	X		
(05)		Explain the three types of gyro wander: — real wander; — apparent wander; — transport wander.	X	X	X	X	X	X		
(06)		Describe the two ways of driving gyroscopes and any associated indications: — air/vacuum; — electrically.	X	X	X	X	X	X	X	
022 04 02 00		Rate-of-turn indicator — Turn coordinator — Balance (slip) indicator								
022 04 02 01		Indications, relation between bank angle, rate of turn and TAS								
(01)		Explain the purpose of a rate-of-turn and balance (slip) indicator.	X	X	X	X	X	X	X	
(02)		Define a 'rate-1 turn'.	X	X	X	X	X	X	X	
(03)		Describe the indications given by a rate-of-turn indicator.	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
(04)		Explain the relation between bank angle, rate of turn and TAS, and how bank angle becomes the limiting factor at high speed (no calculations).	X	X	X	X	X	X	X	
(05)		Explain the purpose of a balance (slip) indicator and its principle of operation.	X	X	X	X	X	X	X	
(06)		Describe the indications of a rate-of-turn and balance (slip) indicator during a balanced, slip or skid turn.	X	X	X	X	X	X	X	
(07)		Describe the indications given by a turn coordinator (or turn- and-bank indicator).	X	X	X	X	X	X	X	
(08)		Compare the indications on the rate-of-turn indicator and the turn coordinator.	X	X	X	X	X	X	X	
022 04 03 00		Attitude indicator (artificial horizon)								
022 04 03 01		Purpose, types, effect of aircraft acceleration, display								
(01)		Explain the purpose of the attitude indicator.	X	X	X	X	X	X	X	
(02)		Identify the two types of attitude indicators: — attitude indicator; — attitude and director indicator (ADI).	X	X	X	X	X	X	X	
(03)	X	State the degrees of freedom.	X	X	X	X	X	X		
(04)		Describe the effects of the aircraft's acceleration and turns on instrument indications.	X	X	X	X	X	X		
(05)		Describe a typical attitude display and instrument markings.	X	X	X	X	X	X	X	
022 04 04 00		Directional gyroscope								
022 04 04 01		Purpose, types, drift, alignment to compass heading								
(01)		Explain the purpose of the directional gyroscope.	X	X	X	X	X	X	X	
(02)		Identify the two types of gyro-driven direction indicators: — direction indicator; — horizontal situation indicator (HSI).	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
(03)		Explain how the directional gyroscope will drift over time due to the following: — rotation of the Earth; — aircraft manoeuvring; — aircraft movement over the Earth's surface/direction of travel.	X	X	X	X	X	X		
(04)		Describe the procedure for the pilot to align the directional gyroscope to the correct compass heading.	X	X	X	X	X	X		
022 04 05 00		Remote-reading compass systems								
022 04 05 01		Operating principles, components, comparison with a direct-reading magnetic compass								
(01)		Describe the principles of operation of a remote-reading compass system.	X	X	X	X	X	X	X	
(02)		Using a block diagram, list and explain the function of the following components of a remote-reading compass system: — flux detection unit; — gyro unit; — transducers, precession amplifiers, annunciator; — display unit (compass card, synchronising and set-heading knob, DG/compass/slave/free switch).	X	X	X	X	X	X	X	
(03)		State the advantages and disadvantages of a remote-reading compass system compared to a direct-reading magnetic compass with regard to: — design (power source, weight and volume); — deviation due to aircraft magnetism; — turning and acceleration	X	X	X	X	X	X		

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		errors; — attitude errors; — accuracy and stability of the information displayed; — availability of the information for several systems (compass card, RMI, automatic flight control system (AFCS)).								
022 04 06 00		Solid-state systems — attitude and heading reference system (AHRS)	X	X	X	X	X	X		
022 04 06 01		Components, indications								
(01)		Explain that the AHRS is a replacement for traditional gyros using solid-state technology with no moving parts and is a single unit consisting of: — solid-state accelerometers; — solid-state rate sensor gyroscopes; — solid-state magnetometers (measurement of the Earth's magnetic field).	X	X	X	X	X	X	X	
(02)		Explain that the AHRS senses rotation and acceleration for all three axes and senses the direction of the Earth's magnetic field where the indications are normally provided on electronic screens (electronic flight instrument system (EFIS)).	X	X	X	X	X	X	X	
022 05 00 00		INERTIAL NAVIGATION								
022 05 01 00		Basic principles								
022 05 01 01		Systems								
(01)		State that inertial navigation/reference systems are the main source of attitude and one of the main sources of navigational data in commercial air transport aeroplanes.	X		X	X				
(02)		State that inertial systems require no external input, except	X		X	X				

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

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter		IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL CPL			
022 05 02 00		Alignment and operation							
022 05 02 01		Alignment process, incorrect data entry, and control panels							
(01)		State that during the alignment process, the inertial platform is levelled (INS) or the local vertical is determined (IRS), and true north/aircraft heading is established.	X		X	X			
(02)		Explain that the aircraft must be stationary during alignment, the aircraft position is entered during the alignment phase, and that the alignment process takes around 10 to 20 minutes at mid latitudes (longer at high latitudes).	X		X	X			
(03)		State that in-flight realignment is not possible and loss of alignment leads to loss of navigational data although attitude information may still be available.	X		X	X			
(04)		Explain that the inertial navigation system (INS) platform is maintained level and north-aligned after alignment is complete and the aircraft is in motion.	X		X	X			
(05)		State that an incorrect entry of latitude may lead to a loss of alignment and is more critical than the incorrect entry of longitude.	X		X	X			
(06)		State that the positional error of a stand-alone INS varies (a typical value can be quoted as 1–2 NM/h) and is dependent on the gyro drift rate, accelerometer bias, misalignment of the platform, and computational errors.	X		X	X			
(07)		Explain that, on a modern aircraft, there is likely to be an air- data inertial reference unit (ADIRU), which is an inertial reference unit (IRU) integrated with an air-data computer (ADC).	X		X	X			
(08)		Identify examples of IRS control panels.	X		X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
(09)		Explain the following selections on the IRU mode selector: — NAV (normal operation); — ATT (attitude only).	X		X	X				
(10)		State that the majority of the IRS data can be accessed through the FMS control and display unit (CDU)/flight management and guidance system (FMGS) multifunction control and display unit (MCDU).	X		X	X				
(11)		Describe the procedure available to the pilot for assessing the performance of individual IRUs after a flight: — reviewing the residual indicated ground speed when the aircraft has parked; — reviewing the drift given as NM/h.	X		X	X				
022 06 00 00		AEROPLANE: AUTOMATIC FLIGHT CONTROL SYSTEMS								
022 06 01 00		General								
022 06 01 01		Definitions and control loops								
(01)		Describe the following purposes of an automatic flight control system (AFCS): — enhancement of flight controls; — reduction of pilot workload.	X	X			X			
(02)		Define and explain the following two functions of an AFCS: — aircraft control: stabilise the aircraft around its centre of gravity (CG); — aircraft guidance: guidance of the aircraft's flight path.	X	X			X			
(03)		Describe the following two automatic control principles: — closed loop, where a feedback from an action or state	X	X						

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		is compared to the desired action or state; — open loop, where there is no feedback loop.								
(04)		List the following elements of a closed-loop control system and explain their basic function: — input signal; — error detector; — signal processor providing a measured output signal according to set criteria or laws; — control element such as an actuator; — feedback signal to error detector for comparison with input signal.	X	X						
(05)		Describe how a closed-loop system may enter a state of self-induced oscillation if the system overcompensates for deviations from the desired state.	X	X						
(06)		Explain how a state of self-induced oscillations may be detected and describe the effects of self-induced oscillations: — aircraft controllability; — aircraft safety; — timely manual intervention as a way of mitigating loss of control; — techniques that may be used to maintain positive control of the aircraft.	X	X						
022 06 02 00		Autopilot system								
022 06 02 01		Design and operation								
(01)		Define the three basic control channels.	X	X						
(02)		Define the three different types of autopilots:	X	X						

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		<ul style="list-style-type: none"> <li>— single or 1 axis (roll);</li> <li>— 2 axes (pitch and roll);</li> <li>— 3 axes (pitch, roll and yaw);</li> </ul>								
(03)		<p>Describe the purpose of the following components of an autopilot system:</p> <ul style="list-style-type: none"> <li>— flight control unit (FCU), mode control panel (MCP) or equivalent;</li> <li>— flight mode annunciator (FMA) (see Subject 022 06 04 00);</li> <li>— autopilot computer;</li> <li>— actuator.</li> </ul>	X	X						
(04)		<p>Explain the following lateral modes:</p> <ul style="list-style-type: none"> <li>— heading (HDG)/track (TRK);</li> <li>— VOR (VOR)/localiser (LOC);</li> <li>— lateral navigation/managed navigation (LNAV or NAV).</li> </ul>	X	X						
(05)		Describe the purpose of control laws for pitch and roll modes.	X	X						
(06)		<p>Explain the following vertical modes:</p> <ul style="list-style-type: none"> <li>— vertical speed (V/S);</li> <li>— flight path angle (FPA);</li> <li>— level change (LVL CHG)/open climb (OP CLB) or open descent (OP DES);</li> <li>— speed reference system (SRS);</li> <li>— altitude (ALT) hold;</li> <li>— vertical navigation (VNAV)/managed climb (CLB) or descent (DES);</li> <li>— glideslope (G/S).</li> </ul>	X	X						
(07)		Describe how the autopilot uses	X	X						

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		speed, aircraft configuration or flight phase as a measure for the magnitude of control inputs and how this may affect precision and stability.								
(08)		Explain the following mixed modes: — take-off; — go-around; — approach (APP).	X	X						
(09)		Describe the two types of autopilot configurations and explain the implications to the pilot for either and when comparing the two principles: — flight-deck controls move with the control surface when the autopilot is engaged; — flight-deck controls remain static when the autopilot is engaged.	X	X						
(10)		Describe the purpose of the following inputs and outputs for an autopilot system: — attitude information; — flight path/trajectory information; — control surface position information; — airspeed information; — aircraft configuration information; — FCU/MCP selections; — FMAs.	X	X						
(11)		Describe the purpose of the synchronisation function when engaging the autopilot and explain why the autopilot should be engaged when the aircraft is in trim.	X	X						
(12)		Define the control wheel steering (CWS) mode as manual manoeuvring of the aircraft	X	X						

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		through the autopilot computer and autopilot servos/actuators using the control column/control wheel.								
(13)		Describe the following elements of CWS: <ul style="list-style-type: none"> <li>— CWS as an autopilot mode;</li> <li>— flight phases where CWS cannot be used;</li> <li>— whether the pilot or the autopilot is controlling the flight path;</li> <li>— the availability of flight path/performance protections;</li> <li>— potential different feel and control response compared to manual flight.</li> </ul>	X	X						
(14)		Describe touch control steering (TCS) and highlight the differences when compared to CWS: <ul style="list-style-type: none"> <li>— autopilot remains engaged but autopilot servos/actuators are disconnected from the control surfaces;</li> <li>— manual control of the aircraft as long as TCS button is depressed;</li> <li>— autopilot servos/actuators reconnect when TCS button is released and the autopilot returns to previously engaged mode(s).</li> </ul>	X	X			X			
(15)		Explain that only one autopilot may be engaged at any time except for when APP is armed in order to facilitate a fail-operational autoland.	X	X			X			
(16)		Explain the difference between an armed and an engaged mode: <ul style="list-style-type: none"> <li>— not all modes have an armed state available;</li> </ul>	X	X			X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		<ul style="list-style-type: none"> <li>— a mode will only become armed if certain criteria are met;</li> <li>— an armed mode will become engaged (replacing the previously engaged mode, if any) when certain criteria are met.</li> </ul>								
(17)		<p>Describe the sequence of events when a mode is engaged and the different phases:</p> <ul style="list-style-type: none"> <li>— initial phase where attitude is changed to obtain a new trajectory in order to achieve the new parameter;</li> <li>— the trajectory will be based on rate of closure which is again based on the difference between the original parameter and the new parameter;</li> <li>— capture phase where the aircraft will follow a predefined rate of change of trajectory to achieve the new parameter without overshooting/undershooting;</li> <li>— tracking or hold phase where the aircraft will maintain the set parameter until a new change has been initiated.</li> </ul>	X	X				X		
(18)		<p>Explain automatic mode reversion and typical situations where it may occur:</p> <ul style="list-style-type: none"> <li>— no suitable data for the current mode such as flight plan discontinuity when in LNAV/managed NAV;</li> <li>— change of parameter during capture phase for original parameter such as change of altitude target during ALT ACQ/ALT*;</li> <li>— mismanagement of a mode resulting in engagement of the autopilot envelope protection, e.g. selecting excessive V/S resulting in a loss of speed control.</li> </ul>	X	X				X		

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
(19)		<p>Explain the dangers of mismanagement of the following modes:</p> <ul style="list-style-type: none"> <li>— use of V/S and lack of speed protection, i.e. excessive V/S or FPA may be selected with subsequent uncontrolled loss or gain of airspeed;</li> <li>— arming VOR/LOC or APP outside the protected area of the localiser or ILS.</li> </ul>	X	X				X		
(20)		<p>Describe how failure of other systems may influence the availability of the autopilot and how incorrect data from other systems may result in an undesirable aircraft state, potentially without any failure indications.</p> <p>Explain the importance of prompt and appropriate pilot intervention during such events.</p>	X	X				X		
(21)		<p>Explain an appropriate procedure for disengaging the autopilot and why both aural and visual warnings are used to indicate that the autopilot is being disengaged:</p> <ul style="list-style-type: none"> <li>— temporary warning for intended disengagement using the design method;</li> <li>— continuous warning for unintended disengagement or using a method other than the design method.</li> </ul>	X	X				X		

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
(22)		<p>Explain the following regarding autopilot and aircraft with manual trim:</p> <ul style="list-style-type: none"> <li>— the autopilot may not engage unless the aircraft controls are in trim;</li> <li>— the aircraft will normally be in trim when the autopilot is disconnected;</li> <li>— use of manual trim when the autopilot is engaged will normally lead to autopilot disconnection and a risk of an out-of-trim situation.</li> </ul>	X	X				X		
022 06 03 00		Flight director: design and operation								
022 06 03 01		Purpose, use, indications, modes, data								
(01)		Explain the purpose of a flight director system.	X	X				X		
(02)		<p>Describe the different types of display:</p> <ul style="list-style-type: none"> <li>— pitch and roll crossbars;</li> <li>— V-bar.</li> </ul>	X	X				X		
(03)		Explain the differences between a flight director and an autopilot and how the flight director provides a means of cross-checking the control/guidance commands sent to the autopilot.	X	X				X		
(04)		<p>Explain why the flight director must be followed when engaged/shown, and describe the appropriate use of the flight director:</p> <ul style="list-style-type: none"> <li>— flight director only;</li> <li>— autopilot only;</li> <li>— flight director and autopilot;</li> <li>— typical job-share between pilots (pilot flying (PF)/pilot monitoring (PM)) for selecting the parameters when autopilot is engaged versus disengaged;</li> </ul>	X	X				X		

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		— highlight when the flight director should not be followed or should be disengaged.								
(05)		Give examples of different scenarios and the resulting flight director indications.	X	X				X		
(06)		Explain that the flight director computes and indicates the direction and magnitude of control inputs required in order to achieve an attitude to follow a trajectory.	X	X				X		
(07)		Explain how the modes available for the flight director are the same as those available for the autopilot, and that the same panel (FCU/MCP) is normally used for selection.	X	X				X		
(08)		Explain the importance of checking the FMC data or selected autopilot modes through the FMA when using the flight directors. If the flight directors are showing incorrect guidance, they should not be followed and should be turned off.	X	X				X		
022 06 04 00		Aeroplane: flight mode annunciator (FMA)								
022 06 04 01		Purpose, modes, display scenarios								
(01)		Explain the purpose of FMAs and their importance being the only indication of the state of a system rather than a switch position.	X	X				X		
(02)		Describe where the FMAs are normally shown and how the FMAs will be divided into sections (as applicable to aircraft complexity): — vertical modes; — lateral modes; — autothrust modes; — autopilot and flight director annunciators; — landing capability.	X	X				X		
(03)		Explain why FMAs for engaged	X	X				X		

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
		or armed modes have different colour or different font size.								
(04)		Describe the following FMA display scenarios: — engagement of a mode; — mode change from armed to becoming engaged; — mode reversion.	X	X				X		
(05)		Explain the importance of monitoring the FMAs and announcing mode changes at all times (including when selecting a new mode) and why only certain mode changes will be accompanied by an aural notification or additional visual cues.	X	X				X		
(06)		Describe the consequences of not understanding what the FMAs imply or missing mode changes, and how it may lead to an undesirable aircraft state.	X	X				X		
022 06 05 00		Autoland								
022 06 05 01		Design and operation								
(01)		Explain the purpose of an autoland system.	X					X		
(02)		Explain the significance of the following components required for an autoland: — autopilot; — autothrust; — radio altimeter; — ILS receivers.	X					X		
(03)		Explain the following terms (reference to CS-AWO 'All Weather Operations'): — fail-passive automatic landing system; — fail-operational automatic landing system; — fail-operational hybrid landing system;	X							

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

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		components thereof; — excessive ILS deviations; — radio-altimeter failure.								
(08)		Describe how the failure of various systems, including systems not directly involved in the autoland process, can influence the ability to perform an autoland or affect the minima down to which the approach may be conducted.	X							
(09)		Describe the fail-operational hybrid landing system as a primary fail-passive automatic landing system with a secondary independent guidance system such as a head-up display (HUD) to enable the pilot to complete a manual landing if the primary system fails.	X							
022 07 00 00		HELICOPTER: AUTOMATIC FLIGHT CONTROL SYSTEMS								
022 07 01 00		General principles								
022 07 01 01		Stabilisation								
(01)		Explain the similarities and differences between SAS and AFCS (the latter can actually fly the helicopter to perform certain functions selected by the pilot). Some AFCSs just have altitude and heading hold whilst others include a vertical speed or IAS hold mode, where a constant rate of climb/decent or IAS is maintained by the AFCS.			X	X	X			
022 07 01 02		Reduction of pilot workload								
(01)		Appreciate how effective the AFCS is in reducing pilot workload by improving basic aircraft control harmony and decreasing disturbances.			X	X	X			
022 07 01 03		Enhancement of helicopter capability								
(01)		Explain how an AFCS improves helicopter flight safety during:			X	X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		<ul style="list-style-type: none"> <li>— search and rescue (SAR) because of increased capabilities;</li> <li>— flight by sole reference to instruments;</li> <li>— underslung load operations;</li> <li>— white-out conditions in snow-covered landscapes;</li> <li>— an approach to land with lack of visual cues.</li> </ul>								
(02)		<p>Explain that the SAR modes of AFCS include the following functions:</p> <ul style="list-style-type: none"> <li>— ability to autohover;</li> <li>— facility for mark on target (MOT) approach to hover;</li> <li>— automatically transition from cruise down to a predetermined point or over-flown point;</li> <li>— ability for the rear crew to move the helicopter around in the hover;</li> <li>— the ability to automatically transition from the hover back to cruise flight;</li> <li>— the ability to fly various search patterns.</li> </ul>			X	X	X			
(03)		<p>Explain that earlier autohover systems use Doppler velocity sensors and modern systems use inertial sensors plus GPS, and normally include a two-dimensional hover-velocity indicator for the pilots.</p>			X	X	X			
(04)		<p>Explain why some SAR helicopters have both radio-altimeter height hold and barometric altitude hold.</p>			X	X	X			
022 07 01 04		Failures								
(01)		<p>Explain the various redundancies and independent systems that are built into the</p>			X	X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		AFCSSs.								
(02)		Appreciate that the pilot can override the system in the event of a failure.			X	X	X			
(03)		Explain a series actuator 'hard over' which equals aircraft attitude runaway.			X	X	X			
(04)		Explain the consequences of a saturation of the series actuators.			X	X	X			
022 07 02 00		Components: operation								
022 07 02 01		Basic sensors								
(01)		Explain the basic sensors in the system and their functions.			X	X	X			
(02)		Explain that the number of sensors will be dependent on the number of coupled modes of the system.			X	X	X			
022 07 02 02		Specific sensors								
(01)		Explain the function of the microswitches and strain gauges in the system which sense pilot input to prevent excessive feedback forces from the system.			X	X	X			
022 07 02 03		Actuators								
(01)		Explain the principles of operation of the series and parallel actuators, spring-box clutches and the autotrim system.			X	X	X			
(02)		Explain the principle of operation of the electronic hydraulic actuators in the system.			X	X	X			
022 07 02 04		Pilot–system interface: control panels, system indications, warnings								
(01)		Describe the typical layout of the AFCSS control panel.			X	X	X			
(02)		Describe the system indications and warnings.			X	X	X			
022 07 02 05		Operation								
(01)		Explain the functions of the redundant sensors' simplex and duplex channels (single/dual			X	X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		channel).								
022 07 03 00		Stability augmentation system (SAS)								
022 07 03 01		General principles and operation								
(01)		<p>Explain the general principles and operation of an SAS with regard to:</p> <ul style="list-style-type: none"> <li>— rate damping;</li> <li>— short-term attitude hold;</li> <li>— effect on static stability;</li> <li>— effect on dynamic stability;</li> <li>— aerodynamic cross-coupling;</li> <li>— effect on manoeuvrability;</li> <li>— control response;</li> <li>— engagement/disengagement;</li> <li>— authority.</li> </ul>			X	X	X			
(02)		Explain and describe the general working principles and primary use of an SAS by damping pitch, roll and yaw motions.			X	X	X			
(03)		Describe a simple SAS with force trim system which uses magnetic clutch and springs to hold cyclic control in the position where it was last released.			X	X	X			
(04)		Explain the interaction of trim with SAS/stability and control augmentation system (SCAS).			X	X	X			
(05)		Appreciate that the system can be overridden by the pilot and that individual channels can be deselected.			X	X	X			
(06)		Describe the operational limits of the system.			X	X	X			
(07)		Explain why the system should be turned off in severe turbulence or when extreme flight attitudes are reached.			X	X	X			
(08)		Explain the safety design features built into some SASs to			X	X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		limit the authority of the actuators to 10–20 % of the full-control throw in order to allow the pilot to override if actuators demand an unsafe control input.								
(09)		Explain how cross-coupling produces an adverse effect on roll- to-yaw coupling when the helicopter is subjected to gusts.			X	X	X			
(10)		Explain the collective-to-pitch coupling, side-slip-to-pitch coupling and inter-axis coupling.			X	X	X			
022 07 04 00		Autopilot — automatic stability equipment								
022 07 04 01		General principles								
(01)		Explain the general autopilot principles with regard to: — long-term attitude hold; — fly-through; — changing the reference (beep trim, trim release).			X	X	X			
022 07 04 02		Basic modes (3/4 axes)								
(01)		Explain the AFCS operation on cyclic axes (pitch/roll), yaw axis, and on collective (fourth axis).			X	X	X			
022 07 04 03		Automatic guidance (upper modes of AFCS)								
(01)		Explain the function of the attitude-hold system in an AFCS.			X	X	X			
(02)		Explain the function of the heading-hold system in an AFCS.			X	X	X			
(03)		Explain the function of the vertical-speed hold system in an AFCS.			X	X	X			
(04)		Explain the function of the navigation-coupling system in an AFCS.			X	X	X			
(05)		Explain the function of the VOR-/ILS-coupling system in an AFCS.			X	X	X			
(06)		Explain the function of the hover-mode system in an AFCS (including Doppler and radio-altimeter systems).			X	X	X			
(07)		Explain the function of the SAR			X	X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		mode (automatic transition to hover and back to cruise) in an AFCS.								
022 07 04 04		Flight director: design and operation								
(01)		Explain the purpose of a flight director system.			X	X	X			
(02)		Describe the different types of display: — pitch and roll crossbars; — V-bar.			X	X	X			
(03)		State the difference between the flight director system and the autopilot system. Explain how each can be used independently.			X	X	X			
(04)		List and describe the main components of the flight director system.			X	X	X			
(05)		Give examples of different situations with the respective indications of the command bars.			X	X	X			
(06)		Explain the architecture of the different flight directors fitted to helicopters and the importance to monitor other instruments as well as the flight director.			X	X	X			
(07)		Explain how some helicopter types have the collective setting as a flight director command; however, the command does not provide protection against a transmission overtorque.			X	X	X			
(08)		Describe the collective setting and yaw depiction on flight director for some helicopters.			X	X	X			
022 07 04 05		Automatic flight control panel (AFCP)								
(01)		Explain the purpose and the importance of the AFCP.			X	X	X			
(02)		State that the AFCP provides: — AFCS basic and upper modes; — flight director selection, SAS and AP engagement; — failure and alert			X	X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		messages.								
022 08 00 00		TRIMS — YAW DAMPER — FLIGHT-ENVELOPE PROTECTION								
022 08 01 00		Trim systems								
022 08 01 01		Design and operation								
(01)		Explain the purpose of the trim system and describe the layout with one trim system for each control axis, depending on the complexity of the aircraft.	X	X						
(02)		Give examples of trim indicators and their function, and explain the significance of a 'green band/area' for the pitch trim.	X	X						
(03)		Describe and explain an automatic pitch-trim system for a conventional aeroplane.	X	X						
(04)		Describe and explain an automatic pitch-trim system for an FBW aeroplane and that it is also operating during manual flight; however, during certain phases it may be automatically disabled to alter the handling characteristics of the aircraft.	X	X						
(05)		Describe the consequences of manual operation on the trim wheel when the automatic pitch-trim system is engaged.	X	X						
(06)		Describe and explain the engagement and disengagement conditions of the autopilot according to trim controls.	X	X						
(07)		Define 'Mach trim' and state that the Mach-trim system can be independent.	X	X						
(08)		Describe the implications for the pilot in the event of a runaway trim or significant out-of-trim state.	X	X						
022 08 02 00		Yaw damper								
022 08 02 01		Design and operation								
(01)		Explain the purpose of the yaw-damper system.	X	X						

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
(02)		Explain the purpose of the Dutch-roll filter (filtering of the yaw input signal).	X	X						
(03)		Explain the operation of a yaw-damper system and state the difference between a yaw-damper system and a 3-axis autopilot operation on the rudder channel.	X	X						
022 08 03 00		Flight-envelope protection (FEP)								
022 08 03 01		Purpose, input parameters, functions								
(01)		Explain the purpose of the FEP.	X	X			X			
(02)		Explain typical input parameters to the FEP: — AoA; — aircraft configuration; — airspeed information.	X	X			X			
(03)		Explain the following functions of the FEP: — stall protection; — overspeed protection.	X	X			X			
(04)		Explain how the stall-protection function and the overspeed-protection function apply to both mechanical/conventional and FBW control systems, but other functions (e.g. pitch or bank limitation) can only apply to FBW control systems.	X	X			X			
022 09 00 00		AUTOTHRUST — AUTOMATIC THRUST CONTROL SYSTEM								
022 09 01 00		Autothrust system								
022 09 01 01		Purpose, operation, overcompensation, speed control								
(01)		Describe the purpose of the autothrust system and explain how the FMAs will be the only indication on active autothrust modes.	X							
(02)		Explain the operation of an autothrust system with regard to the following modes: — take-off/go-around	X							

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		(TOGA); — climb or maximum continuous thrust (MCT), N1 or EPR targeted (THR CLB, THR MCT, N1, THR HOLD, EPR); — speed (SPEED, MCP SPD); — idle thrust (THR IDLE, RETARD/ARM); — landing (RETARD, THR IDLE).								
(03)		Describe the two main variants of autothrust systems: — mode selections available on the FCU/MCP and thrust levers move with autothrust commands; — mode selections made using the thrust levers which remain static during autothrust operation.	X							
(04)		Explain how flight in turbulence/wind shear giving fluctuating airspeed indications may lead to the autothrust overcompensating in an oscillating manner and that manual thrust may be required to settle the airspeed. Airspeed indications/trend vectors may give an indication of appropriate thrust adjustments but any reaction should not be too aggressive.	X							
(05)		Explain the threats associated with the use of autothrust resulting in the pilot losing the sense of energy awareness (e.g. speed, thrust).	X							
(06)		Explain the relationship between autopilot pitch modes and autothrust modes, and how the autopilot and autothrust will interact upon selecting modes for one of the systems.	X							
(07)		Explain the principles of speed control and how speed can be controlled:	X							

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
		<ul style="list-style-type: none"> <li>— by varying the engine thrust;</li> <li>— by varying the aircraft pitch.</li> </ul>								
(08)		<p>Explain the potential implications on speed control when the autothrust controls speed and the autopilot pitch channel has a fixed pitch target for the following mode combinations:</p> <ul style="list-style-type: none"> <li>— MCP SPD/SPEED and ALT HOLD/ALT;</li> <li>— MCP SPD/SPEED and VSP (climb);</li> <li>— MCP SPD/SPEED and VSP (descent).</li> </ul>	X							
(09)		<p>Explain the potential implications on speed control when the autothrust has a fixed thrust target and the autopilot pitch channel controls speed for the following mode combinations:</p> <ul style="list-style-type: none"> <li>— N1/THR CLB and LVL CHG/OP CLB;</li> <li>— ARM/THR IDLE and LVL CHG/OP DES.</li> </ul>	X							
022 10 00 00		COMMUNICATION SYSTEMS								
022 10 01 00		Voice communication, data-link transmission								
022 10 01 01		Definitions and transmission modes								
(01)		Describe the purpose of a data-link transmission system.	X		X	X				
(02)		Compare voice communication versus data-link transmission systems.	X		X	X				
(03)		<p>Describe the communication links that are used in aircraft:</p> <ul style="list-style-type: none"> <li>— high-frequency (HF) communications;</li> <li>— very high-frequency (VHF) communications;</li> <li>— satellite communications (SATCOM).</li> </ul>	X		X	X				

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
(04)		Consider the properties of the communication links with regard to: — signal quality; — range/area coverage; — range; — line-of-sight limitations; — quality of the signal received; — interference due to ionospheric conditions; — data transmission speed.	X		X	X				
(05)		Define and explain the following terms in relation to aircraft data-link communications: — message/data uplink; — message/data downlink.	X		X	X				
022 10 01 02		Systems: architecture, design and operation								
(01)		Describe the purpose of the ACARS network.	X							
(02)		Describe the systems using the ACARS network through the air traffic service unit (ATSU) suite: — aeronautical/airline operational control (AOC); — air traffic control (ATC).	X							
(03)		Explain the purpose of the following parts of the on-board equipment: — ATSU communications computer; — control and display unit (CDU)/multifunction control and display unit (MCDU); — data communication display unit (DCDU); — ATC message visual annunciator; — printer.	X							
(04)		Give examples of airline	X							

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		operations communications (AOC) data-link messages such as: <ul style="list-style-type: none"> <li>— out of the gate, off the ground, on the ground, into the gate (OOOI);</li> <li>— load sheet;</li> <li>— passenger information (connecting flights);</li> <li>— weather reports (METAR, TAF);</li> <li>— maintenance reports (engine exceedances);</li> <li>— aircraft technical data;</li> <li>— free-text messages.</li> </ul>								
(05)		Give examples of ATC data-link messages such as: <ul style="list-style-type: none"> <li>— departure clearance;</li> <li>— oceanic clearance;</li> <li>— digital ATIS (D-ATIS);</li> <li>— controller–pilot data-link communications (CPDLC).</li> </ul>	X							
022 10 02 00		Future air navigation systems (FANSs)								
022 10 02 01		Versions, applications, CPDLC messages, ADS contracts								
(01)		Describe the existence of the ICAO communication, navigation, surveillance/air traffic management (CNS/ATM) concept.	X							
(02)		Explain the two versions of FANSs: <ul style="list-style-type: none"> <li>— FANS A/FANS 1 using the ACARS network;</li> <li>— FANS B/FANS 2 using the ACARS network and the aeronautical telecommunication network (ATN).</li> </ul>	X							
(03)		List and explain the following FANS A/FANS 1 applications: <ul style="list-style-type: none"> <li>— ATS facility notification</li> </ul>	X							

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
		(AFN); — automatic dependent surveillance (ADS); — CPDLC.								
(04)		Compare the ADS application with the secondary surveillance radar function, and the CPDLC application with VHF communication systems.	X							
(05)		State that an ATCU can use the ADS application only, or the CPDLC application only, or both of them (not including AFN).	X							
(06)		Describe the AFN process for logging on with an ATCU and typical data that will be included in the message.	X							
(07)		Describe typical types of CPDLC messages and the typical pilot work practices when requesting or accepting a CPDLC clearance.	X							
(08)		List and describe the different types of ADS contracts that are controlled by the ATCU and beyond the control of the pilot: — periodic: data sent at set time intervals; — on demand: data sent when requested; — on event: data sent when an event occurs (e.g. heading change, climb initiated, etc.); — emergency mode.	X							
(09)		Describe the purpose of the ADS emergency mode contract and highlight the difference to the ATCU controlled contracts.	X							
022 11 00 00		FLIGHT MANAGEMENT SYSTEM (FMS)/ FLIGHT MANAGEMENT AND GUIDANCE SYSTEM (FMGS)								
022 11 01 00		Design								
022 11 01 01		Purpose, architecture, failures, functions								

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter		IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL			
(01)		Explain the purpose of an FMS.	X		X	X		X	
(02)		Describe a typical dual FMS architecture including the following components: — flight management computer (FMC); — CDU/MCDU; — cross-talk bus.	X		X	X			
(03)		Describe the following failures of a dual FMS architecture and explain the potential implications to the pilots: — failure of one FMC; — failure of one CDU/MCDU; — failure of the cross-talk bus.	X		X	X			
(04)		Describe how the FMS integrates with other systems and gathers data in order to provide outputs depending on its level of complexity.	X		X	X		X	
(05)		Explain how the FMS may provide the following functions: — navigation; — lateral and vertical flight planning; — performance parameters.	X	X	X	X		X	
022 11 02 00		FMC databases							
022 11 02 01		Navigation database							
(01)		Explain the purpose of, and describe typical content of, the navigation database.	X		X	X		X	X
(02)		Describe the 28-day aeronautical information regulation and control (AIRAC) update cycle of the navigation database and explain the reason for having two navigation databases (one active, one standby) and the implication this has to the pilot.	X		X	X		X	X
(03)		Explain the purpose of typical	X		X	X		X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		user-defined waypoints such as: — latitude/longitude coordinates; — place/bearing/distance (PBD); — place/bearing place/bearing (PBX); — place/distance (PD).								
(04)		Explain that the pilot cannot change or overwrite any of the data in the navigation database and that any user-defined waypoints, routes and inputted data will be erased when a different database is activated.	X		X	X		X	X	
(05)		Explain the threats and implications to the pilot of changing the database by error either on the ground or while flying.	X		X	X		X		
022 11 02 02		Aircraft performance database								
(01)		Explain the purpose of, and describe the typical content of, the aircraft performance database.	X		X	X		X		
(02)		Explain the importance of verifying that the aircraft performance database is based on the correct data, such as engine type and aircraft variant.	X		X	X		X		
(03)		Explain that the contents of the aircraft performance database cannot be modified by the pilot.	X		X	X		X		
(04)		Explain the purpose of performance factor and how it influences the calculations.	X		X	X		X		
(05)		Explain the purpose of cost index (CI) and how it influences the calculations.	X							
022 11 03 00		Operations, limitations								
022 11 03 01		Data, calculations, position inputs, raw data								
(01)		Describe typical data that may be provided by the FMS: — lateral and vertical	X		X	X		X		

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		navigation guidance; — present position; — time predictions; — fuel predictions; — altitude/flight level predictions.								
(02)		Explain how the FMS will use a combination of inputted/database and measured data in order to calculate projections and provide output data.	X		X	X		X		
(03)		Explain the issues and threats using inputted/database data and give examples of consequences of inputting data incorrectly/using incorrect data.	X		X	X		X		
(04)		Describe fuel consumption calculations during standard operations and explain typical data that will have an influence on the accuracy of the calculations.	X		X	X				
(05)		Explain the implications on the accuracy of the calculations during flight in abnormal configurations (such as engine out, gear down, flaps extended, spoilers extended, etc.) if the FMS is unable to detect the failure.	X		X	X				
(06)		Describe and explain the purpose of an FMS having dedicated radio-navigation receivers that it will tune automatically.	X		X	X				
(07)		Explain typical position inputs to an FMS: — GPS; — IRS; — DME; — VOR; — LOC; — runway threshold (RWY THR).	X		X	X		X		

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
(08)		<p>Explain how the FMS will create its own FMS position fix and that the FMS calculations will be based on the FMS position. Depending on the type of system, the FMS position may be calculated from:</p> <ul style="list-style-type: none"> <li>— a single source of position data where the most accurate data available at a given time will be used;</li> <li>— multiple sources from which a position will be derived using the combined inputs.</li> </ul>	X		X	X				
(09)		Explain the implications of a reduction in available position inputs to the FMS, especially GPS in relation to the capability of performing RNP/PBN approaches.	X		X	X				
(10)		Explain the difference between following the FMS data compared to following raw data from radio-navigation receivers and describe how there may be limitations for using FMS data as primary source to follow an instrument approach procedure (IAP) such as LOC, VOR or NDB.	X		X	X	X			
022 11 04 00		Human-machine interface (control and display unit (CDU)/ multifunction control and display unit (MCDU))								
022 11 04 01		Purpose, scratchpad, data input, set-up process								
(01)		Describe the purpose of a CDU/MCDU.	X		X	X	X			
(02)		<p>Describe the typical layout of a CDU/MCDU and the general purpose of the following:</p> <ul style="list-style-type: none"> <li>— screen;</li> <li>— line select keys;</li> <li>— menu select keys;</li> <li>— alphanumeric keys.</li> </ul>	X		X	X	X			
(03)		Explain the function of the 'scratchpad' part of the screen.	X		X	X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
(04)		Describe how input of some data is compulsory for the function of the FMS and other data is optional, and that different symbology is used to highlight this: — rectangular boxes = compulsory information; — dashed line = optional information.	X		X	X		X		
(05)		Describe a typical FMS pre-flight set-up process through the CDU/MCDU to cover the most basic information (with the aim to create awareness of required information as this is irrespective of aircraft type and FMS/FMGS make): — ident page (who am I = aircraft type/variant, engine type/rating and appropriate navigation database); — position initialisation (where am I = position for aligning the IRS and FMS position); — route initialisation (where am I going to = place of departure/destination and alternate(s)); — route programming (how will I get there = SIDs, STARS, route (company or otherwise)); — performance initialisation (when will I arrive = weights, flap setting, FLEX/assumed temperature/derate, take-off speeds).	X							
022 12 00 00		ALERTING SYSTEMS, PROXIMITY SYSTEMS								
022 12 01 00		General								
022 12 01 01		Alerting systems according to CS-25 and CS-29								
(01)		State definitions, category, criteria and characteristics of alerting systems according to	X	X	X	X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		CS-25/AMC 25.1322 for aeroplanes and CS-29 for helicopters as appropriate.								
022 12 02 00		Flight warning systems (FWSs)								
022 12 02 01		Annunciations, master warning, master caution, advisory								
(01)		State the annunciations given by the FWS and typical location for the annunciator(s): — master warning; — master caution; — advisory.	X	X	X	X	X	X		
(02)		Explain master warning: — colour of annunciator: red; — nature of aural alerts: continuous; — typical failure scenarios triggering the alert.	X	X	X	X	X	X		
(03)		Explain master caution: — colour of the annunciator: amber or yellow; — nature of aural alerts: attention-getter; — typical failure scenarios triggering the alert.	X	X	X	X	X	X		
(04)		Describe a typical procedure following a master warning or master caution alert: — acknowledging the failure; — silencing the aural warning; — initiating the appropriate response/procedure.	X	X	X	X	X	X		
(05)		Explain advisory: — colour of the annunciator: any other than red, amber, yellow or green; — absence of aural alert; — typical scenarios	X	X	X	X	X	X		

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
		triggering the advisory.								
022 12 03 00		Stall warning systems (SWSs)								
022 12 03 01		Function, types, components								
(01)		Describe the function of an SWS and explain why the warning must be unique.	X	X						
(02)		Describe the different types of SWSs.	X	X						
(03)		List the main components of an SWS.	X	X						
(04)		Explain the difference between the stall warning speed and the actual stalling speed of the aeroplane.	X	X						
022 12 04 00		Stall protection								
022 12 04 01		Function, types								
(01)		Describe the function of a stall protection system.	X							
(02)		Describe the different types of stall protection systems including the difference between mechanical and FBW controls.	X							
(03)		Explain the difference between an SWS and a stall protection system.	X							
022 12 05 00		Overspeed warning								
022 12 05 01		Purpose, aural warning, $V_{MO}/M_{MO}$ pointer								
(01)		Explain the purpose of an overspeed warning system ( $V_{MO}/M_{MO}$ pointer).	X	X						
(02)		State that for large aeroplanes, an aural warning must be associated to the overspeed warning if an electronic display is used (see AMC 25.11, paragraph 10.b(2), p. 2-GEN-22).	X	X						
(03)		Describe and give examples of $V_{MO}/M_{MO}$ pointer: barber's/barber pole pointer, barber's/barber pole vertical scale.	X	X						
022 12 06 00		Take-off warning								

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
022 12 06 01		Purpose								
(01)		Explain the purpose of a take-off warning system and list the typical abnormal situations which generate a warning (see AMC 25.703, paragraphs 4 and 5).	X							
022 12 07 00		Altitude alert system								
022 12 07 01		Function, displays, alerts								
(01)		Describe the function of an altitude alert system.	X	X	X	X	X	X		
(02)		Describe different types of displays and possible alerts.	X	X	X	X	X	X		
022 12 08 00		Radio altimeter								
022 12 08 01		Purpose, range, displays, incorrect indications								
(01)		Explain the purpose of a low-altitude radio altimeter.	X	X	X	X	X	X		
(02)		Describe the principle of the distance (height) measurement.	X	X	X	X	X	X		
(03)		Describe the different types of radio-altimeter displays.	X	X	X	X	X	X		
(04)		Describe how the radio altimeter provides input to other systems and how a radio-altimeter failure may impact on the functioning of these systems.	X	X	X	X	X	X		
(05)		State the range of a radio altimeter.	X	X	X	X	X	X		
(06)		Explain the potential implications of a faulty radio-altimeter and how this in particular may affect the following systems: — autothrust (flare/retard); — ground-proximity warning systems (GPWSs).	X	X				X		
022 12 09 00		Ground-proximity warning systems (GPWSs)								
022 12 09 01		GPWSs: design, operation, indications								
(01)		Explain the purpose of GPWSs.	X		X	X				
(02)		Explain inputs and outputs of a GPWS and describe its operating principle.	X		X	X				

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
(03)		List and describe the different modes of operation of a GPWS.	X		X	X				
022 12 09 02		Terrain-avoidance warning system (TAWS); other name: enhanced GPWS (EGPWS)	X		X	X				
(01)		Explain the purpose of a TAWS for aeroplanes and of a HTAWS for helicopters, and explain the difference from a GPWS.	X		X	X				
(02)		Explain inputs and outputs of a TAWS/HTAWS and describe its working principle.	X		X	X				
(03)		Give examples of terrain displays and list the different possible alerts.	X		X	X				
(04)		Give examples of time response left to the pilot according to look-ahead distance, speed and aircraft performances.	X		X	X				
(05)		Explain why the TAWS/HTAWS must be coupled to a precise-position sensor.	X		X	X				
(06)		Explain the possibility of triggering spurious TAWS/HTAWS warnings as a result of mismanaging the flight path in the proximity to obstacles: — high rate of descent; — high airspeed; — a combination of high rate of descent and high airspeed.	X		X	X				
022 12 09 03		Intentionally left blank								
022 12 10 00		ACAS/TCAS	X	X	X	X	X			
022 12 10 01		Principles and operations								
(01)		State that ACAS II is an ICAO standard for anti-collision purposes.	X	X	X	X	X			
(02)		Explain that ACAS II is an anti-collision system and does not guarantee any specific separation.	X	X	X	X	X			
(03)		Describe the purpose of an ACAS II system as an anti-	X	X	X	X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		collision system.								
(04)		Describe the following outputs from a TCAS: — other intruders; — proximate intruders; — traffic advisory (TA); — resolution advisory (RA).	X	X	X	X	X			
(05)		State that ACAS II will issue commands in the vertical plane only (climb, descent or maintain), and that the commands are complied with as a manual manoeuvre.	X	X	X	X	X	X		
(06)		Explain that an RA may or may not require any active control input and the implications of reacting instinctively without awareness of actual control inputs required to comply with the RA.	X	X	X	X	X	X		
(07)		Explain that if two aircraft are fitted with ACAS II, the RA will be coordinated.	X	X	X	X	X	X		
(08)		State that ACAS II equipment can take into account several threats simultaneously.	X	X	X	X	X	X		
(09)		State that a detected aircraft without altitude-reporting can only generate a TA; describe typical type of traffic and how this can create distractions during flight in certain areas of significant air traffic activity.	X	X	X	X	X	X		
(10)		Describe the interaction between the TCAS II system and the transponder, radio altimeter and the air-data computer: — antenna used; — computer and links with radio altimeter, air-data computer and mode-S transponder.	X	X	X	X	X	X		
(11)		Explain the principle of TCAS II interrogations.	X	X	X	X	X	X		
(12)		State the typical standard detection range for TCAS II:	X	X	X	X	X	X		

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		<ul style="list-style-type: none"> <li>— 35–40 NM horizontally;</li> <li>— approximately 2 000 ft above and below (any setting);</li> <li>— extension to approximately 10 000 ft above (ABV selected) or approximately 10 000 ft below (BLW selected).</li> </ul>								
(13)		Explain the principle of 'reduced surveillance'.	X	X	X	X	X	X		
(14)		Explain that in high-density traffic areas the range may automatically be decreased in order to enable detection of the threats in the proximity of the aircraft due to a limitation of the maximum number of possible intruders the system is able to process.	X	X	X	X	X	X		
(15)		Identify the equipment which an intruder must be fitted with in order to be detected by TCAS II.	X	X	X	X	X	X		
(16)		<p>Explain in the anti-collision process:</p> <ul style="list-style-type: none"> <li>— the criteria used to trigger an alarm (TA or RA) are the time to reach the closest point of approach (CPA) (called TAU) and the difference of altitude;</li> <li>— an intruder will be classified as 'proximate' when being less than 6 NM and 1 200 ft from the TCAS-equipped aircraft;</li> <li>— the time limit to CPA is different depending on aircraft altitude, is linked to a sensitivity level (SL), and state that the value to trigger an RA is from 15 to 35 seconds;</li> <li>— in case of an RA, the intended vertical separation varies from 300 to 600 ft (700 ft above FL420), depending on the SL;</li> <li>— below 1 000 ft above ground, no RA can be generated;</li> </ul>	X	X	X	X	X	X		

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		<ul style="list-style-type: none"> <li>— below 1 450 ft (radio-altimeter value) 'increase descent' RA is inhibited;</li> <li>— at high altitude, performances of the type of aircraft are taken into account to inhibit 'climb' and 'increase climb' RA.</li> </ul>								
(17)		<p>List and interpret the following information available from TCAS:</p> <ul style="list-style-type: none"> <li>— the different possible statuses of a detected aircraft: 'other', 'proximate', 'intruder';</li> <li>— the appropriate graphic symbols and their position on the horizontal display;</li> <li>— different aural warnings.</li> </ul>	X	X	X	X	X	X		
(18)		<p>Explain the indications of a TA and an RA and how an RA will generate a red area on the VSI. Explain the indications of a TA and an RA and how an RA will generate a red area on the VSI. Some variants will also include a green area. To manoeuvre the aircraft to comply with the RA, the pilot should 'avoid the red' or 'fly the green'.</p>	X	X	X	X	X	X		
(19)		<p>Explain that the pilot must not interpret the horizontal track of an intruder upon the display.</p>	X	X	X	X	X	X		
022 12 11 00		Rotor/engine overspeed alert system								
022 12 11 01		Design, operation, displays, alarms								
(01)		Describe the basic design principles, operation, displays and warning/alarm systems fitted to different helicopters.			X	X	X			
022 13 00 00		INTEGRATED INSTRUMENTS — ELECTRONIC DISPLAYS								
022 13 01 00		Electronic display units								
022 13 01 01		Design, limitations								
(01)		List the different technologies used, e.g. CRT and LCD, and the associated limitations:	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		<ul style="list-style-type: none"> <li>— cockpit temperature;</li> <li>— glare;</li> <li>— resolution.</li> </ul>								
022 13 02 00		Mechanical integrated instruments								
022 13 02 01		Attitude and director indicator (ADI)/ horizontal situation indicator (HSI)								
(01)		Describe an ADI and an HSI.	X	X	X	X	X	X	X	
(02)		List all the information that can be displayed on either instrument.	X	X	X	X	X	X	X	
022 13 03 00		Electronic flight instrument systems (EFISs)								
022 13 03 01		Design, operation								
(01)		List the following parts of an EFIS: <ul style="list-style-type: none"> <li>— control panel;</li> <li>— display units;</li> <li>— symbol generator;</li> <li>— remote light sensor.</li> </ul>	X	X	X	X	X	X		
(02)		Describe the typical layout of the EFIS display units and how there may be a facility to transfer the information from one display unit on to another if a display unit fails.	X	X	X	X	X	X		
(03)		Explain the need for standby instruments to supplement the EFIS in the event of all the display units failing and the challenge of using these standby instruments, namely their size and position on the flight deck.	X	X	X	X	X	X		
(04)		Explain the difference between a symbol generator failing and a display unit failing, and the implications if there are redundant symbol generators available.	X	X	X	X	X	X		
(05)		Describe the purpose of an EFIS control panel and typical selections that may be available: <ul style="list-style-type: none"> <li>— altimeter pressure setting;</li> </ul>	X	X	X	X	X	X		

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
		<ul style="list-style-type: none"> <li>— navigation display (ND) mode selector;</li> <li>— ND range selector;</li> <li>— ND data selector (waypoints, facilities, constraints, data, etc.);</li> <li>— radio-navigation aids selector (VOR 1/2 or ADF 1/2);</li> <li>— decision altitude (DA)/decision height (DH) selection.</li> </ul>								
022 13 03 02		Primary flight display (PFD), electronic attitude director indicator (EADI)								
(01)		<p>Describe that a PFD (or an EADI) presents a dynamic colour display of all the parameters necessary to control the aircraft, and that the main layout conforms with the 'basic T' principle:</p> <ul style="list-style-type: none"> <li>— attitude information in the centre;</li> <li>— airspeed information on the left;</li> <li>— altitude information on the right;</li> <li>— heading/track indication lower centre;</li> <li>— flight mode annunciation;</li> <li>— basic T;</li> <li>— take-off and landing reference speeds;</li> <li>— minimum airspeed;</li> <li>— lower selectable airspeed;</li> <li>— Mach number.</li> </ul>	X	X	X	X	X	X	X	
(02)		Describe the typical design of the attitude information: artificial horizon with aircraft symbol; superimposed flight director command bars.	X	X	X	X	X	X	X	
(03)		Describe the typical design of	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		the speed tape: — rolling speed scale with numerical read-out of current speed; — limiting airspeeds according to configuration; — speed trend vector; — bug/indication for selected airspeed.								
(04)		Explain the Mach number indications and how a selected Mach number is presented with the speed bug on a corresponding IAS on the speed tape with the Mach number shown as a numerical indication outside the speed tape.	X							
(05)		Describe the typical design of the altitude information: — rolling altitude scale with numerical read-out of current altitude; — altimeter pressure setting; — bug/indication for selected altitude; — means of highlighting the altitude if certain criteria are met.	X	X	X	X	X	X	X	
(06)		Describe the typical design of the heading/track information: — rolling compass scale/rose with numerical read-out of current heading/track; — bug/indication for selected heading/track.	X	X	X	X	X	X	X	
(07)		Describe the typical design and location of the following information: — flight mode annunciators (FMAs); — vertical speed indicator including TCAS RA command indications;	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		<ul style="list-style-type: none"> <li>— radio altitude;</li> <li>— ILS localiser/glideslope and RNP/PBN, GBAS or SBAS horizontal/vertical flight path deviation indicator</li> <li>— decision altitude/height (DA/H).</li> </ul>								
022 13 03 03		Navigation display (ND), electronic horizontal situation indicator (EHSI)								
(01)		Describe that an ND (or an EHSI) provides a mode-selectable colour flight ND.	X	X	X	X	X	X	X	
(02)		List the following four modes typically available to be displayed on an ND unit: <ul style="list-style-type: none"> <li>— MAP (or ARC);</li> <li>— VOR (or ROSE VOR);</li> <li>— APP (or ROSE LS);</li> <li>— PLAN.</li> </ul>	X	X	X	X	X	X		
(03)		List and explain the following information that can be displayed with the MAP (or ARC) mode selected on an ND unit: <ul style="list-style-type: none"> <li>— aircraft symbol, compass scale and range markers;</li> <li>— current heading and track (either one may be 'up' depending on selection), true or magnetic;</li> <li>— selected heading and track;</li> <li>— TAS/GS;</li> <li>— wind direction and speed (W/V);</li> <li>— raw data radio magnetic indicator (RMI) needles/pointers for VOR/automatic direction-finding equipment (ADF), if selected, including the frequency or ident of the selected navigation facility;</li> <li>— route/flight plan data from</li> </ul>	X	X	X	X	X	X		

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		the FMS; <ul style="list-style-type: none"> <li>— TO/next waypoint data from the FMS;</li> <li>— data from the navigation database such as airports, waypoints or navigation facilities as selected;</li> <li>— weather radar information;</li> <li>— TCAS traffic information (no TCAS commands);</li> <li>— TAWS (EGPWS) terrain information;</li> <li>— failure flags and messages.</li> </ul>								
(04)		List and explain the following information that can be displayed with the VOR or APP (or ROSE VOR or ROSE LS) mode selected on an ND unit: <ul style="list-style-type: none"> <li>— aircraft symbol and compass scale;</li> <li>— current heading and track (either one may be 'up' depending on selection), true or magnetic;</li> <li>— selected heading and track;</li> <li>— TAS/ground speed (GS);</li> <li>— wind direction and speed (W/V);</li> <li>— VOR or ILS frequency and identification of the selected navigation aid;</li> <li>— VOR selected course, deviation indicator and a TO/FROM indicator in a HSI-type display format when in VOR mode;</li> <li>— localiser selected course, deviation indicator and glideslope indicator in a HSI-type display format when in APP</li> </ul>	X	X	X	X	X	X		

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		<p>mode.</p> <ul style="list-style-type: none"> <li>— weather radar information;</li> <li>— TCAS traffic information (no TCAS commands);</li> <li>— TAWS (EGPWS) terrain information;</li> <li>— failure flags and messages.</li> </ul>								
(05)		<p>List and explain the following information that can be displayed with the PLAN mode selected on an ND unit:</p> <ul style="list-style-type: none"> <li>— north-up compass rose and range markers;</li> <li>— aircraft symbol oriented according to aircraft heading;</li> <li>— TAS/GS;</li> <li>— wind direction and speed (W/V);</li> <li>— route/flight plan data from the FMS;</li> <li>— TO/next waypoint data from the FMS;</li> <li>— data from the navigation database such as airports, waypoints or navigation facilities as selected;</li> <li>— failure flags and messages.</li> </ul>	X	X	X	X	X	X		
(06)		<p>Explain the purpose of PLAN mode and its characteristics such as:</p> <ul style="list-style-type: none"> <li>— no compass information;</li> <li>— north is up on the display unit at all times;</li> <li>— the centre waypoint is the selected waypoint on the FMS CDU;</li> <li>— scrolling through the flight plan on the FMS CDU will shift the map view along the</li> </ul>	X	X	X	X	X	X		

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		flight path; — the aircraft symbol will be positioned in the appropriate place along the flight path; — using PLAN mode as the primary mode during flight may lead to disorientation and loss of situational awareness.								
(07)		Distinguish the difference between the appearance of an EXPANDED or FULL/ROSE mode and how the displayed range differs between them.	X	X	X	X	X	X		
(08)		Explain the combination of mode and range selection including how selecting the appropriate range and displayed data can improve situational awareness for a given phase of flight.	X	X	X	X	X	X		
022 13 04 00		Engine parameters, crew warnings, aircraft systems, procedure and mission display systems								
022 13 04 01		Purposes of systems, display systems, checklists								
(01)		State the purpose of the following systems: — engine instruments centralised display unit; — crew alerting system/aircraft display unit; — facility for appropriate on-screen checklists; — that the aircraft systems display unit enables the display of normal and degraded modes of operation of the aircraft systems; — that the systems/aircraft display unit is able to show pictorial systems diagrams/schematics and associated parameters.	X		X	X				
(02)		Describe the similarities to EFIS with regard to basic system architecture.	X		X	X				

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
(03)		Give the following different names by which engine parameters, crew warnings, aircraft systems and procedures display systems are known: <ul style="list-style-type: none"> <li>— multifunction display unit (MFDU);</li> <li>— engine indication and crew alerting systems (EICASs);</li> <li>— engine and warning display (EWD);</li> <li>— electronic centralised aircraft monitor (ECAM);</li> <li>— systems display (S/D).</li> </ul>	X							
(04)		Give the names of the following different display systems and describe their main functions: <ul style="list-style-type: none"> <li>— vehicle engine monitoring display (VEMD);</li> <li>— integrated instruments display system (IIDS).</li> </ul>			X	X				
(05)		State the purpose of a mission display unit.			X	X				
(06)		Describe the architecture of each system and give examples of display.			X	X				
(07)		Explain why awareness of the consequences of the actions commanded by the automatic checklist is required.	X		X	X				
(08)		Explain the limited ability of the computer to assess a situation other than using the exceedance of certain thresholds to trigger the main and subsequent events and programmed actions.	X		X	X				
(09)		Describe an appropriate procedure for following an on-screen checklist associated with a failure scenario including the following: <ul style="list-style-type: none"> <li>— confirm the failure with the other flight crew member prior to performing any of the actions;</li> </ul>	X		X	X				

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		<ul style="list-style-type: none"> <li>— seek confirmation prior to manipulating any guarded switches or thrust levers;</li> <li>— follow the checklist slowly and methodically;</li> <li>— assess the possible implications of making certain selections, such as opening the fuel cross-feed if there is a fuel leak even though the electronic checklist may ask for the action.</li> </ul>								
022 13 05 00		Engine first limit indicator								
022 13 05 01		Design, operation, information on display								
(01)		Describe the principles of design and operation, and compare the different indications and displays available.			X	X	X			
(02)		Describe what information can be displayed on the screen, when the screen is in the limited composite mode.			X	X	X			
022 13 06 00		Electronic flight bag (EFB)								
022 13 06 01		Purpose, certification, malfunctions								
(01)		Explain the purpose of the EFB and list typical equipment: <ul style="list-style-type: none"> <li>— computer laptop;</li> <li>— tablet device;</li> <li>— integrated avionics suite in the aircraft.</li> </ul>	X	X	X	X	X	X		
(02)		Describe the 'class' hardware certification: <ul style="list-style-type: none"> <li>— portable: portable electronic device (PED) that can be used inside or outside the aircraft, is not part of the certified aircraft configuration and does not require tools to remove it from the flight-deck cradle, if one exists;</li> <li>— installed: an electronic device that is considered an aircraft part covered by the</li> </ul>	X		X	X				

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
		aircraft airworthiness approval, thus is a minimum equipment list (MEL) item in the event of failure.								
(03)		Describe the 'type' software certification: — type A: applications whose misuse or malfunctions have no adverse effect on flight safety; — type B: applications for which evaluation of the hazards presented by misuse or malfunctions is required.	X		X	X				
(04)		Explain implications of malfunctions with the EFB installation in a fully electronic flight-deck environment: — mass and balance calculations; — performance calculations; — access to charts; — access to manuals.	X		X	X				
022 13 07 00		Head-up display (HUD), synthetic vision system (SVS) and enhanced visual system (EVS)	X		X	X				
022 13 07 01		Components, benefits, modes of operation								
		State the components of a typical HUD installation: — HUD projector and stowable combiner; — HUD controls such as declutter and dimmer; — HUD computer.	X		X	X				
		Explain the reasons and benefits of having an HUD: — increased situational awareness due to reduced need to look inside to view primary flight information; — lower minima for both departure and landing;	X		X	X				

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		<ul style="list-style-type: none"> <li>— improved accuracy of flying thus reduced susceptibility to enter a state of aircraft upset.</li> </ul>								
		<p>Describe how the HUD replicates the information on the primary flight display (PFD) by showing the following data:</p> <ul style="list-style-type: none"> <li>— altitude;</li> <li>— speed, including speed trend;</li> <li>— heading;</li> <li>— flight path vector (track and vertical flight path);</li> <li>— flight mode annunciator (FMA);</li> <li>— CAS, TAWS and wind shear command annunciations.</li> </ul>	X		X	X				
		<p>Describe the following modes of operation of an HUD:</p> <ul style="list-style-type: none"> <li>— normal display mode that may automatically adapt the information based on the phase of flight;</li> <li>— declutter function.</li> </ul>	X		X	X				
		<p>Describe the principle of SVS:</p> <ul style="list-style-type: none"> <li>— an enhanced database used as reference to provide terrain and ground features to be shown on the PFD;</li> <li>— limitations due to being a synthetic image not based on actual sensory information thus not lowering landing minima;</li> <li>— implications if aircraft position accuracy becomes reduced.</li> </ul>	X		X	X				
		<p>Describe the principle of EVS:</p> <ul style="list-style-type: none"> <li>— includes external sensors such as infrared cameras to generate a real-time image on the PFD or on the HUD;</li> <li>— limitation of the fact that an infrared camera uses</li> </ul>	X		X	X				

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			ATPL	CPL	ATPL/IR	ATPL	CPL			
		temperature and temperature difference in order to produce an image; — enables lower minima because of the real-time image, thus enhancing the visibility as experienced by the pilot.								
022 14 00 00		MAINTENANCE, MONITORING AND RECORDING SYSTEMS								
022 14 01 00		Cockpit voice recorder (CVR)								
022 14 01 01		Purpose, components, parameters								
(01)		Describe the purpose of a CVR, its typical location, and explain the implications of knowingly erasing or tampering with any information or equipment.	X	X	X	X	X			
(02)		List the main components of a CVR: — a shock-resistant tape recorder or digital storage associated with an underwater locating beacon (ULB); — a cockpit area microphone (CAM); — a control unit with the following controls: auto/on, test and erase, and a headset jack; — limited flight-deck controls such as erase and test switches.	X	X	X	X	X			
(03)		List the following main parameters recorded on the CVR: — voice communications transmitted from or received on the flight deck; — the aural environment of the flight deck; — voice communication of flight crew members using the aeroplane's interphone system; — voice or audio signals introduced into a headset or speaker;	X	X	X	X	X			

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			ATPL	CPL	ATPL/IR	ATPL	CPL			
		— voice communication of flight crew members using the public address system, if installed.								
022 14 02 00		Flight data recorder (FDR)								
022 14 02 01		Purpose, components, parameters								
(01)		Describe the purpose of an FDR and its typical location.	X	X						
(02)		List the main components of an FDR: — a shock-resistant data recorder associated with a ULB; — a data interface and acquisition unit; — a recording system (digital flight data recorder); — two control units (start sequence, event mark setting); — limited flight-deck controls, but includes an event switch.	X	X						
(03)		List the following main parameters recorded on the FDR: — time or relative time count; — attitude (pitch and roll); — airspeed; — pressure altitude; — heading; — normal acceleration; — propulsive/thrust power on each engine and flight-deck thrust/power lever position, if applicable; — flaps/slats configuration or flight-deck selection; — ground spoilers or speed brake selection.	X	X						
(04)		State that additional parameters	X							

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter		IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL CPL			
		can be recorded according to FDR capacity and applicable operational requirements.							
022 14 03 00		Maintenance and monitoring systems							
022 14 03 01		Helicopter operations monitoring program (HOMP): design, operation, performance							
(01)		Describe the HOMP as a helicopter version of the aeroplane flight data monitoring (FDM) program.			X	X			
(02)		State that the HOMP software consists of three integrated modules: — flight data events (FDEs); — flight data measurements (FDMs); — flight data traces (FDTs).			X	X			
(03)		Describe and explain the information flow of an HOMP.			X	X			
(04)		Describe HOMP operation and management processes.			X	X			
022 14 03 02		Integrated health and usage monitoring system (IHUMS): design, operation, performance							
(01)		Describe the main features of an IHUMS: — rotor system health; — cockpit voice recorder (CVR)/flight data recorder (FDR); — gearbox system health; — engine health; — exceedance monitoring; — usage monitoring; — transparent operation; — ground station features; — monitoring; — rotor track and balance; — engine performance			X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		trending; — quality controlled to level 2.								
(02)		Describe the ground station features of an IHUMS.			X	X				
(03)		Summarise the benefits of an IHUMS including: — reduced risk of catastrophic failure of rotor or gearbox; — improved rotor track and balance giving lower vibration levels; — accurate recording of flight exceedances; — CVR/FDR allows accurate accident/incident investigation and HOMP; — maintenance cost savings.			X	X				
(04)		State the benefits of an IHUMS and an HOMP.			X	X				
022 14 03 03		Aeroplane condition monitoring system (ACMS): general, design, operation								
(01)		State the purpose of an ACMS.	X							
(02)		Describe the structure of an ACMS including: — inputs: aircraft systems (such as air conditioning, autoflight, flight controls, fuel, landing gear, navigation, pneumatic, APU, engine), MCDU; — data management unit; — recording unit: digital recorder; — outputs: printer, ACARS or ATSU.	X							
(03)		State that maintenance messages sent by an ACMS can be transmitted without crew notification.	X							
(05)		Explain that data from the ACMS can be used as part of an FDM	X							

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			ATPL CPL		ATPL/IR	ATPL CPL				
		and safety programme.								
(05)		Explain that the FDM program collects data anonymously; however, grave exceedance of parameters may warrant a further investigation of the event by the operator.	X							
(06)		Explain the purpose of FDM as a system for identifying adverse safety trends and tailoring training programmes in order to enhance the overall safety of the operation.	X							
022 15 00 00		DIGITAL CIRCUITS AND COMPUTERS								
022 15 01 00		Digital circuits and computers								
022 15 01 01		General, definitions and design								
(01)		Define a 'computer' as a machine for manipulating data according to a list of instructions.	X		X	X		X	X	
(02)		Explain the term 'bus' being used as a term for a facility (wiring, optical fibre, etc.) transferring data between different parts of a computer, both internally and externally.	X		X	X		X	X	
(03)		Define the terms 'hardware' and 'software'.	X		X	X		X	X	
(04)	X	With the help of the relevant 022 references, give examples of airborne computers and list the possible peripheral equipment for each system, such as: — ADC with pitot probe(s), static port(s) and indicators; — FMS with GPS, CDU/MCDU and ND; — GPWS with radio altimeter, ADC and ND.	X		X	X		X	X	