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INTRODUCTION

		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 00 00 00	**AIRCRAFT GENERAL KNOWLEDGE – AIRFRAME AND SYSTEMS, ELECTRICS, POWERPLANT, EMERGENCY EQUIPMENT**						
021 01 00 00	**SYSTEM DESIGN, LOADS, STRESSES, MAINTENANCE**						
021 01 01 00	**Design concepts**						
021 01 01 01	Design, level of certification	x	x	x	x	x	
LO	Describe the following design concepts: - safe-life - fail-safe - redundancy - damage-tolerant Levels of certification: - Explain the safety objectives associated with failure conditions (AMC 25.1309 Figure 2) - Explain the relationship between the probability of a failure and the severity of the failure effects. - Explain why some systems are duplicated or triplicated.						
021 01 02 00	**Loads and combination loadings applied to an aircraft's structure**	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain : - stress - tension - compression - bending - torsion - static loads - dynamic loads - cyclic loads Explain the difference between stress (Force/unit of area) and load (Force). Describe the loads during : - taxi - take off - cruise - landing						
021 01 03 00	**Fatigue**	x	x	x	x	x	
LO	Describe the phenomenon of fatigue. Explain the relationship between the magnitude of the tension and the number of cycles (Wöhler curve) Explain the implication of stress concentration factor. Explain the possible consequences of fatigue on the use of the aeroplane.						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 01 04 00	**Corrosion**	x	x	x	x	x	
LO	Describe the following types of corrosion: - oxidation - electrolytic. Describe the precautions to be taken to prevent corrosion by the manufacturer and the aircraft user . Describe the interaction between fatigue and corrosion (stress corrosion)						
021 01 05 00	**Maintenance methods**						
021 01 05 01	Maintenance methods: hard time and on condition	x	x	x	x	x	
LO	Explain: - hard time maintenance - on condition maintenance.						
021 02 00 00	**AIRFRAME**						
021 02 01 00	**Construction and attachment methods**	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the the following construction methods: -monocoque -semi-monocoque - cantilever - sandwich - truss Describe the following attachment methods: - rivetting - welding - bolting - pinning - adhesives						
021 02 02 00	**Materials**						
	Explain the following : - elasticity - rigidity - strength - strength to density ratio - fatigue						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Basic properties and their effects on aircraft construction for Aluminium, Steel, Magnesium, Titanium and of their alloys must be known. In this paragraph, no difference is made between a composite material and a composite strucuture (eg Glass fibre reinforced structure).						
021 02 02 01	Materials for metal constructions and basic alloys: properties, characteristics, examples	x	x	x	x	x	
LO	Explain the need to use alloys rather than pure metals. State the advantages and disadvantages of the following metals: - aluminum alloys - high temperature treatment steel - titanium alloys						
021 02 02 02	Composite materials: structure, construction, use, examples	x	x	x	x	x	
LO	Explain the principle of a composite material. Describe the function of the following components: - core - fibres State the advantages and disadvantages of the following composite fibre materials: - carbon - glass - aramide (Kevlar)						
021 02 03 00	**Wings, tail surfaces and control surfaces**						
021 02 03 01	Design and construction	x	x				

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the following types of wing construction: - cantilever - non cantilever : brace Describe and explain the following design configurations: - convential (low set) tailplane - T-tail - V-tail						
021 02 03 02	Structural components	x	x				
LO	Describe the function of the following structural components of a wing : - spar and its components (web and girder). - ribs - skin - torsion box						
021 02 03 03	Loads, Stresses and aeroelastic vibrations (“flutter”)	x	x				
LO	Describe the wing loads on the ground and in flight. Describe flutter. Explain the significance of the following on stress relief and flutter: - engine position - fuel quantity - fuel distribution						
021 02 04 00	**Fuselage, doors, floor, wind-screen and windows**						

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Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 02 04 01	Design and construction	x	x	x	x	x	
LO	Describe the following types of fuselage construction: - monocoque - semi-monocoque Describe the plug typed door. Describe the flight deck windows - discuss the need for an eye reference position. - describe the operating principle of cockpit window heating - explain the implication of a direct vision window.						
021 02 04 02	Structural components, loads and stresses	x	x	x	x	x	
LO	Describe the function of the following structural components of a fuselage : - frames - stiffeners, stringers - skin, doublers Explain the function of floor venting Describe the types of construction used for the flight deck window. Discuss the implication of : - delamination and cracking - loss of windscreen heating						
021 02 05 00	**Helicopter: Flight and control surfaces**						
021 02 05 01	Design and construction			x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List the functions of the flight controls						
	Understand and describe the different design concepts and constructions of the flight and control surfaces for conventional, tandem, coaxial, side by side, NOTAR and fenestron equipped helicopters						
	Explain the advantages and disadvantages and limitations of the respective designs.						
	Explain the function of the synchronised elevator.						
	Describe the construction methods of vertical and horizontal stabilser.						
021 02 05 02	Structural components and materials			x	x	x	
LO	Name the main components of the flight and control surfaces. Understand the components and materials in terms of fatigue life and methods of checking for sevicability.						
021 02 05 03	Loads, Stresses and aeroelastic vibrations			x	x	x	
	Understand where the main stresses are applied to components.						
	Understand and appreciate the dangers and stresses regarding the safety and serviceabilty of flight and control surfaces when the manufacturers design envelope are exceeded.						
	Explain the process of component balancing: • static chordwise balancing • static spanwise balancing • blade alignment • dynamic chordwise balancing • dynamic spanwise balancing • blade sweeping						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Explain the process of blade tracking: • the pre-track method of blade tracking • the use of delta incidence numbers • aircraft configuration whilst carrying out tracking • factors affecting blade flying profile • graound tracking and in-flight trend analysis • use of pitch link and blade trim tab adjusments • blade tracking techniques, including stick, flag and electronic						
	Describe the use of Integrated Health and Usage Monitoring System (IHUMS) i.e. HUMS + Flight Data Recorder (FDR).						
	Describe the use of Helicopter Operations Monitoring Programme (HOMP).						
	Describe and understand the early warning signs and vibrations which are likely to be experienced when the main rotor blades and tail rotor are out of balance and/or tracking, including the possible early warning signs due to possible fatigue and stress failure						
	Describe the various planes of vibration measurement: • vertical • lateral • fore and aft						
LO	Understand the methods of reducing stress and vibrations and how some helicopters have onboard monitoring systems to be analysed after flight and some transmit real time data to a ground base station for immediate action if a failure is imminent.						
021 02 06 00	**Structural limitations**	X	X	X	X	X	

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Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the maximum structural masses: - Maximum ramp mass - Maximum take off mass - Maximum zero fuel mass - Maximum landing mass Explain that airframe life is limited by fatigue, created by the load cycles, pressurisation. Note: Structural limitations imposed by load factor and speed considerations are covered and questionned in subject 081.						
021 03 00 00	**HYDRAULICS**						
021 03 01 00	**Hydromechanics: basic principles**	x	x	x	x	x	
LO	Explain the concept and basic principles of hydromechanics.						
021 03 02 00	**Hydraulic systems**						
021 03 02 01	Hydraulic fluids: types, characteristics, limitations	x	x	x	x	x	
LO	List and explain the desirable properties of an hydraulic fluid and list the different types. State that the fluid does not retain its original colour after system operation.						
021 03 02 02	System components: design, operation, degraded modes of operation, indications and warnings	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the working principle of a hydraulic system. Describe the difference between a constant pressure system and a system pressurised only on specific demand (open-centre). State the differences between a passive hydraulic system (without a pressure pump) and an active hydraulic system (with a pressure pump). List the main advantages and disadvantages of a hydraulic systems when compared with a mechanical system. List the main uses of hydraulic systems. Describe the working principle and functions of the following components - pressure pump: - constant pressure pump (swahplate or camplate) - pressure pump whose output is dependant on pump RPM - with the following power sources: - manual - engine - electrical - air (pneumatic and Ram Air Turbine) - hydraulic (Power Transfer Unit) or Reversible motor pumps - reservoir - accumulators - case drain lines and fluid cooler						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	- return lines - piston actuators - hydraulic motors - check (non-return) valves - relief valves - restrictor valves - selector valves - by-pass valves - shuttle valves - fire shut-off valves - priority valves - fuse valves State the normal pressure of most large transport aircraft is 3000 psi. Explain how redundancy is obtained by giving examples. Explain the implication of a high system demand. Explain the implication of a system internal leakage. List and describe the instruments and alerts for monitoring the hydraulic system. State the indications and explain the implications of the following malfunctions: - System leak or Low level - Low pressure - High temperature						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 04 00 00	**LANDING GEAR, WHEELS, TYRES, BRAKES**						
021 04 01 00	**Landing gear**						
021 04 01 01	Types	x	x	x	x	x	
LO	Name the different landing gear configurations: - Nose-wheel - Tail-wheel						
021 04 01 02	System components, design, operation, indications and warnings, on ground/in flight protections, emergency extension systems	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the function of the following components of a landing gear - oleo leg/shock strut - axles - bogies - drag struts - side stays/struts - torsion links - locks - gear doors and retraction mechanisms (normal and emergency operation). Identify landing gear components with the aid of a simple schematic diagram. Schematic diagram to be included (normal and emergency operation). Describe the sequence of events during normal operation of the landing gear. State how landing gear position indication and alerting is implemented. Describe the various protection devices to avoid inadvertant gear retraction on the ground. Describe the possible methods for emergency gear extension:						
021 04 02 00	**Nose wheel steering: design, operation**	x	x				

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	- Explain the operating principle of nose-wheel steering - Explain the functioning of the following systems: - differential braking with free castoring nosewheel. - tiller or handwheel steering - rudder pedal nose wheel steering - Explain centering mechanism - Define the term 'shimmy' and the possible consequenses for the nosewheel. - Explain the purpose of main-wheel (body) steering.						
021 04 03 00	**Brakes**						
021 04 03 01	Types and materials	x	x	x	x	x	
LO	Describe the basic operating principle of a disk brake. State the different materials used in a disc brake (steel, carbon). Describe their advantages and characteristics.						
021 04 03 02	System components, design, operation, indications and warnings	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State the limitation of the brake energy and describe the operational consequences. Explain how the brakes are actuated. Identify the task of an autoretract brake system. State the torque limitations of the brakes Describe the function of a brake accumulator. Describe the function of the parking brake. Explain the function of wear indicators. Explain the reason for the brake temperature indicator. Explain the relationship between the real and the indicated temperature (thermal delay).						
021 04 03 03	Anti-skid	x	x				
LO	Describe the operating principle of the anti-skid system. List the system components. Explain: - slip ratio for maximum braking performance. - locked wheel prevention - impact on performance						
021 04 03 04	Auto-brake	x	x				

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the operating principle of the auto-brake system: List the system components State the difference between arming/disarming and engagement/disengagement of the system. Impact on performance.						
021 04 04 00	**Wheels and Tyres**						
021 04 04 01	Types, structural components and materials, operational limitations, thermal plugs	x	x	x	x	x	
LO	Describe the different tyre types and constructions (tubeless, diagonal and radial). Define the following terms - ply rating - tyre tread - tyre creep - retread (cover) List typical tyre pressure values for transport aircraft. Explain the function of thermal/fusible plugs. Explain the implcations of tread separation and tyre burst. Explain why the ground speed of the tyres is limited. Describe material and basic construction of the rim of an aircraft wheel.						
021 04 05 00	**Helicopter equipments**			x	x	x	

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Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Have a basic knowledge and be able to describe how the following eqipments: Winches/hoists, underslung load beams, camera pods, search lights and floatation devices are fitted to helicopters and how they are powered/driven and operated by: mechanical, air, cable or electric						
	Understand that with most helicopters there are IAS limitations, before and when the floatation devices are deployed.						
021 05 00 00	**FLIGHT CONTROLS**						
021 05 01 00	**Helicopter : Flight Controls**			x	x	x	
	List the different primary flight controls and describe their operating principle.						
	Explain the methods of locking the controls on the ground.						
	Describe the main rotor droop stops and how static rotor flapping is restricted.						
	Describe the need for linear and rotary control input/ output.						
	Explain the principle.phase lag and advanced angle .						
	Describe the four axis of control operation and their associated cocpit controls: • Collective control • Cyclic fore and aft • Cyclic lateral • Yaw						

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Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Describe the swashplate or azimuth star control and list the following: • Swashplate inputs • Function of the non-rotating swashplate • Function of the rotating swashplate • How swashplate tilt is achieved • Swatchplate pitch axis • Swashplate roll axis • Balancing of pitch/roll/collective inputs to the swashplate to equalise torsional loads.						
	Describe the main rotor spider control system and list the following: • The collective beam • Pitch/roll/collective inputs to the collective beam • Spider drive						
	Describe the Bell method of cyclic/collective control and list the following: • Pitch/roll inputs to the swashplate • Collective inputs to the main rotor						
	Describe the need for control system interlinks, in particular: • Collective/yaw • Collective/throttle • Cyclic/stabilator • Interaction betweencyclic yaw controls with horizon and vertical stabilisers						
	State the need for “feel systems” in the hydraulic actuated flight control system.						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Describe the purpose of a trim system						
	Have a understanding of and list the different types of trim system.						
	List the basic components of a trim system in particular: • Force trim switch • Force gradient • Parallel trim actuator • Cyclic 4-way trim switch • Interaction of trim system with a SAS/SCAS/ASS stability system • The use of trim motor indicators						
	Describe the different types of control runs						
	Explain the use of control stops						
021 05 02 00	**Aeroplane : Primary Flight Controls**	X	X				
LO	Define a primary flight control. List the different primary flight control surfaces: - elevator - aileron, roll spoilers - rudder List the various means of control surface actuation: - manual - fully powered (irreversible) - partially powered (reversible)						

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Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 05 02 01	Manual controls	x	x				
LO	Explain the basic principle of a fully manual control system.						
021 05 02 02	Fully powered controls (irreversible)	x	x				
LO	Explain the basic principle of a fully powered control system. Explain the concept of irreversibility in a flight control system. Explain the need for 'feel systems' in a fully powered control system.						
021 05 02 03	Partially powered controls (reversible)	x	x				
LO	Explain the basic principle of a partially powered control system. Explain why a 'feel systems' is not necessary in a partially powered control system.						
021 05 02 04	System components, design, operation, indications and warnings, degraded modes of operation, jamming	x	x				
LO	List the components for the above flight control systems. For each component, describe its function. Explain how redundancy is obtained in primary flight control systems of large transport aeroplanes. Explain the danger of control jamming and the means of retaining sufficient control capability. Explain the methods of locking the controls on the ground and describe "control lock" warnings. Explain the concept of a rudder deflection limitation system and the various means of implementation (rudder ration changer, variable stops, blow-back).						
021 05 03 00	**Aeroplane: Secondary Flight Controls**						

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Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 05 03 01	System components, design, operation, degraded modes of operation, indications and warnings	x	x				
LO	Define a secondary flight control. List the different secondary flight control surfaces: - lift augmentation devices (flaps and slats) - speed brakes - spoilers - trimming devices Describe secondary flight control actuation methods and sources of actuating power. Describe the requirement for limiting speeds for the various secondary flight control surfaces. For lift augmentation devices, explain the load limiting protection devices and the functioning of an auto-retraction system. Explain the flap/slat asymmetry protection device. Describe an auto-slat system. Explain the concept of control surface blow-back.						
021 05 04 00	**Fly-by-Wire (FBW) control systems**	x	x	x	x	x	

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Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain that a FBW flight control system is composed of the following: - Pilot's input command (control stick/column) - Electrical signaling: - Pilot input input to computer - Computer to flight control surfaces - Feedback from aircraft response to computer - Command unit (Flight control computers) (TBReviewed - Actuators - Control surfaces State the differences between a FBW and other mechanical flight control systems.						
021 05 05 00	**Controlable twist rotor blade**			x	x	x	
LO	To be deleted						
021 06 00 00	**PNEUMATIC – PRESSURISATION AND AIR CONDITIONING SYSTEMS**						
021 06 01 00	**Pneumatic/Bleed air supply**						
021 06 01 01	Piston engine air supply	x	x	x	x	x	
LO	State the method of supplying air for the pneumatic systems for piston engine aircraft. State that an air supply is required for the following systems: - instrumentation - heating - de-icing						
021 06 01 02	Gas turbine engine: bleed air supply						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the possible bleed air sources for gas turbine engine aircraft are the following: - engine - APU - ground supply State that a bleed air supply can be used for the following systems or components: - pressurisation and air conditioning - anti-icing - engine air starter - pressurisation of a hydraulic reservoir - air driven slats or flaps - air driven hydraulic pumps State that the bleed air supply system can comprise the following: - pneumatic ducts - isolation valve - pressure regulating valve - engine bleed valve (HP/IP valves) - fan air pre-cooler - temperature and pressure sensors Describe the cockpit indications for bleed air systems. State how the bleed air supply system is controlled and monitored. List the different air bleed malfunctions: - over temperature - over pressure - low pressure						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 06 02 00	**Air conditioning systems**						
021 06 02 01	Types, system components, design, operation, degraded modes of operation, indications and warnings			x	x	x	
LO	Describe the purpose of an airconditioning system.						
	Explain how the system is controlled.						
	Indentify the components from a diagram of an airconditioning system and describe the operating priciple and function: • Air cycle machine (pack) • Pack cooling fan • Water separator • Mixing valves • Flow control valves • Isolation valves • Ram air valves • Re-circulation fans • Filters for re-circulation • Temperature sensors List and describe the controls, indications and warnings related to the air-conditioning system.						
021 06 03 00	**Pressurisation and air conditioning system**						
021 06 03 01	System components, design, operation, degraded modes of operation, indications and warnings	x	x				

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that a pressurisation and an air conditonning system of an aeroplane controls:						
	- ventilation						
	- temperature						
	- pressure						
	State that humidity is not controlled.						
	Identify the components that constitute the pressurization system:						
	pneumatic system as the power source						
	- outflow valve						
	- outflow valve actuator						
	- pressure controller						
	- excessive differential pressure relief valve						
	- negative differential pressure relief valve						
	Identify the components that constitute an air-conditioning system and describe their operating principles and function:						
	- air cycle machine (pack, bootstrap system)						
	- pack cooling fan						
	- water separator						
	- mixing valves						
	- flow control valves						
	- isolation valves						
	- ram air valve						
	- re-circulation fans						
	- filters for re-circulated air						
	- temperature sensors						
	Describe the use of hot trim air						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 07 00 00	**ANTI AND DE-ICING SYSTEMS**						
021 07 01 00	**Types, design, operation, indications and warnings, operational limitations**	X	X	X	X	X	X

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Identify the location of pneumatic de-ice systems.						
	Name the categories of aeroplanes where these systems are installed.						
	Describe the working principle of the inflatable rubber boots.						
	State how the inflation and deflation is controlled.						
	Explain when the system should be operated.						
	State how the system is controlled and monitored.						
	State how the system can be used as an anti-ice system						
	Explain the difference between de-icing and anti-icing.						
	Describe when anti-ice systems have to be switched on.						
	Name the components of an aircraft that are protected from ice accretion by the use of bleed air.						
	Identify the components which constitute the anti-ice system and describe their function:						
	pneumatic source						
	shut-off valves						
	pneumatic ducts						
	perforated pneumatic ducts						
	outflow holes under the wings or into the nacelles						
	Describe the operating principle of the anti-ice system.						
	Describe the two different operating principles of ice detectors.						
	Identify the monitoring instruments and controls of the anti-ice systems.						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Describe the construction, the operating principle and the operation of electric anti-icing of a propeller. List other electrically ice protected aircraft components and describe their operation. Explain the operating principle of the weeping wing system. Explain the principle and method of operation of windshield rain protecting systems.						
021 07 02 00	**Ice warning systems: types, operation, and indications**	x	x	x	x	x	x
LO	Describe the principlpe of operation of ice warning systerms						
021 07 03 00	**Helicopter equipments**			x	x	x	
	Main and tail rotor heating systems						
	Understand the limitations on blade heating and the fact that on some helicopters, the heating does not heat all the main rotor blades at the same time						
021 08 00 00	**FUEL SYSTEM**						
021 08 01 00	**Piston engine**						
021 08 01 01	Design, operation, system components, degraded modes of operation, indications and warnings	x	x	x	x	x	
LO	See below.						
021 08 02 00	**Turbine engine**						
021 08 02 00	Design, operation, system components, degraded modes of operation, indications and warnings	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List the different types of fuel tanks, describe their construction and state their advantages. Indicate typical tank locations on aircraft and state their advantages. Identify the components of the fuel tank system and explain their function: - tanks - baffles - vent system - overpressure relief valve - surge vent tank - refuel adapter and panel - automatic top-off unit Explain the refueling sequence for tanks which are to be only partially filled. Describe the location and the purpose of the drains. Define the term ‘unusable fuel’. Describe the various methods of refueling. Describe precautions to be observed before refueling.						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Describe the methods of fuel feed to the engines and indicate their use. Identify the components of a fuel system and describe their operating principle and function: - tank system - fuel lines - selector valves - check valves - screens, filters, strainers - fire shut-off valves - fill shut-off valves - cross-feed valve Describe the monitoring instruments and controls of the fuel system.						
	Describe the operating principle of a fuel dump system. Name the requirements for the minimum fuel remaining. State which aircraft have fuel dumping systems.						
	Explain the fuel management system and its operation during flight. Describe system management by cross-feed valve operation and fuel pump selection. Describe the method used to indicate fuel quantity. State that in case of low fuel pressure (e.g. pump off) a warning light illuminates. Describe the method of fuel temperature measurement and control, and its limits, related to fuel type. Describe the use and purpose of dip-sticks						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 09 00 00	**ELECTRICS**						
021 09 01 00	**General, definitions**						
021 09 01 01	Direct Current: - voltage, current, resistance, conductivity, Ohm's law, power, work	x	x	x	x	x	x

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Electric circuits						
	Name examples of conductors, semiconductors and insulators.						
	State the relationship between voltage, current and resistance in a closed electrical circuit.						
	Name different types of switches.						
	State the purpose of the guard cap in the case of toggle switches.						
	State how the following devices work: thermo-, bimetallic-, time- and proximity-switches.						
	Voltage, current, resistance						
	Define voltage in words and state the relevant unit of measurement.						
	Define current in words and state the relevant unit of measurement.						
	Ohm’s law						
	State Ohm’s Law in qualitative terms.						
	Calculate voltage, current and resistance using Ohm’s Law.						
	Resistive circuits						
	Calculate the total value of resistance in series and parallel circuits						
	Explain the relationship between individual voltages and current when resistors are connected in series.						
	Explain the relationship between individual currents and voltage when resistors are connected in parallel.						
	Resistance as a function of temperature						
	Define the change of resistance of a material as a function of temperature						
	State that resistances can have a positive temperature coefficient (PTC) or a negative temperature coefficient (NTC)						
	State that PTC and NTC resistors are used in aircraft systems for temperature measurement						
	Electrical power, electrical work						
	Define electrical power in qualitative terms and name the relevant unit of measurement						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Fuses, circuit breaker (function, type and operation) Describe the method of operation of the circuit-breaker. Explain how a fuse is rated State the difference between a ”trip-free” and ”non-trip-free” circuit breaker. State the methods of detecting failures in fuses and circuit-breakers. List the different types of circuit breakers. The electrical field Define the term ”electrical field” in qualitative terms State the difference between an electrical field and a magnetic field. The capacitor (function) State the principle of construction of a capacitor. State how the capacitance (of a capacitor) is related to the plate area, the distance between the plates ,and the dielectric constant. State, in qualitative terms, the alteration in total capacitance of capacitors when connected in series or in parallel.						
021 09 01 02	Alternating Current: - voltage, current, amplitude, phase, frequency, resistance, capacitance, inductance, peak and RMS values, impedance, reactance, active and reactive power, power factor	x	x	x	x	x	x

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Single and multi-phase AC						
	Draw a single-phase AC voltage in the form of a line and vector diagram.						
	Draw a three-phase AC voltage in the form of a line and vector diagram.						
	State that in aircraft with AC power distribution a three phase system is used.						
	Frequency						
	Define frequency in qualitative terms and state the relevant unit of measurement.						
	Explain the use of a particular electrical frequency in aircraft.						
	Phase shift						
	Define phase shift in qualitative terms.						
	State the phase shift of an ideal inductance in an AC circuit.						
	State the phase shift of an ideal capacitor in an AC circuit.						
	State the possible range of phase shift for an electrical circuit consisting of inductance, capacitor ad ohmic resistor supplied with AC voltage.						
	AC components						
	Name components which work only with AC						
021 09 01 03	Resistors, capacitors, inductance coil	x	x	x	x	x	x
LO	Describe the behaviour of an ohmic resistor in an AC circuit						
	Describe the behaviour of a capacitor in an AC circuit.						
	Describe the behaviour of a coil in an AC circuit.						
021 09 01 04	Circuits: series, parallel	x	x	x	x	x	x
LO	To be Defined						

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Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 09 01 05	Magnetic field: effects in an electrical circuit	X	X	X	X	X	X
LO	Permanent magnetism						
	State the properties of a magnet.						
	Name the two poles of a permanent magnet						
	List the ferromagnetic materials that can be used for permanent magnets						
	State the direction of the magnetic flux outside the magnetic poles and inside the magnet						
	Electromagnetism						
	State that an electrical current produces a magnetic field around a conductor and define the direction of that field						
	Indicate how the strength of the magnetic field changes if supported by a ferromagnetic core						
	Explain the purpose of a relay						
	Name the components of a relay						
	Explain the purpose of a circuit breaker						
	Name the components of a circuit breaker						
	Explain how the coil circuit is insulated from the contact circuit						
	Explain the difference between a normally-open, a normally-closed and a changeover contact in a relay.						
	Electromagnetic power						
	State how the inductance of a coil depends on the number of windings, the cross-sectional area of the coil the coil length and the magnetic conductivity.						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Electromagnetic induction Explain the principle of electromagnetic induction. State how the induced voltage in a coil depends on the number of windings, the magnetic flux and the rate of change of the magnetic flux						
021 09 02 00	**Batteries**						
021 09 02 01	Types, characteristics and limitations	x	x	x	x	x	x

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	- Types, characteristics - State the components of a battery - Name the types of rechargeable batteries used in aircraft - For lead acid & NiCd batteries - describe the processes which occur during charging and discharging - differentiate between cell voltage and charging voltage - state the effect of temperature. - State the charging voltages which corresponds with different battery voltages. - Compare lead-acid and NiCd batteries in respect of voltage, load behaviour, self-discharge, thermal runaway and storage life - Capacity - Define the term ”capacity of batteries”. - State the relationship between voltage and capacity when batteries are connected in series or in parallel - Uses - List the uses of lead acid batteries and NiCd batteries. - Compare the relative advantages and disadvantages of lead acid and NiCd batteries						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Hazards State the dangers involved in overcharging lead-acid and NiCd batteries Indicate the behaviour of NiCd batteries in the case of too high a temperature (thermal runaway). Indicate why charging of lead-acid batteries with too high a voltage is dangerous State that NiCd batteries are monitored to avoid damages resultant from excessive temperature increase						
021 09 02 02	Battery chargers, characteristics and limitations	x	x	x	x	x	x
LO	To be Defined						
021 09 03 00	**Static electricity: general**						
021 09 03 01	Basic principles, Faraday's Law	x	x	x	x	x	x
LO	Explain what static elektricity is. State Faraday's law						
021 09 03 02	Static dischargers	x	x	x	x	x	x
LO	Explain the purpose of "static dischargers" Explain why the aircraft must first be grounded in case of refueling.						
021 09 03 03	Protection against interference	x	x	x	x	x	x
LO	To be Defined						
021 09 03 04	Lightning effects	x	x	x	x	x	x
LO	To be Defined						
021 09 04 00	**Generation: production, distribution, use**						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 09 04 01	DC Generation: - types, design, operation, system components, degraded modes of operation, indications and warnings	X	X	X	X	X	X
LO	Alternator Principle, function and applications Describe the condition for a voltage to be induced in a conductor. Name the type of voltage which is induced in a rotating conductor loop in a homogeneous magnetic field Name the components of a simple generator. Define resonance. State in qualitative terms how voltage depends on number of turns, field strength, rpm and load Define the term ”internal-pole machine”. Name the components of an alternator. Compare the alternator and the simple generator with regard to: voltage response at low rpm power/weight ratio brush sparking current supply for the consumer AC-DC conversion						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Describe the different generator switching possibilities in multiengine aircraft. With regard to load distribution, compare and contrast the split system with the parallel system. List the requirements to connect DC generators in parallel Explain how control of load sharing is achieved when two DC generators are operating in parallel Monitoring devices Name different monitoring devices Regulation, control and protection Explain the principle of voltage control. List the types of voltage regulators and explain their method of operation. Explain why reverse current flow from the battery to the generator must be prevented. Name the different types of reverse-current protection devices and explain how they work. Describe the different alternator designs Starter generator Describe how the starter generator is constructed and indicate its purpose.						
021 09 04 02	AC Generation: - types, design, operation, system components, degreded modes of operation, indications and warnings	x	x	x	x	x	x

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Three phase generator/brushless generator (construction and operation) Describe the components of a three-phase generator. Explain how a three-phase generator works. List possible types of connection for the 3 windings. Describe how a three phase AC generator is usually connected. Define phase and line voltage and state the voltage values used in aircraft. State the relation between phase voltage and line voltage. Name the principle involved in voltage control. State in qualitative terms the relation between frequency, number of pole pairs, and RPM of a three-phase generator. Variable speed constant frequency (VSCF) drive Explain the purpose of a VSCF. Describe how constant output voltage and frequency is achieved. Explain the function of disconnect. Explain the purpose of a VSCF State that the voltage and frequency output of a VSCF is identical to the output of a hydraulic constant speed driven AC generator as well as to an IDG.						
021 09 04 03	AC Generation: Constant Speed Drive systems (CSD/IDG) - basic principles, limitations and warnings	x					

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Generator drive Constant speed drive (CSD) Explain the purpose of a constant speed drive (CSD) Name the different types of constant-speed drives. List the component parts of a CSD. Describe how, in a CSD, oil pressure and oil temperature are monitored Explain what happens in the event of mechanical disconnect. Explain the significance of the monitoring instruments. Integrated drive List the components of the integrated drive generator (IDG). Describe the function of an IDG. Explain the consequences of a mechanical disconnect during flight. State that in the case of failure an indication is given to the pilot.						
021 09 05 00	**Electric components**						
021 09 05 01	Basic elements: - cables and connectors: materials, components, characteristics and limitations - basic principles of switches, relays, circuit-breakers and proximity switches - Semiconductors: basic principles, diode, transistor: description, functions, characteristics and limitations Logic circuits: basic functions (AND, OR, NOT, NOR) symbols and associated gates, association of basic functions	x	x	x	x	x	x

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 09 05 02	Motors (DC/AC): - types, design, operation, system components, degraded modes of operation, indications and warnings	x	x	x	x	x	x
LO	Synchronous and asynchronous motors Operation Name the components of a synchronous motor. Describe how a synchronous motor works. State the relationship between RPM, frequency and number of pole pairs for a synchronous motor. List the characteristics of a synchronous motor. Name the components of a 3-phase asynchronous motor Describe how a 3-phase asynchronous motor works. Describe the relationship between the rotating velocity of the rotary field in the stator and the rotor RPM of the asynchronous motor. Name the components of a 2-phase asynchronous motor. List the characteristics of an asynchronous motor. Explain how the direction of a 3 phase AC motor can be changed Application Name typical applications for an asynchronous motor.						
021 09 05 03	Other elements: Transformers, transformer rectifiers, static inverters, converters, current transformers - design, operation, limitations	x	x	x	x	x	x

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Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Inverter State the purpose of static inverters List the parts used in the construction of a static inverter. Describe the function of a static inverter. State the commonly used output voltages of inverters Name typical applications for an inverter. Transformer Rectifier Units (tru) Specify the purpose of a Transformer Rectifier Unit (TRU). Explain the construction and output voltage of a TRU. State that TRU's are used in commercial aircraft for supplying the DC network Transformers Describe the task of a transformer. State that AC transformers exist for single-phase AC and for three-phase AC. Name the component parts of a transformer. State in qualitative terms the dependence of I and U on the transformation rate.						
021 09 06 00	**Distribution**						
021 09 06 01	General: - bus bar, common earth, priority - AC and DC comparison	x	x	x	x	x	x

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Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Use a block diagram to describe the flight supply system Explain the purpose of electrical bonding State which pole of the battery and which pole of the alternator are typically grounded to the fuselage in aircraft power supply. State the advantages and drawbacks of electrical bonding						
021 09 06 02	DC distribution: - Coupled and un-coupled systems, protection and monitoring circuits	x	x	x	x	x	x

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Current distribution (buses)						
	Explain the purpose of the bus						
	Name the purpose of the battery bus and of the hot bus						
	Name the components of the electrical power supply system used in flight						
	State the number of ammeters in a multi generator system						
	Use a block diagram to describe the supply system used in flight						
	Monitoring of electrical systems						
	State the methods of monitoring of electrical systems						
	Name the components of a moving-coil instrument						
	Explain the function of a moving-coil instrument						
	Explain the function of a Wheatstone Bridge						
	Ammeter, voltmeter						
	State the difference between a voltmeter and an ammeter with regard to resistance						
	State the purpose of an ammeter and show how it is connected to the electrical load						
	State the purpose of a voltmeter and show how it is connected to the electrical load						
	Describe the possibilities for extending the measuring range of voltmeters and ammeters						
	Interpret the different ammeter indications of the ammeter which monitors the charge current of the battery.						

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Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Annunciators						
	Identify different types of annunciators.						
	Electrical consumers						
	List types of electrical consumers (loads) for an aircraft, and their different purposes:						
	lighting						
	heating						
	magnetic devices						
	avionics systems						
	instruments						
	Describe the components of a DC motor						
	Describe the circuitry for the field winding in the case of series, shunt, and compound wound motors.						
	Describe the RPM and torque behaviour of a series-wound motor and a shunt-wound motor as the load increases/decreases.						
	Explain how the direction of rotation of a DC motor can be changed.						
	Name typical applications for series and shunt field motor.						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	DC power distribution: Construction, operation and system monitoring Using simplified schematics, explain the construction of single- and multi-engined DC flight equipment Using simplified schematics, show the effects of different switching operations. Using simplified schematics, show the effects of the following cases: generator failure generator overloading overvoltage battery over/undercharge. List the sources of external power supply. List the significant points to be observed when operating with an external power supply. State the effects on the progress of the flight if the generator or generator and battery fails. State how fire, due to electrical causes, can be checked.						
021 09 06 03	AC distribution: - Coupled and un-coupled systems, protection and monitoring circuits	x	x	x	x	x	x

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Construction, operation and monitoring List the different types of electrical power supply in AC circuits. Describe the power distribution in the case of a split system. Explain the consequences of one generator failing. State that the auxiliary power unit (APU) is fitted with a 3 phase AC generator for use on the ground and in flight. Explain the construction of three-phase flight equipment. List the different monitoring instruments for parallel and split system operation. Protection circuits, paralleling of ac-generators Explain how the bus bars are connected in the case of parallel connection. Explain the conditions to be met for paralleling AC generators Name the synchronization conditions for parallel connection of three-phase generators. Describe how different reactive loads become compensated in the case of paralleled AC generators. Describe how different real loads become compensated in the case of paralleled AC generators. List different protective circuits for parallel operation.						
021 09 06 04	Electrical load management systems: - Automatic generators and bus switching during normal and failure operation, indications and warnings	x		x			
LO	To be Defined						
021 10 00 00	**PISTON ENGINES**						

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Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 10 01 00	**General**						
	This section includes diesel engines and petrol engines.						
021 10 01 01	Types of internal combustion engine: basic principles, definitions	x	x	x	x	x	
LO	Define the following terms and expressions: - RPM - torque - Manifold Absolute Pressure (MAP) - power output - specific fuel consumption - mechanical efficiency, thermal efficiency, volumetric efficiency - compression ratio, clearance volume, swept (displaced) volume, total volume Describe the influence of compression ratio on thermal efficiency.						
021 10 01 02	Engine: design, operation, components and materials	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the main mechanical engine components, their materials and state their function Name and identify the various types of engine design with regard to cylinder arrangement and working cycle. Describe the gas state changes, the valve positions and the ignition timing during the four strokes of the theoretical piston engine cycle. Explain the main differences between the theoretical and practical four stroke piston engine cycles. Describe the differences between petrol engines and diesel engines as: - means of ignition - maximum compression ratio - air supply to the engine inlet - specific power output (kW/kg)						
021 10 02 00	**Fuel**						
021 10 02 01	Types, grades, characteristics, limitations	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Name the type of fuel used for petrol engines (AVGAS). Name the types of fuel for diesel engines (kerosene or diesel). Define the term 'octane rating'. Describe the combustion process in a piston engine cylinder for both petrol and diesel engines. Define the term „flame rate“ and describe its variations depending on the fuel-air mixture only for petrol engines. Define the term „detonation“ and describe the causes and effects of detonation for both petrol and diesel engines. Describe the term „pre-ignition” and describe the causes and effects of pre-ignition for both petrol and diesel engines. Identify conditions and power settings that promote detonation for petrol engines. Describe how detonation in petrol engines is recognised. Name the anti-detonation petrol fuel additive (Tetra Ethyl Lead) Describe the method of checking the fuel for water content. State the typical value of fuel density for aviation gasoline and diesel fuel. Explain volatility, viscosity and vapour locking for petrol and diesel fuels.						
021 10 02 02	Alternate fuel: characteristics, limitations	x	x	x	x	x	
LO	Name the alternate type of fuel used for petrol engines (MOGAS) and state its limitations.						
021 10 03 00	**Carburator/Injection system**						
021 10 03 01	Carburator: design, operation, degraded modes of operation, indications and warnings	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State the purpose of a carburettor. Describe the operating principle of the simple float chamber carburettor. Describe the method of achieving correct mixture ratio over the whole engine speed and altitude range. Describe the method of achieving reliable idle operation. Describe the methods of obtaining mixture control including provision of a method of stopping the engine. Explain the purpose and the operating principle of an accelerator pump. Explain the purpose and operation of power enrichment jet. Describe the function of the carburettor heat system. Explain the effect of carburettor heat on mixture ratio and power output.						
021 10 03 02	Injection: design, operation, degraded modes of operation, indications and warnings	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the low pressure, continuous flow type fuel injection system used on light aircraft piston petrol engines with the aid of a schematic diagram. Explain the advantages of an injection system compared with a carbuettor system Explain the requirement for two different pumps in the fuel injection system and describe their operation. Describe the task and explain the operating principle of the fuel and mixture control valves in the injection system for petrol engines. Describe the task and explain the operating principle of the fuel manifold valve, the discharge nozzles and the fuel flow meter in the fuel injection system for petrol engines. Describe the injection system of a diesel engine and explain the function of: - high pressure fuel injection pump - fuel lines - fuel injectors						
021 10 03 03	Icing	x	x	x	x	x	
	Describe the causes and effects of carburettor icing and the action to be taken if carburettor icing is suspected. Name the meteorological conditions within which carburettor icing may occur. Describe the indications of the presence of carburettor icing with both a fixed pitch and a consant speed propeller. Describe the indications that will occur upon selection of carburettor heat if ice is present or not. Explain the reason for the use of alternate air on fuel injection systems and describe its operating principle. State the meteorological conditions under which induction system icing may occur.						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 10 04 01	**Air cooling systems**						
021 10 04 01	Design, operation, indications and warnings	x	x	x	x	x	
LO	Specify the reasons for cooling a piston engine. Describe the design features to enhance cylinder air cooling. Compare the advantages of liquid and air cooling systems. Identify the cylinder head temperature indication to monitor engine cooling. Describe the function and the operation of cowl flaps. Dangers associated with over-cooling						
021 10 05 00	**Lubrication systems**						
021 10 05 01	Lubricants: types, characteristics, limitations	x	x	x	x	x	
LO	Describe the term ‘viscosity’ including the effect of temperature. Describe the viscosity grade numbering system used in aviation.						
021 10 05 02	Design, operation, indications and warnings	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State the functions of a piston engine lubrication system. Describe the working principle of a dry sump lubrication system and the functions of the following components: - oil tank (reservoir) - pressure pump and relief valve - scavenge pump - oil cooler - oil cooler by-pass valve (thermo static) - filter - pressure and temperature sensors - lines State the differnces between a wet and a dry sump lubrication system. State the advantages/disadvantages of each system. Explain the factors influencing oil consumption Describe the interaction between oil pressure and oil temperature and oil quantity.						
021 10 06 01	**Ignition circuits**						
021 10 06 01	Design, operation	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the working principle of a magneto ignition system and the functions of the following components: - magneto - contact breaker points - capacitor (condenser) - coils or windings - ignition switches - distributor - spark plug - High tension (HT) cable Explain the location of the component parts of an ignition system with the aid of a schematic diagram. State why piston engines are equipped with two electrically independent ignition systems. State the function and operating principle of the following methods of spark augmentation: - starter vibrator (booster coil) - impulse start coupling Explain the function of the magneto check. State the reasons for correct temperature grade of the spark plug. Explain the function of ignition timing advance or retard. Explain how ignition takes place in diesel engines.						
021 10 07 01	**Mixture**						
021 10 07 01	Definition, characteristic mixtures, control instruments, associated control levers, indications	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define the following terms: - mixture - chemically correct ratio (stoichometric) - best power ratio - lean (weak) mixture - rich mixture State fuel air ratio values or range of values for the above mixtures. Describe the advantages and disadvantages of weak and rich mixtures. Describe the relation between engine specific fuel consumption and mixture ratio. Describe the use of the exhaust gas temperature as an aid to mixture setting. Explain the relation between mixture ratio and detonation and pre ignition. Explain the absence of mixture control in diesel engines.						
021 10 08 00	**Propellers**						
021 10 08 01	Definitions, general.	x	x				
LO	Definitions and aerodynamic concepts are detailed in 081 07 LOs and may be subject to change pending the FTO consultation period during April 2006. Ater this consultation period and combined SET 021-081 review, the relevant part wil be included under this paragraph.						
021 10 08 02	Constant speed propeller: - Design, operation, system components	x	x				

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the operating principle of a constant speed propeller system under normal flight operations with the aid of a schematic diagram. Explain the need for a MAP indicator for the power setting with a constant speed propeller. State the purpose of a torque-meter and describe its operating principle State the purpose and describe the operation of a low pitch stop (centrifugal latch). Describe the operating principle of a single acting and a double acting variable pitch propeller. Describe the function and the basic operating principle of synchronising and synchrophasing systems. Define the terms Alpha range, Beta range and reverse thrust as applied to a variable pitch propeller. Explain the dangers of inadvertant Beta range selection in flight. Explain the purpose and the basic operating principle of an auto-feathering system including un-feathering.						
021 10 08 03	Reduction gearing: - Design	x	x				
LO	State the purpose of reduction gearing.						
021 10 08 04	Propeller handling: - Associated control levers, degraded modes of operation, indications and warnings	x	x				

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the necessity for checking the propeller for its physical condition before flight. Describe the checks to be carried out on the constant speed propeller system after engine start. Describe the operation of a constant speed propeller system during flight including an overspeeding propeller. Describe the operating principle of a constant speed propeller system when feathering and unfeathering a propeller, including the operation of cockpit controls.						
021 10 09 00	**Performance and engine handling**						
021 10 09 01	Performance: influence of engine parameters, influence of atmospheric conditions, limitations, power augmentation systems	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Engine performance						
	Define the following terms:						
	- pressure altitude						
	- density altitude						
	Describe the effect on power output of a piston engine of the following parameters:						
	- pressure						
	- temperature						
	- altitude						
	- humidity.						
	Explain the term normally aspirated engine.						
	Power Augmentation Devices						
	Explain the requirement for power augmentation (supercharging) of a piston engine.						
	Describe the difference between an externally driven supercharger (turbocharger) and an internally driven supercharger.						
	Describe the function and the principle of operation of the following main components of a turbocharger:						
	- turbine						
	- compressor						
	- waste gate						
	Explain the difference between an altitude-boosted turbocharger and a ground-boosted turbocharger.						
	Define the term critical altitude.						
	Explain the function of an intercooler.						
	Compare the curve of maximum power output versus altitude of a normally aspirated engine and the same engine fitted with different types of supercharging devices.						
	Define the terms full throttle height and rated altitude.						

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Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 10 09 02	Engine handling: power and mixture settings during various flight phases, operational limitations	x	x	x	x	x	
LO	State the correct procedures for setting the engine controls when increasing or decreasing power. Define the following terms - Take-off Power - Maximum Continuous Power. Define the term „critical rpm“ and state the consequence for engine operation. Describe the term hydraulicing and the precautions to be taken prior to engne start. Describe the start problems associated with extreme cold weather						
021 11 00 00	**TURBINE ENGINES**						
021 11 01 00	**Thrust formula**						
LO	Describe how the thrust is produced by a basic gas turbine engine. Describe the simple form of the thrust formula. State that thrust can be considered to remain approximately constant over the whole aeroplane speed range.						
021 11 02 00	**Definitions**						
021 11 02 01	Design, operation, types of turbine engines, components and materials	x	x	x	x	x	

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Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List the main components of a basic gas turbine engine. Describe the system of station numbering in a gas turbine engine. Describe the variation of static pressure, temperature and axial velocity in a gas turbine engine under normal operating conditions. Describe the gas state changes in a gas turbine engine with the aid of a working cycle diagram. Describe the differences between absolute, circumferential (tangential) and axial velocity. Describe how the thrust is produced by turbojet and turbofan engines. Describe how power is produced by turboprop engines. List the different types of gas turbine engines. Types Of Construction Describe the term ‘equivalent horsepower’. Describe the operating principle of turbojet, turbofan and turboprop engines. Define the term bypass ratio, perform simple calculations. List the advantages and disadvantages of turbojet, turbofan and turboprop engines. Define the terms propulsive efficiency, thermal efficiency and total efficiency. Describe the influence of compressor pressure ratio on thermal efficiency. Explain the variations of propulsive efficiency for turbojet, turbofan and turboprop engines. Define the term ‘specific fuel consumption’ for turbojets and turboprops.						
021 11 02 02	Coupled turbine engine: design, operation, components and materials			x	x	x	
LO	Name the main assembly parts of a coupled turbine engine and explain the operation of the engine.						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Learn the limitations of the materials used in particular in regard to the maximum turbine temperature and engine and drive train torque limits.						
	Describe the possible effects on engine components when limits are exceeded.						
	Understand the importance of reporting and logging engine exceedences.						
021 11 02 03	Free turbine engine: design, operation, components and materials			x	x	x	
LO	Describe the design methods to keep engine size small for installation in helicopters.						
	List the main components of a free turbine engine.						
	Describe how the thrust force is developed by a turboshaft/free turbine engine.						
	Explain how the exhaust gas temperature is used to monitor turbine stress.						
021 11 03 00	**Fuel**						
021 11 03 01	Types, characteristics, limitations	x	x	x	x	x	
LO	Fuel List the types of fuel used for gas turbine engines and their flash and freezing points, their colour and their specific weight. Identify the possible problems with the fuel at low temperatures. State that the fuel must be checked for dissolved water.						
021 11 04 00	**Main engine components**						
021 11 04 01	Aeroplane: Air intake - Design, operation, materials - Noise reduction	x	x				

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Name the most important tasks of the engine air inlet/air intake. Describe the geometry of a pitot type subsonic air inlet. Explain the gas parameter changes in a pitot air inlet at different flight speeds. Describe the purpose and the principle of operation of multi shock air inlets at supersonic flight speeds. Name the different types of multi shock air inlets and identify them on different aircraft. Describe the reasons for and the dangers of the following operational problems concerning the engine air inlet: airflow separations, especially in crosswinds on the ground inlet icing inlet damage foreign object ingestion Damage FOD heavy in-flight turbulence Describe the action taken by the pilot to counteract the above problems Describe conditions and circumstances during ground operations in which the danger may arise of foreign objects or persons being sucked into the air inlet.						
021 11 04 02	Compressor - Types, design, operation, components and materials - Stresses and limitations - Stall, surge, means of prevention	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List the purposes of the compressor. Describe the types of centrifugal and axial compressors used in aircraft engines. Name the main components of a compressor stage and describe their function. Describe the gas parameter changes in a compressor stage. Define the term pressure ratio and state its order of magnitude for a centrifugal compressor stage and for an axial compressor stage. State the advantage of a double stage centrifugal compressor. List the advantages and disadvantages of a centrifugal compressor compared with an axial type. State that some engines use both axial and centrifugal compressors. Explain the convergent air annulus through an axial compressor. State the entrance and the outlet velocity of an axial compressor stage. State that axial compressors have pressure ratios of up to 35 and outlet temperatures of up to 600°C. Describe the reason for twisting the compressor blades with the aid of velocity triangles. State the task of inlet guide vanes. State the reason for the clicking noise if the compressor rotates on the ground, e.g. due to windmilling. Describe the two (and three) shaft compressor design in modern engines and its principle, and list its advantages. Define the terms ‘compressor stall’ and ‘surge’						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the following conditions are causes for stall and surge						
	rapid increase in fuel flow during increase of RPM						
	low engine RPM, e.g. idle						
	strong crosswind on ground						
	engine air inlet icing						
	contaminated or damaged compressor blades						
	damaged engine air inlet						
	Describe, in full, the following indications of stall and surge						
	thrust loss						
	abnormal engine noise						
	vibrations						
	RPM variations						
	increased EGT						
	sometimes burning gas out of inlet and exhaust						
	List the actions to be taken by the pilot in the case of surge.						
	Describe the design features used to minimize the occurrence of stall and surge as variable inlet guidevanes, VIGV.variable stator vanesVSV and variable by-pass valves VBV or more then two axis.						
	State measures taken by the pilot to prevent stall and surge.						
	Describe a compressor map (surge envelope) with RPM-lines, stall limit, steady state line and acceleration line.						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Diffuser Describe the function of the diffuser.						
021 11 04 03	Combustion chamber - Types, design, operation, components and materials - Stresses and limitations - Emission problems	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define the task of the combustion chamber. List the requirements for combustion. Describe the principle of operation of the combustion chamber. State that the low flame front velocity is the reason for diffusing the airflow at the combustion chamber entrance. State the function of the swirler. Define the terms ‘primary airflow’ and ‘secondary airflow’ and explain their purpose. Explain the mixture ratios fuel: primary airflow and fuel: total airflow. Describe the change of the gas parameters (p,t,v) through the combustion chamber. State that the outlet temperature of the combustion chamber is between 1000°C and 1500°C. Name the main components of a combustion chamber and their tasks. Describe the following combustion chamber systems and state the differences between them: can or mutiple can can-annular or tubo-annular annular reverse-flow annular Describe the principle of operation of the different fuel spray nozzles.						
021 11 04 04	Turbine - Types, design, operation, components and materials - Stresses, creep and limitations	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain why the available engine thrust is limited by the turbine inlet temperature.						
	Explain the tasks of the turbine in single- and multi-shaft turbojets, turbofans and turboprops.						
	Explain the term free turbine or free power turbine.						
	Name the main components of a turbine stage and their function.						
	Describe the gas parameter (p,t,v) changes in a turbine stage.						
	Explain that stall does not occur in a turbine						
	Explain the divergent air annulus through an axial turbine.						
	Describe the principles of operation of impulse, reaction and impulse-reaction axial turbines.						
	Explain the divergent gasflow annulus through the turbine.						
	Describe turbine blade convection, impingement and film cooling.						
	Explain why there is high mechanical and thermal stress in the turbine blades and wheels.						
	State that turbine wheels and blades are submitted to creep.						
	Explain the positive influence of reduced thrust on turbines life.						
	Explain the term creep.						
	Explain the term seizure.						
	State that the exhaust gas temperature, measured after the high pressure turbine or after the low pressure turbine, is used to monitor the turbine stress.						
	Describe the effect of acceleration and deceleration on the EGT.						
	Explain the terms low and high cycle fatigue.						

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Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 11 04 05	Exhaust - Design, operation, materials - Noise reduction	x	x	x	x	x	
LO	Define the task of the jet pipe of the gas turbine engine. Specify the danger created by the high velocity exhaust gas. Explain the operating principle of the jet pipe. Describe the gas parameter changes and exhaust mach-numbers in both a convergent and a convergent-divergent nozzle. Define the term ‘choked exhaust nozzle’. Describe the two different exhaust nozzle systems of turbofan engines. Explain how engine exhaust noise can be reduced.						
021 11 04 06	Fuel control units - Types, operation, sensors	x	x	x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Identify the components of a gas turbine fuel system and describe their function with the help of a schematic fuel system: low pressure pump fuel heater fuel filter high pressure pump or Engine Driven Fuel Pump fuel control unit high pressure shut off valve pressurization and dump valve fuel injector nozzles Name the two types of high pressure pump, both driven by the engine high pressure shaft. Define the tasks and describe the operating principle of the fuel control unit. Identify the input signals for the fuel control unit. Name the different types of fuel control units as hydromechanical MEC, PMS or PMC and FADEC. Name the controls and indicators of the fuel system.						
021 11 04 07	Helicopter: Air intake - Different types, design, operation, materials, optional equipments			x	x	x	
LO	Name the most important task of the engine air intake.						
	Describe the use of a convergent air intake ducting on helicopters.						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Describe the reasons for and the dangers of the following operational problems concerning the engine air intake: • Airflow separations • Intake icing • Intake damage • Foreign object damage • Heavy in flight turbulence						
	Describe the conditions and circumstances during ground operations when foreign object damage is most likely to occur.						
	Describe and understand the principals of air intake filter systems that can be fitted to some helicopters for operation in icing and sand conditions.						
	Describe the function of the heated pads on some helicopter air intakes.						
021 11 05 00	**Additional components and systems**						
021 11 05 01	Aeroplane: Additional components and systems: - Lubrication system, ignition circuit, starter, accessory gearbox: design, operation, components - Thrust reverser: design, operation, components and materials	x	x				

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Lubrication						
	State that avery ax is fitted with a ball bearing and two or more roller bearings						
	State that these bearings are fitted in bearing sumps.						
	State that the bearings need cooling oil						
	Explain the use of compressor air and labyrinth system to prevent the oil from leaking out of the sump						
	Explain that the oil is cooled by a fuel heater that cools the oil						
	Name the type of oil used in gas turbine engines.						
	Describe the tasks of the lubrication system.						
	Name the components of a gas turbine engine lubrication system and describe their tasks with the aid of a system schematic:						
	oil tank						
	pressure pump						
	oil cooler (fuel/oil heat exchanger)						
	oil filter						
	return pumps						
	sump						
	seals						
	magnetic chip detectors						
	centrifugal breather						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	scavenge pump Identify the normal/abnormal indications used to monitor the lubrication system. Explain the problems caused by internal leakage in the fuel/oil heat exchanger. Explain the problems caused by oil filter clogging stating the possible reasons, indications, and consequences explain the possible problems when the oilcooler is placed downstream of the EDFP						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Auxiliary Gearbox Define the tasks of the auxiliary gearbox. Describe how the auxiliary gear is normally connected with the high pressure shaft of the engine. Engine Systems Ignition Name the components of a gas turbine ignition system with the help of a schematic ignition system. Describe the function of the components energy source igniter plugs start lever / eng. master switch start switch / eng. start selector / ign. selector Name the different modes of operation of the ignition system and state when they are used ground start in-flight start continuous ignition automatic ignition						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Starter Explain the principle of a turbine engine start. Describe the following types of starters electric pneumatic Describe a typical start sequence for a two-spool turbofan engine with an air starter. Define the self sustaining speed and state its order of magnitude as approx. 30% N2 State the idle speeds as approx. 60% N2 and approx. 25% N1. Engine Start Malfunctions Describe an in-flight restart. Describe the causes, indications and actions in the case of a false (dry or wet) start, hot start, hung (abortive) start and no N1 rotation.						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Reverse Thrust Describe the principle of thrust reversal. List the occasions where reverse thrust may be required during operations. Identify the advantage and disadvantage of using reverse thrust during normal operations. Describe the operating problems which may occur when using reverse thrust, and explain what measures may be taken by the pilot to reduce these problems. Describe the following reverser types: 'clamshell', 'external' and 'blocker door'. Explain the loss of reverse thrust bu using only cold stream reversal Explain the possibitity of preselectionExplain the function of the flight-ground switch for high and low mounted engines. Identify pneumatically-, hydraulically- and mechanically-driven thrust reversers. Describe the control levers, their operation and the monitor lights provided for reverse thrust. Discuss advantages and disadvantages of use of turbine reversers on high bypass ratio jet engines						
021 11 05 02	Helicopter: Additional components and systems: - Lubrication system, ignition circuit, starter, accessory gearbox, free wheel units: design, operation, components			x	x	x	
LO	Understand and list the common helicopter lubrication system and name the components from a diagram: reservoir, pump assembly, external oil filter, magnetic chip detectors, electronic chip detectors, thermostatic oil coolers, breather and indentify the indications used to monitor the system including warning systems.						
	Understand the differences and appropriate use of straight oil and compound oil and describe the oil numbering system for aviation use.						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Understand and describe the ignition circuit for engine start and engine re-light facility when the selection is set forboth automatic and manual functions.						
	Understand and describe the starter motor and the sequence of events when starting, for most helicopters the starter becomes the generator after the starting sequence is over.						
	Understand the priciples of taking drive from the engine and through the accessory gearbox						
	Understand the various accessory gearbox assemblies and explain the function of various types of free wheel units.						
021 11 06 00	**Performance aspects**						
021 11 06 01	Thrust, performance aspects, engine handling and limitations: - Engine ratings - Engine performance and limitations - Engine handling	x	x				
LO	Thrust State the idle values of RPM and thrust as approx. 25% N1 and 5% of takeoff thrust. Describe the variation of thrust and specific fuel consumption with altitude. Describe the variation of thrust with outside air temperature and humidity. Describe the variation of thrust and specific fuel consumption with TAS and altitude for turbojets, turbofans and turboprops with the help of the simple thrust equation. Define the term ‘engine pressure ratio’ (EPR). Interpret the term flat rated engine by describing the change of take-off thrust, turbine inlet temperature engine RPM with OAT and thrust lever position. Define the term ‘engine thrust rating’. Discuss use of reduced and derated thrust, advantages and disadvantages						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Powerplant Operation and Monitoring	x	x	x	x	x	
	Name all engine ratings (takeoff, go-around, max. continuous, max. climb, max. cruise) and their use during operation.						
	Distinguish between ground idle and flight idle by stating the reasons for the differences (short acceleration time, bleed air supply).						
	Describe how thrust/power are controlled in turbojet, turbofan and turboprop engines.						
	Describe the terms α-range and β-range of the turboprop power lever.						
	Describe the differences in thrust lever operation between FADEC and non-FADEC equipped aircraft.						
	Name the turbofan engine monitoring instruments and state their use.						
	Explain the term trending						
	Name the turboprop engine monitoring instruments and state their use.						
021 11 06 02	Torque, performance aspects, engine handling and limitations: - Engine ratings - Engine performance and limitations - Engine handling			x	x	x	

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Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Performance and Thrust augmentation Describe the operating principle of an afterburner. Describe the operating principle of a water/methanol injection system, its purpose and the different points of injection. Bleed Air Explain the different functions of bleed air. Describe the effects of bleed air extraction on RPM, EGT, thrust, EGT and specific fuel consumption. Describe the function and the working principle of the Active Clearance Control system. Identify situations in which the cabin air bleeds need to be closed. Name the possibility of bleedless aeroplanes						
021 11 07 00	**Auxiliary Power Unit (APU)**						
021 11 07 01	Design, operation, functions, operational limitations	x	x	x	x		
LO	Explain the operating principle of the auxiliary power unit (APU) and list its tasks. State that the APU is able to generate electric and pneumatic power. State that the APU usually provides power on the ground when the engines are shut down, but also can be used to provide emergency power during flight, especially for ETOPS operations. Define maximum operating and maximum starting altitude. Describe how an APU is protected against overloading at high altitudes. Name the typical APU controls and monitoring instruments. Describe the APU's automatic shut-down protection in case of malfunctions.						
021 12 00 00	**PROTECTION AND DETECTION SYSTEMS**						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 12 01 00	**Smoke detection**						
021 12 01 01	Types, design, operation, indications and warnings	x	x	x	x	x	
LO	Name the different locations where smoke detectors have to be, or may be additionally, installed. Explain the basic operating principle of the different smoke detection systems Describe the smoke warning system operation, warnings, indications and function tests. Explain why smoke warning systems are sometimes subject to false warnings.						
021 12 02 00	**Fire protection systems**						
021 12 03 01	Types, design, operation, indications and warnings	x	x	x	x	x	
LO	Explain the operating principle of a built-in fire extinguishing system and describe its components. Describe the operation, the extinguishing agent, the indications and the function test of a fire extinguishing system. List the different fire extinguishing agents and their use at different types of fire.						
021 12 03 00	**Fire detection systems**						
021 12 03 01	Types, design, operation, indications and warnings	x	x	x	x	x	
LO	State the locations in an aircraft, where fire detection systems have to be installed. State locations where fire detection systems could be additionally installed. Explain the operating principle of the different fire detection sensors. Describe the fire warning system operation, its warnings, its indications and function tests.						
021 13 00 00	**OXYGEN SYSTEMS**						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	State the reasons why oxygen systems are required on transport aircraft. State which type of aircraft must be equipped with oxygen systems and list the regulations when it has to be used.						
021 13 01 00	**Aeroplane: Oxygen systems**						
021 13 01 01	Crew systems: types, operation, components	x	x				
LO	Explain the basic operating principle of a cockpit oxygen system. Describe the operation of cockpit oxygen masks.						
021 13 01 02	Passenger systems: types, operation, components	x	x				
LO	Explain the basic operating principles of the two types of passenger oxygen systems. Describe the actuation methods for passenger oxygen. Identify the fire and explosion danger in relation to the use of oxygen and name the safety precautions State the regulation about accessibility of emergency exits during aircraft operation. Describe the operation of doors and emergency exits. Name the maximum time allowed to open the doors and emergency exits. Describe the inside and outside markings of doors and emergency exits. State the purpose of floor exit markings. State the regulation about passenger evacuation time through the emergency exits. Describe the use and operation of evacuation slides.						
	Identify typical locations of life jackets and life rafts and describe their operation. Describe the operation of emergency locator beacons / transmitters and their endurance.						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 13 02 00	**Helicopter: Oxygen systems**						
021 13 02 01	Crew systems: types, operation, components			x	x	x	
LO	Understand the requirement for the helicopter to be equipped and capable of storing and dispensing supplemental oxygen supplies when operating over 10,000 feet.						
	Describe how the serviceability checks of the oxygen supply system are carried out.						
021 14 00 00	**HELICOPTER: MISCELLANEOUS SYSTEMS**						
021 14 01 00	**Noise protection**						
LO	To be Defined						
021 14 02 00	**Variable rotor speed**			x	x	x	
LO	Understand and describe the procedure for bleeping the NR an extra 3% or 4% to enable a safer take-off in Category A helicopters.						
	Understand and describe the operational procedure when pilots in certain helicopters can bleep the NR an extra 4% when manouevering, landing and taking-off, normally at higher altitudes, to obtain extra tail rotor thrust , which makes manouevering more positive and safer						
021 14 04 00	**Active vibration suppression**			x	x	x	
LO	Understand and describe how the active vibration suppression system works through high speed actuators and accelerometer inputs						
021 15 00 00	**HELICOPTER: ROTOR HEADS**						
021 15 01 00	**Main rotor**						
021 15 01 01	Types			x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the following rotor head systems • Rigid • Semi-regid • Fully articulated						
	Understand the following configuration of rotor systems and their advantages and disadvantages: • Tandem • Coaxial • Side by side						
	Explain how flapping, dragging and feathering is achieved in each rotor head system.						
021 15 01 02	Structural components and materials, stresses, structural limitations			x	x	x	
LO	List from a diagram the main structural components of the three main types of rotor head.						
	Understand and descibe the materials used and learn how to detect damage and stresses.						
	Understand and describe the structural limitations to respective rotor systems, including the dangers of negitive G inputs to certain rotor head systems.						
	Describe the various rotor head lubrication methods.						
021 15 01 03	Design and construction			x	x	x	

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Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the material technology used in rotor head design, including construction using the following materials or mixture of materials: • Composites • Fibreglass • Alloys • Elastometrics						
021 15 01 04	Adjustment			x	x	x	
LO	Understand the methods of adjustment which are possible on various helicoper rotor head assemblies.						
021 15 02 00	**Tail rotor**						
021 15 02 01	Types			x	x	x	
LO	Describe the following tail rotor systems • Delta 3 hinge • Multi bladed delta 3 effect • Fenestron or ducted fan tail rotor • No TAil Rotor (NOTAR) High velocity air jet flows from adjustable nozzles						
021 15 02 02	Structural components and materials, stresses, structural limitations			x	x	x	
LO	List from a diagram the main structural components of the four main types of tail rotor system						
	Understand and descibe the materials used and learn how to detect damage and stresses on the tailrotor and assembly.						
	Understand and describe the structural limitations to the respective tail rotor systems and possible limitations regarding the turn rate.						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Understand and describe the methods helicopter designers use to minimise tail rotor drift and roll. • Reducing the couple arm (tail rotor on a pylon) • Off setting the rotor mast • Use of “bias” in cyclic control mechanisim						
	Explain Pitch input mechanisms						
	Explain the relationship between tail rotor thrust and engine power						
	Understand how the virtical fin on some helicopters reduces the power demand of the fenestron						
021 15 02 03	Design and construction			x	x	x	
LO	Understand the varous tail rotor designs and construction methods used on current helicopters in service						
021 15 02 04	Adjustment			x	x	x	
LO	Understand the rigging and adjustment of the tail rotor system to obtain optimum position of the pilots’ yaw pedals						
021 16 00 00	**HELICOPTER: TRANSMISSION**						
021 16 01 00	**Main gear box**						
021 16 01 01	Different types, design, operation, limitations			x	x	x	
LO	Describe the main principals of helicopter transmission systems for single, twin and three engine helicopters: • Drive for the main and tail rotor • Accessory Drive for the generator/s alternator/s, hydraulic and oil pumps, oil cooler/s and tachometers						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	Understand the reason for limitations on multi engine helicopter transmissions in various engine out situations.						
	Understand how the passive vibration control works with gearbox mountings on some helicopter types.						
021 16 02 00	**Rotor brake**						
021 16 02 01	Different types, design, operation, limitations			x	x	x	
LO	Describe the function of the main types of rotor brake: Drum and Disc type.						
	Describe both hydrualic and cable operated systems.						
	Describe the different options for the location of the brake.						
	List the operational consideration for the use of rotorbrakes: • Rotor speed at engagement of rotor brake • Risk of blade sailing in windy conditions • Risk of rotor brake over heating and possible fire when brake is applied above the maximum limit , particularly when exposed hydrualic fluid is present.. • Avoid stopping blades over jet pipe exhaust with engine running • Cockpit annunciation of rotorbrake operation						
021 16 03 00	**Auxiliary systems**			x	x	x	
LO	Understand how the drive is taken off the auxiliary gear box for the Hoist/ Winch on some larger helicopters						
	Understand how the drive for the airconditioning system is taken off the auxiliary gear box on some helicopters						
021 16 04 00	**Drive shaft and associated installation**			x	x	x	

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe how drive is transmitted from the engine to the main rotor gearbox.						
	Describe the material and construction of the drive shaft.						
	Explain the need for alignment between the engine and the main rotor gearbox.						
	Indentify how temporary misalignment occurs between driving and driven components.						
	Explain the use of: • Flexable couplings • Thomas couplings • Flexible disc packs • Driveshaft support bearings and temparature measurement						
	Explain the relationship between the driveshaft speed and torque.						
	Describe the methods in which drive is delivered to the tail rotor.						
	Describe and indentify the construction and materials of tail rotor/fenistrons driveshafts.						
021 16 05 00	**Intermediate and tail gear box**						
021 16 05 01	Different types, design, operation, limitations			x	x	x	
LO	Understand and describe the various arrangements when the drive takes a different direction and the need for an intermediate gear box is necessary.						
	Understand the lubrication requirements for intermediate and tail rotor gear box and methods of checking levels.						
	Understand how on most helicopters the tail rotor gear box contains gearing etc for the tail rotor pitch change mechanism.						
021 17 00 00	**HELICOPTER: BLADES**						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 17 01 00	**Main rotor blade**						
021 17 01 01	Design, construction			x	x	x	
LO	Describe the different type of blade construction and the need for the following: • Good Lift Drag ratio • A symmeteric aerofoil (small piching moment) • Torsional stiffness						
LO	List the reasons for washout, taper and blade thickness.						
LO	Understand the principals of heating systems/pads on some blades for anti/de-icing.						
021 17 01 02	Structural components and materials			x	x	x	
LO	List the materials used in the construction of blades.						
	List the main structural components of a blade and their function.						
021 17 01 03	Stresses			x	x	x	
LO	Describe the blade loading on the ground and in flight.						
	Understand where the most common stress areas are on rotorblades.						
021 17 01 04	Structural limitations			x	x	x	
LO	Understand the structural limitations in terms of bending and rotor RPM.						
021 17 01 05	Adjustment			x	x	x	
LO	Explain the use of the trim tab.						
021 17 01 06	Tip shape			x	x	x	
LO	Understand the various tip shapes used by different manufacturers and explain the possible advantages of some designs						

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		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
021 17 02 00	**Tail rotor blade**						
021 17 02 01	Design, construction			x	x	x	
	Understand and describe the function of the two main tail rotor.						
021 17 02 02	Structural components and materials			x	x	x	
LO	List the materials used in the construction of blades.						
	List the main structural components of a blade and their function.						
021 17 02 03	Stresses			x	x	x	
LO	Describe the blade loading on the ground and in flight.						
021 17 02 04	Structural limitations			x	x	x	
LO	Understand the structural limitations of the tail rotor blade.						
021 17 02 05	Adjustment			x	x	x	
LO	Understand the adjustment of yaw pedals to obtain optimum control positions for tail rotor control.						