FCL.215 Theoretical knowledge examination

Regulation (EU) 2020/359

Applicants for a PPL shall demonstrate a level of theoretical knowledge appropriate to the privileges granted through examinations in the following subjects:

(a) common subjects:

- Air law,
- Human performance,
- Meteorology,
- Communications, and
- Navigation.

(b) specific subjects concerning the different aircraft categories:

- Principles of flight,
- Operational procedures,
- Flight performance and planning, and
- Aircraft general knowledge.

AMC1 FCL.210; FCL.215 Training course and theoretical knowledge examination

ED Decision 2020/005/R

SYLLABUS OF THEORETICAL KNOWLEDGE FOR THE PPL(A) AND PPL(H)

The following tables contain the syllabi for the courses of theoretical knowledge, as well as for the theoretical knowledge examinations for the PPL(A) and PPL(H). The training and examination should cover aspects related to non-technical skills in an integrated manner, taking into account the particular risks associated to the licence and the activity.

The DTO or the ATO responsible for the training should check if all the appropriate elements of the training course of theoretical knowledge instruction have been completed to a satisfactory standard before recommending the applicant for the examination.

The applicable items for each licence are marked with ‘x’. An ‘x’ on the main title of a subject means that all the sub-divisions are applicable.

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
1.	**AIR LAW AND ATC PROCEDURES**				
	International law: conventions, agreements and organisations				
	The Convention on international civil aviation (Chicago) Doc. 7300/6				
	Part I Air Navigation: relevant parts of the following chapters: (a) general principles and application of the convention; (b) flight over territory of Contracting States; (c) nationality of aircraft; (d) measures to facilitate air navigation; (e) conditions to be fulfilled on aircraft; (f) international standards and recommended practices; (g) validity of endorsed certificates and licences; (h) notification of differences.	x		x	
	Part II The International Civil Aviation Organisation (ICAO): objectives and composition	x		x	
	Annex 8: Airworthiness of aircraft				
	Foreword and definitions	x		x	
	Certificate of airworthiness	x		x	
	Annex 7: Aircraft nationality and registration marks				
	Foreword and definitions	x		x	
	Common- and registration marks	x		x	
	Certificate of registration and aircraft nationality	x		x	
	Annex 1: Personnel licensing				
	Definitions	x		x	
	Relevant parts of Annex 1 connected to Part-FCL and Part-Medical	x		x	
	Annex 2: Rules of the air				
	Essential definitions, applicability of the rules of the air, general rules (except water operations), visual flight rules, signals and interception of civil aircraft	x		x	
	Procedures for air navigation: aircraft operations doc. 8168-ops/611, volume 1				
	Altimeter setting procedures (including IACO doc. 7030 – regional supplementary procedures)				
	Basic requirements (except tables), procedures applicable to operators and pilots (except tables)	x		x	
	Secondary surveillance radar transponder operating procedures (including ICAO Doc. 7030 – regional supplementary procedures)				
	Operation of transponders	x		x	
	Phraseology	x		x	
	Annex 11: Doc. 4444 air traffic management				
	Definitions	x		x	
	General provisions for air traffic services	x		x	
	Visual separation in the vicinity of aerodromes	x		x	
	Procedures for aerodrome control services	x		x	
	Radar services	x		x	
	Flight information service and alerting service	x		x	
	Phraseologies	x		x	
	Procedures related to emergencies, communication failure and contingencies	x		x	

		Aeroplane		Helicopter	
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	Annex 15: Aeronautical information service				
	Introduction, essential definitions	x		x	
	AIP, NOTAM, AIRAC and AIC	x		x	
	Annex 14, volume 1 and 2: Aerodromes				
	Definitions	x		x	
	Aerodrome data: conditions of the movement area and related facilities	x		x	
	Visual aids for navigation: (a) indicators and signalling devices; (b) markings; (c) lights; (d) signs; (e) markers.	x		x	
	Visual aids for denoting obstacles: (a) marking of objects; (b) lighting of objects.	x		x	
	Visual aids for denoting restricted use of areas	x		x	
	Emergency and other services: (a) rescue and fire fighting; (b) apron management service.	x		x	
	Annex 12: Search and rescue				
	Essential definitions	x		x	
	Operating procedures: (a) procedures for PIC at the scene of an accident; (b) procedures for PIC intercepting a distress transmission; (c) search and rescue signals.	x		x	
	Search and rescue signals: (a) signals with surface craft; (b) ground or air visual signal code; (c) air or ground signals.	x		x	
	Annex 17: Security				
	General: aims and objectives	x		x	
	Annex 13: Aircraft accident investigation				
	Essential definitions	x		x	
	Applicability	x		x	
	National law				
	National law and differences to relevant ICAO Annexes and relevant EU regulations.	x		x	
2.	**HUMAN PERFORMANCE**				
	Human factors: basic concepts				
	Human factors in aviation				
	Becoming a competent pilot	x		x	
	Basic aviation physiology and health maintenance				
	The atmosphere: (a) composition; (b) gas laws.	x		x	

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	Respiratory and circulatory systems: (a) oxygen requirement of tissues; (b) functional anatomy; (c) main forms of hypoxia (hypoxic and anaemic): (1) sources, effects and countermeasures of carbon monoxide; (2) counter measures and hypoxia; (3) symptoms of hypoxia. (d) hyperventilation; (e) the effects of accelerations on the circulatory system; (f) hypertension and coronary heart disease.	x		x	
	Man and environment				
	Central, peripheral and autonomic nervous systems	x		x	
	Vision: (a) functional anatomy; (b) visual field, foveal and peripheral vision; (c) binocular and monocular vision; (d) monocular vision cues; (e) night vision; (f) visual scanning and detection techniques and importance of 'look-out'; (g) defective vision.	x		x	
	Hearing: (a) descriptive and functional anatomy; (b) flight related hazards to hearing; (c) hearing loss.	x		x	
	Equilibrium: (a) functional anatomy; (b) motion and acceleration; (c) motion sickness.	x		x	
	Integration of sensory inputs: (a) spatial disorientation: forms, recognition and avoidance;	x		x	
	(b) illusions: forms, recognition and avoidance: (1) physical origin; (2) physiological origin; (3) psychological origin. (c) approach and landing problems.				
	Health and hygiene				
	Personal hygiene: personal fitness	x		x	
	Body rhythm and sleep: (a) rhythm disturbances; (b) symptoms, effects and management.	x		x	
	Problem areas for pilots: (a) common minor ailments including cold, influenza and gastro-intestinal upset; (b) entrapped gases and barotrauma, (scuba diving); (c) obesity; (d) food hygiene; (e) infectious diseases; (f) nutrition; (g) various toxic gases and materials.	x		x	

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	Intoxication:	x		x	
	(a) prescribed medication; (b) tobacco; (c) alcohol and drugs; (d) caffeine; (e) self-medication.				
	Basic aviation psychology				
	Human information processing				
	Attention and vigilance: (a) selectivity of attention; (b) divided attention.	x		x	
	Perception: (A) perceptual illusions; (B) subjectivity of perception; (C) processes of perception.	x		x	
	Memory: (a) sensory memory; (b) working or short term memory; (c) long term memory to include motor memory (skills).	x		x	
	Human error and reliability				
	Reliability of human behaviour	x		x	
	Error generation: social environment (group, organisation)	x		x	
	Decision making				
	Decision-making concepts:	x		x	
	(a) structure (phases);				
	(b) limits; (c) risk assessment; (d) practical application.				
	Avoiding and managing errors: cockpit management				
	Safety awareness: (a) risk area awareness; (b) situational awareness.	x		x	
	Communication: verbal and non-verbal communication	x		x	
	Human behaviour				
	Personality and attitudes: (a) development; (b) environmental influences.	x		x	
	Identification of hazardous attitudes (error proneness)	x		x	
	Human overload and underload				
	Arousal	x		x	
	Stress: (a) definition(s); (b) anxiety and stress; (c) effects of stress.	x		x	
	Fatigue and stress management: (a) types, causes and symptoms of fatigue; (b) effects of fatigue; (c) coping strategies; (d) management techniques; (e) health and fitness programmes;	x		x	

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3.	**METEOROLOGY**				
	The atmosphere				
	Composition, extent and vertical division				
	Structure of the atmosphere	x		x	
	Troposphere	x		x	
	Air temperature				
	Definition and units	x		x	
	Vertical distribution of temperature	x		x	
	Transfer of heat	x		x	
	Lapse rates, stability and instability	x		x	
	Development of inversions and types of inversions	x		x	
	Temperature near the earth's surface, surface effects, diurnal and seasonal variation, effect of clouds and effect of wind	x		x	
	Atmospheric pressure				
	Barometric pressure and isobars	x		x	
	Pressure variation with height	x		x	
	Reduction of pressure to mean sea level	x		x	
	Relationship between surface pressure centres and pressure centres aloft	x		x	
	Air density				
	Relationship between pressure, temperature and density	x		x	
	ISA				
	ICAO standard atmosphere	x		x	
	Altimetry				
	Terminology and definitions	x		x	
	Altimeter and altimeter settings	x		x	
	Calculations	x		x	
	Effect of accelerated airflow due to topography	x		x	
	Wind				
	Definition and measurement of wind				
	Definition and measurement	x		x	
	Primary cause of wind				
	Primary cause of wind, pressure gradient, coriolis force and gradient wind	x		x	
	Variation of wind in the friction layer	x		x	
	Effects of convergence and divergence	x		x	
	General global circulation				
	General circulation around the globe	x		x	
	Local winds				
	Anabatic and katabatic winds, mountain and valley winds, Venturi effects, land and sea breezes	x		x	
	Mountain waves (standing waves, lee waves)				
	Origin and characteristics	x		x	
	Turbulence				
	Description and types of turbulence	x		x	
	Formation and location of turbulence	x		x	
	THERMODYNAMICS				
	Humidity				
	Water vapour in the atmosphere	x		x	
	Mixing ratio	x		x	

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	Temperature/dew point, relative humidity	x		x	
	Change of state of aggregation				
	Condensation, evaporation, sublimation, freezing and melting, latent heat	x		x	
	Adiabatic processes				
	Adiabatic processes, stability of the atmosphere	x		x	
	CLOUDS AND FOG				
	Cloud formation and description				
	Cooling by adiabatic expansion and by advection	x		x	
	Cloud types and cloud classification	x		x	
	Influence of inversions on cloud development	x		x	
	Fog, mist, haze				
	General aspects	x		x	
	Radiation fog	x		x	
	Advection fog	x		x	
	Steaming fog	x		x	
	Frontal fog	x		x	
	Orographic fog (hill fog)	x		x	
	PRECIPITATION				
	Development of precipitation				
	Processes of development of precipitation	x		x	
	Types of precipitation				
	Types of precipitation, relationship with cloud types	x		x	
	AIR MASSES AND FRONTS				
	Air masses				
	Description, classification and source regions of air masses	x		x	
	Modifications of air masses	x		x	
	Fronts				
	General aspects	x		x	
	Warm front, associated clouds, and weather	x		x	
	Cold front, associated clouds, and weather	x		x	
	Warm sector, associated clouds, and weather	x		x	
	Weather behind the cold front	x		x	
	Occlusions, associated clouds, and weather	x		x	
	Stationary front, associated clouds, and weather	x		x	
	Movement of fronts and pressure systems, life cycle	x		x	
	Changes of meteorological elements at a frontal wave	x		x	
	PRESSURE SYSTEMS				
	Anticyclone				
	Anticyclones, types, general properties, cold and warm anticyclones, ridges and wedges, subsidence	x		x	
	Non-frontal depressions				
	Thermal, orographic and polar depressions, troughs	x		x	
	CLIMATOLOGY				
	Climatic zones				
	General seasonal circulation in the troposphere	x		x	
	Typical weather situations in the mid-latitudes				
	Westerly situation	x		x	
	High-pressure area	x		x	
	Flat-pressure pattern	x		x	

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	Local winds and associated weather				
	e.g. Foehn	x		x	
	FLIGHT HAZARDS				
	Icing				
	Conditions for ice accretion	x		x	
	Types of ice accretion	x		x	
	Hazards of ice accretion, avoidance	x		x	
	Turbulence				
	Effects on flight, avoidance	x		x	
	Wind shear				
	Definition of wind shear	x		x	
	Weather conditions for wind shear	x		x	
	Effects on flight, avoidance	x		x	
	Thunderstorms				
	Conditions for, and process of, development, forecast, location, type specification	x		x	
	Structure of thunderstorms, life cycle, squall lines, electricity in the atmosphere, static charges	x		x	
	Electrical discharges				
	Development and effects of downbursts	x		x	
	Thunderstorm avoidance	x		x	
	Inversions				
	Influence on aircraft performance	x		x	
	Hazards in mountainous areas				
	Influence of terrain on clouds and precipitation, frontal passage	x		x	
	Vertical movements, mountain waves, wind shear, turbulence, ice accretion	x		x	
	Development and effect of valley inversions	x		x	
	Visibility-reducing phenomena				
	Reduction of visibility caused by precipitation and obscuration	x		x	
	Reduction of visibility caused by other phenomena	x		x	
	METEOROLOGICAL INFORMATION				
	Observation				
	Surface observations	x		x	
	Radiosonde observations	x		x	
	Satellite observations	x		x	
	Weather radar observations	x		x	
	Aircraft observations and reporting	x		x	
	Weather charts				
	Significant weather charts	x		x	
	Surface charts	x		x	
	Information for flight planning				
	Aviation weather messages	x		x	
	Meteorological broadcasts for aviation	x		x	
	Use of meteorological documents	x		x	
	Meteorological warnings	x		x	
	Meteorological services				
	World area forecast system (WAFS) and meteorological offices	x		x	

		Aeroplane		Helicopter	
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4.	**COMMUNICATIONS**				
	VFR COMMUNICATIONS				
	Definitions				
	Meanings and significance of associated terms	x		x	
	ATS abbreviations	x		x	
	Q-code groups commonly used in RTF airground communications	x		x	
	Categories of messages	x		x	
	General operating procedures				
	Transmission of letters	x		x	
	Transmission of numbers (including level information)	x		x	
	Transmission of time	x		x	
	Transmission technique	x		x	
	Standard words and phrases (relevant RTF phraseology included)	x		x	
	R/T call signs for aeronautical stations including use of abbreviated call signs	x		x	
	R/T call signs for aircraft including use of abbreviated call signs	x		x	
	Transfer of communication	x		x	
	Test procedures including readability scale	x		x	
	Read back and acknowledgement requirements	x		x	
	Relevant weather information terms (VFR)				
	Aerodrome weather	x		x	
	Weather broadcast	x		x	
	Action required to be taken in case of communication failure	x		x	
	Distress and urgency procedures				
	Distress (definition, frequencies, watch of distress frequencies, distress signal and distress message)	x		x	
	Urgency (definition, frequencies, urgency signal and urgency message)	x		x	
	General principles of VHF propagation and allocation of frequencies	x		x	
5.	**PRINCIPLES OF FLIGHT**				
5.1.	**PRINCIPLES OF FLIGHT: AEROPLANE**				
	Subsonic aerodynamics				
	Basics concepts, laws and definitions				
	Laws and definitions:	x	x		
	(a) conversion of units; (b) Newton´s laws; (c) Bernoulli's equation and venture; (d) static pressure, dynamic pressure and total pressure; (e) density; (f) IAS and TAS.				
	Basics about airflow: (a) streamline; (b) two-dimensional airflow; (c) three-dimensional airflow.	x	x		
	Aerodynamic forces on surfaces: (a) resulting airforce; (b) lift;	x	x		

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	(c) drag; (d) angle of attack.				
	Shape of an aerofoil section: (a) thickness to chord ratio; (b) chord line; (c) camber line; (d) camber; (e) angle of attack.	x	x		
	The wing shape: (a) aspect ratio; (b) root chord; (c) tip chord; (d) tapered wings; (e) wing planform.	x	x		
	The two-dimensional airflow about an aerofoil				
	Streamline pattern	x	x		
	Stagnation point	x	x		
	Pressure distribution	x	x		
	Centre of pressure	x	x		
	Influence of angle of attack	x	x		
	Flow separation at high angles of attack	x	x		
	The lift – α graph	x	x		
	The coefficients				
	The lift coefficient C_l: the lift formula	x	x		
	The drag coefficient C_d: the drag formula	x	x		
	The three-dimensional airflow round a wing and a fuselage				
	Streamline pattern: (a) span-wise flow and causes; (b) tip vortices and angle of attack; (c) upwash and downwash due to tip vortices; (d) wake turbulence behind an aeroplane (causes, distribution and duration of the phenomenon).	x	x		
	Induced drag: (a) influence of tip vortices on the angle of attack; (b) the induced local α; (c) influence of induced angle of attack on the direction of the lift vector; (d) induced drag and angle of attack.	x	x		
	Drag				
	The parasite drag: (a) pressure drag; (b) interference drag; (c) friction drag.	x	x		
	The parasite drag and speed	x	x		
	The induced drag and speed	x	x		
	The total drag	x	x		
	The ground effect				
	Effect on take off and landing characteristics of an aeroplane	x	x		

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	The stall				
	Flow separation at increasing angles of attack: (a) the boundary layer: (1) laminar layer; (2) turbulent layer; (3) transition. (b) separation point; (c) influence of angle of attack; (d) influence on: (1) pressure distribution; (2) location of centre of pressure; (3) $C_{L;}$ (4) $C_{D;}$ (5) pitch moments. (e) buffet; (f) use of controls.	x	x		
	The stall speed: (a) in the lift formula; (b) 1g stall speed; (c) influence of: (1) the centre of gravity; (2) power setting; (3) altitude (IAS); (4) wing loading; (5) load factor n: (i) definition; (ii) turns; (iii) forces.	x	x		
	The initial stall in span-wise direction: (a) influence of planform; (b) geometric twist (wash out); (c) use of ailerons.	x	x		
	Stall warning: (a) importance of stall warning; (b) speed margin; (c) buffet; (d) stall strip; (e) flapper switch; (f) recovery from stall.	x	x		
	Special phenomena of stall: (a) the power-on stall; (b) climbing and descending turns; (c) t-tailed aeroplane; (d) avoidance of spins: (1) spin development; (2) spin recognition; (3) spin recovery. (e) ice (in stagnation point and on surface): (1) absence of stall warning; (2) abnormal behaviour of the aircraft during stall.	x	x		

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	CL augmentation				
	Trailing edge flaps and the reasons for use in take-off and landing: (a) influence on C_L - α-graph; (b) different types of flaps; (c) flap asymmetry; (d) influence on pitch movement.	x	x		
	Leading edge devices and the reasons for use in take-off and landing	x	x		
	The boundary layer				
	Different types: (a) laminar; (b) turbulent.	x	x		
	Special circumstances				
	Ice and other contamination: (a) ice in stagnation point; (b) ice on the surface (frost, snow and clear ice); (c) rain; (d) contamination of the leading edge; (e) effects on stall; (f) effects on loss of controllability; (g) effects on control surface moment; (h) influence on high lift devices during takeoff, landing and low speeds.	x	x		
	Stability				
	Condition of equilibrium in steady horizontal flight				
	Precondition for static stability	x	x		
	Equilibrium: (a) lift and weight; (b) drag and thrust.	x	x		
	Methods of achieving balance				
	Wing and empennage (tail and canard)	x	x		
	Control surfaces	x	x		
	Ballast or weight trim	x	x		
	Static and dynamic longitudinal stability				
	Basics and definitions: (a) static stability, positive, neutral and negative; (b) precondition for dynamic stability; (c) dynamic stability, positive, neutral and negative.	x	x		
	Location of centre of gravity: (a) aft limit and minimum stability margin; (b) forward position; (c) effects on static and dynamic stability.	x	x		
	Dynamic lateral or directional stability				
	Spiral dive and corrective actions	x	x		
	Control				
	General				
	Basics, the three planes and three axis	x	x		
	Angle of attack change	x	x		
	Pitch control				
	Elevator	x	x		

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	Downwash effects	x	x		
	Location of centre of gravity	x	x		
	Yaw control				
	Pedal or rudder	x	x		
	Roll control				
	Ailerons: function in different phases of flight	x	x		
	Adverse yaw	x	x		
	Means to avoid adverse yaw: (a) frise ailerons; (b) differential ailerons deflection.	x	x		
	Means to reduce control forces				
	Aerodynamic balance: (a) balance tab and anti-balance tab; (b) servo tab.	x	x		
	Mass balance				
	Reasons to balance: means	x	x		
	Trimming				
	Reasons to trim	x	x		
	Trim tabs	x	x		
	Limitations				
	Operating limitations				
	Flutter	x	x		
	V_{fe}	x	x		
	V_{no}, V_{ne}	x	x		
	Manoeuvring envelope				
	Manoeuvring load diagram: (a) load factor; (b) accelerated stall speed; (c) V_a; (d) manoeuvring limit load factor or certification category.	x	x		
	Contribution of mass	x	x		
	Gust envelope				
	Gust load diagram	x	x		
	Factors contributing to gust loads	x	x		
	Propellers				
	Conversion of engine torque to thrust				
	Meaning of pitch	x	x		
	Blade twist	x	x		
	Effects of ice on propeller	x	x		
	Engine failure or engine stop				
	Windmilling drag	x	x		
	Moments due to propeller operation				
	Torque reaction	x	x		
	Asymmetric slipstream effect	x	x		
	Asymmetric blade effect	x	x		
	Flight mechanics				
	Forces acting on an aeroplane				
	Straight horizontal steady flight	x	x		
	Straight steady climb	x	x		
	Straight steady descent	x	x		

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	Straight steady glide	x	x		
	Steady coordinated turn: (a) bank angle; (b) load factor; (c) turn radius; (d) rate one turn.	x	x		
5.2.	**PRINCIPLES OF FLIGHT: HELICOPTER**				
	Subsonic aerodynamics				
	Basic concepts, laws and definitions			x	x
	Conversion of units			x	x
	Definitions and basic concepts about air:			x	x
	(a) the atmosphere and International Standard Atmosphere; (b) density; (c) influence of pressure and temperature on density.				
	Newton's laws: (a) Newton's second law: Momentum equation; (b) Newton's third law: action and reaction.			x	x
	Basic concepts about airflow: (a) steady airflow and unsteady airflow; (b) Bernoulli's equation; (c) static pressure, dynamic pressure, total pressure and stagnation point; (d) TAS and IAS; (e) two-dimensional airflow and three-dimensional airflow; (f) viscosity and boundary layer.			x	x
	Two-dimensional airflow			x	x
	Aerofoil section geometry: (a) aerofoil section; (b) chord line, thickness and thickness to chord ratio of a section; (c) camber line and camber; (d) symmetrical and asymmetrical aerofoils sections.			x	x
	Aerodynamic forces on aerofoil elements: (a) angle of attack; (b) pressure distribution; (c) lift and lift coefficient (d) relation lift coefficient: angle of attack; (e) profile drag and drag coefficient; (f) relation drag coefficient: angle of attack; (g) resulting force, centre of pressure and pitching moment.			x	x
	Stall: (a) boundary layer and reasons for stalling; (b) variation of lift and drag as a function of angle of attack; (c) displacement of the centre of pressure and pitching moment.			x	x
	Disturbances due to profile contamination: (a) ice contamination; (b) ice on the surface (frost, snow and clear ice).			x	x
	The three-dimensional airflow round a wing and a fuselage			x	x
	The wing:			x	x
	(a) planform, rectangular and tapered wings;				

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	(b) wing twist.				
	Airflow pattern and influence on lift:			x	x
	(a) span wise flow on upper and lower surface; (b) tip vortices; (c) span-wise lift distribution.				
	Induced drag: causes and vortices			x	x
	The airflow round a fuselage: (a) components of a fuselage; (b) parasite drag; (c) variation with speed.			x	x
	Transonic aerodynamics and compressibility effects				
	Airflow velocities			x	x
	Airflow speeds: (a) speed of sound; (b) subsonic, high subsonic and supersonic flows.			x	x
	Shock waves: (a) compressibility and shock waves; (b) the reasons for their formation at upstream high subsonic airflow; (c) their effect on lift and drag.			x	x
	Influence of wing planform: sweep-angle			x	x
	Rotorcraft types			x	x
	Rotorcraft			x	x
	Rotorcraft types: (a) autogyro; (b) helicopter.			x	x
	Helicopters			x	x
	Helicopters configurations: the single main rotor helicopter			x	x
	The helicopter, characteristics and associated terminology: (a) general lay-out, fuselage, engine and gearbox; (b) tail rotor, fenestron and NOTAR;			x	x
	(c) engines (reciprocating and turbo shaft engines); (d) power transmission;				
	(e) rotor shaft axis, rotor hub and rotor blades; (f) rotor disc and rotor disc area; (g) teetering rotor (two blades) and rotors with more than two blades;				
	(h) skids and wheels; (i) helicopter axes and fuselage centre line;				
	(j) roll axis, pitch axis and normal or yaw axis; (k) gross mass, gross weight and disc loading.				
	Main rotor aerodynamics			x	x
	Hover flight outside ground effect			x	x
	Airflow through the rotor discs and round the blades: (a) circumferential velocity of the blade sections; (b) induced airflow, through the disc and downstream; (c) downward fuselage drag; (d) equilibrium of rotor thrust, weight and fuselage drag; (e) rotor disc induced power; (f) relative airflow to the blade; (g) pitch angle and angle of attack of a blade section;			x	x

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	(h) lift and profile drag on the blade element; (i) resulting lift and thrust on the blade and rotor thrust; (j) collective pitch angle changes and necessity of blade feathering; (k) required total main rotor-torque and rotor-power; (l) influence of the air density.				
	Anti-torque force and tail rotor: (a) force of tail rotor as a function of main rotor-torque; (b) anti-torque rotor power; (c) necessity of blade feathering of tail rotor blades and yaw pedals.			x	x
	Maximum hover altitude OGE: (a) total power required and power available; (b) maximum hover altitude as a function of pressure altitude and OAT.			x	x
	Vertical climb			x	x
	Relative airflow and angles of attack:			x	x
	(a) climb velocity V_C, induced and relative velocity and angle of attack; (b) collective pitch angle and blade feathering.				
	Power and vertical speed: (a) induced power, climb power and profile power;			x	x
	(b) total main rotor power and main rotor torque;				
	(c) tail rotor power;				
	(d) total power requirement in vertical flight.				
	Forward flight			x	x
	Airflow and forces in uniform inflow distribution: (a) assumption of uniform inflow distribution on rotor disc; (b) advancing blade (90°) and retreating blade (270°); (c) airflow velocity relative to the blade sections, area of reverse flow; (d) lift on the advancing and retreating blades at constant pitch angles; (e) necessity of cyclic pitch changes; (f) compressibility effects on the advancing blade tip and speed limitations; (g) high angle of attack on the retreating blade, blade stall and speed limitations; (h) thrust on rotor disc and tilt of thrust vector; (i) vertical component of the thrust vector and gross weight equilibrium; (j) horizontal component of the thrust vector and drag equilibrium.			x	x
	The flare (power flight):			x	x
	(a) thrust reversal and increase in rotor thrust; (b) increase of rotor RPM on non governed rotor.				
	Power and maximum speed: (a) induced power as a function of helicopter speed; (b) rotor profile power as a function of helicopter speed; (c) fuselage drag and parasite power as a function of forward speed;			x	x

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	(d) tail rotor power and power ancillary equipment; (e) total power requirement as a function of forward speed; (f) influence of helicopter mass, air density and drag of additional external equipment;				
	(g) translational lift and influence on power required.				
	Hover and forward flight in ground effect			x	x
	Airflow in ground effect and downwash: rotor power decrease as a function of rotor height above the ground at constant helicopter mass			x	x
	Vertical descent			x	x
	Vertical descent, power on:			x	x
	(a) airflow through the rotor, low and moderate descent speeds; (b) vortex ring state, settling with power and consequences.				
	Autorotation: (a) collective lever position after failure; (b) up flow through the rotor, auto-rotation and anti-autorotation rings; (c) tail rotor thrust and yaw control; (d) control of rotor RPM with collective lever; (e) landing after increase of rotor thrust by pulling collective and reduction in vertical speed.			x	x
	Forward flight: Autorotation			x	x
	Airflow through the rotor disc: (a) descent speed and up flow through the disc; (b) the flare, increase in rotor thrust, reduction of vertical speed and ground speed.			x	x
	Flight and landing:			x	x
	(a) turning; (b) flare; (c) autorotative landing; (d) height or velocity avoidance graph and dead man's curve.				
	Main rotor mechanics			x	x
	Flapping of the blade in hover			x	x
	Forces and stresses on the blade: (a) centrifugal force on the blade and attachments; (b) limits of rotor RPM; (c) lift on the blade and bending stresses on a rigid attachment; (d) the flapping hinge of the articulated rotor and flapping hinge offset; (e) the flapping of the hinge less rotor and flexible element.			x	x
	Coning angle in hover:			x	x
	(a) lift and centrifugal force in hover and blade weight negligible (b) flapping, tip path plane and disc area.				
	Flapping angles of the blade in forward flight			x	x
	Forces on the blade in forward flight without cyclic feathering: (a) aerodynamic forces on the advancing and retreating blades without cyclic feathering;			x	x

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	(b) periodic forces and stresses, fatigue and flapping hinge; (c) phase lag between the force and the flapping angle (about 90°); (d) flapping motion of the hinged blades and tilting of the cone and flap back of rotor; (e) rotor disc attitude and thrust vector tilt.				
	Cyclic pitch (feathering) in helicopter mode, forward flight: (a) necessity of forward rotor disc tilt and thrust vector tilt; (b) flapping and tip path plane, virtual rotation axis or no flapping axis and plane of rotation; (c) shaft axis and hub plane; (d) cyclic pitch change (feathering) and rotor thrust vector tilt; (e) collective pitch change, collective lever, swash plate, pitch link and pitch horn; (f) cyclic stick, rotating swash plate and pitch link movement and phase angle.			x	x
	Blade lag motion			x	x
	Forces on the blade in the disc plane (tip path plane) in forward flight: (a) forces due to the Coriolis effect because of the flapping; (b) alternating stresses and the need of the drag or lag hinge.			x	x
	The drag or lag hinge: (a) the drag hinge in the fully articulated rotor; (b) the lag flexure in the hinge less rotor; (c) drag dampers.			x	x
	Ground resonance: (a) blade lag motion and movement of the centre of gravity of the blades and the rotor; (b) oscillating force on the fuselage; (c) fuselage, undercarriage and resonance.			x	x
	Rotor systems			x	x
	See-saw or teetering rotor			x	x
	Fully articulated rotor: (a) three hinges arrangement; (b) bearings and elastomeric hinges.			x	x
	Hinge less rotor and bearing less rotor			x	x
	Blade sailing: (a) low rotor RPM and effect of adverse wind; (b) minimising the danger;			x	x
	(c) droop stops.				
	Vibrations due to main rotor: (a) origins of the vibrations: in plane and vertical; (b) blade tracking and balancing.			x	x
	Tail rotors			x	x
	Conventional tail rotor			x	x
	Rotor description: (a) two-blades tail rotors with teetering hinge; (b) rotors with more than two blades; (c) feathering bearings and flapping hinges;			x	x

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	(d) dangers to people and to the tail rotor, rotor height and safety.				
	Aerodynamics: (a) induced airflow and tail rotor thrust; (b) thrust control by feathering, tail rotor drift and roll; (c) effect of tail rotor failure and vortex ring.			x	x
	The fenestron: technical lay-out			x	x
	The NOTAR: technical lay-out			x	x
	Vibrations: high frequency vibrations due to the tail rotors			x	x
	Equilibrium, stability and control			x	x
	Equilibrium and helicopter attitudes			x	x
	Hover: (a) forces and equilibrium conditions; (b) helicopter pitching moment and pitch angle; (c) helicopter rolling moment and roll angle.			x	x
	Forward flight: (a) forces and equilibrium conditions; (b) helicopter moments and angles; (c) effect of speed on fuselage attitude.			x	x
	Control			x	x
	Control power			x	x
	(a) fully articulated rotor; (b) hinge less rotor; (c) teetering rotor.				
	Static and dynamic roll over			x	x
	Helicopter performances Engine performances			x	x
	Piston engines:			x	x
	(a) power available; (b) effects of density altitude.				
	Turbine engines: (a) power available; (b) effects of ambient pressure and temperature.			x	x
	Helicopter performances			x	x
	Hover and vertical flight: (a) power required and power available; (b) OGE and IGE maximum hover height; (c) influence of AUM, pressure, temperature and density.			x	x
	Forward flight: (a) maximum speed; (b) maximum rate of climb speed; (c) maximum angle of climb speed; (d) range and endurance; (e) influence of AUM, pressure, temperature and density.			x	x
	Manoeuvring: (a) load factor; (b) bank angle and number of g's; (c) manoeuvring limit load factor.			x	x
	Special conditions: (a) operating with limited power; (b) over pitch and over torque.			x	x

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
6.	**OPERATIONAL PROCEDURES**				
	General				
	Operation of aircraft: ICAO Annex 6, General requirements				
	Definitions	x	x	x	x
	Applicability	x	x	x	x
	Special operational procedures and hazards (general aspects)	x	x	x	x
	Noise abatement				
	Noise abatement procedures	x	x	x	x
	Influence of the flight procedure (departure, cruise and approach)	x	x	x	x
	Runway incursion awareness (meaning of surface markings and signals)	x	x	x	x
	Fire or smoke				
	Carburettor fire	x	x	x	x
	Engine fire	x	x	x	x
	Fire in the cabin and cockpit, (choice of extinguishing agents according to fire classification and use of the extinguishers)	x	x	x	x
	Smoke in the cockpit and (effects and action to be taken) and smoke in the cockpit and cabin (effects and actions taken)	x	x	x	x
	Windshear and microburst				
	Effects and recognition during departure and approach	x	x	x	x
	Actions to avoid and actions taken during encounter	x	x	x	x
	Wake turbulence				
	Cause	x	x	x	x
	List of relevant parameters	x	x	x	x
	Actions taken when crossing traffic, during take-off and landing	x	x	x	x
	Emergency and precautionary landings				
	Definition	x	x	x	x
	Cause	x	x	x	x
	Passenger information	x	x	x	x
	Evacuation	x	x	x	x
	Action after landing	x	x	x	x
	Contaminated runways				
	Kinds of contamination	x	x		
	Estimated surface friction and friction coefficient	x	x		
	Rotor downwash			x	x
	Operation influence by meteorological conditions (helicopter)				
	White out, sand or dust			x	x
	Strong winds			x	x
	Mountain environment			x	x
	Emergency procedures				
	Influence by technical problems				
	Engine failure			x	x
	Fire in cabin, cockpit or engine			x	x
	Tail, rotor or directional control failure			x	x
	Ground resonance			x	x
	Blade stall			x	x
	Settling with power (vortex ring)			x	x
	Overpitch			x	x
	Overspeed: rotor or engine			x	x

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	Dynamic rollover			x	x
	Mast bumping			x	x
7.	**FLIGHT PERFORMANCE AND PLANNING**				
7.1.	**MASS AND BALANCE: AEROPLANES OR HELICOPTERS**				
	Purpose of mass and balance considerations				
	Mass limitations				
	Importance in regard to structural limitations	x	x	x	x
	Importance in regard to performance limitations	x	x	x	x
	CG limitations				
	Importance in regard to stability and controllability	x	x	x	x
	Importance in regard to performance	x	x	x	x
	Loading				
	Terminology				
	Mass terms	x	x	x	x
	Load terms (including fuel terms)	x	x	x	x
	Mass limits				
	Structural limitations	x	x	x	x
	Performance limitations	x	x	x	x
	Baggage compartment limitations	x	x	x	x
	Mass calculations				
	Maximum masses for take-off and landing	x	x	x	x
	Use of standard masses for passengers, baggage and crew	x	x	x	x
	Fundamentals of CG calculations				
	Definition of centre of gravity	x	x	x	x
	Conditions of equilibrium (balance of forces and balance of moments)	x	x	x	x
	Basic calculations of CG	x	x	x	x
	Mass and balance details of aircraft				
	Contents of mass and balance documentation				
	Datum and moment arm	x	x	x	x
	CG position as distance from datum	x	x	x	x
	Extraction of basic mass and balance data from aircraft documentation				
	BEM	x	x	x	x
	CG position or moment at BEM	x	x	x	x
	Deviations from standard configuration	x	x	x	x
	Determination of CG position				
	Methods				
	Arithmetic method	x	x	x	x
	Graphic method	x	x	x	x
	Load and trim sheet				
	General considerations	x	x	x	x
	Load sheet and CG envelope for light aeroplanes and for helicopters	x	x	x	x
7.2.	**PERFORMANCE: AEROPLANES**				
	Introduction				
	Performance classes	x	x		
	Stages of flight	x	x		
	Effect of aeroplane mass, wind, altitude, runway slope and runway conditions	x	x		

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	Gradients	x	x		
	SE aeroplanes				
	Definitions of terms and speeds	x	x		
	Take-off and landing performance				
	Use of aeroplane flight manual data	x	x		
	Climb and cruise performance				
	Use of aeroplane flight data	x	x		
	Effect of density altitude and aeroplane mass	x	x		
	Endurance and the effects of the different recommended power or thrust settings	x	x		
	Still air range with various power or thrust settings	x	x		
7.3.	**FLIGHT PLANNING AND FLIGHT MONITORING**				
	Flight planning for VFR flights				
	VFR navigation plan				
	Routes, airfields, heights and altitudes from VFR charts	x	x	x	x
	Courses and distances from VFR charts	x	x	x	x
	Aerodrome charts and aerodrome directory	x	x	x	x
	Communications and radio navigation planning data	x	x	x	x
	Completion of navigation plan	x	x	x	x
	Fuel planning				
	General knowledge	x	x	x	x
	Pre-flight calculation of fuel required				
	Calculation of extra fuel	x	x	x	x
	Completion of the fuel section of the navigation plan (fuel log) and calculation of total fuel	x	x	x	x
	Pre-flight preparation				
	AIP and NOTAM briefing				
	Ground facilities and services	x	x	x	x
	Departure, destination and alternate aerodromes	x	x	x	x
	Airway routings and airspace structure	x	x	x	x
	Meteorological briefing				
	Extraction and analysis of relevant data from meteorological documents	x	x	x	x
	ICAO flight plan (ATS flight plan)				
	Individual flight plan				
	Format of flight plan	x	x	x	x
	Completion of the flight plan	x	x	x	x
	Submission of the flight plan	x	x	x	x
	Flight monitoring and in-flight replanning				
	Flight monitoring				
	Monitoring of track and time	x	x	x	x
	In-flight fuel management	x	x	x	x
	In-flight re-planning in case of deviation from planned data	x	x	x	x
7.4.	**PERFORMANCE: HELICOPTERS**				
	General				
	Introduction				
	Stages of flight			x	x
	Effect on performance of atmospheric, airport or heliport and helicopter conditions			x	x
	Applicability of airworthiness requirements			x	x

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	Definitions and terminology			x	x
	Performance: SE helicopters				
	Definitions of terms (a) masses; (b) velocities: v_x, v_y;			x	x
	(c) velocity of best range and of maximum endurance; (d) power limitations; (e) altitudes.				
	Take-off, cruise and landing performance **Use and interpretation of diagrams and tables:** (a) Take-off: (1) take-off run and distance available; (2) take-off and initial climb; (3) effects of mass, wind and density altitude; (4) effects of ground surface and gradient. (b) Landing: (1) effects of mass, wind, density altitude and approach speed; (2) effects of ground surface and gradient. (c) In-flight: (1) relationship between power required and power available; (2) performance diagram; (3) effects of configuration, mass, temperature and altitude; (4) reduction of performance during climbing turns; (5) autorotation; (6) adverse effects (icing, rain and condition of the airframe).			x	x
8.	**AIRCRAFT GENERAL KNOWLEDGE**				
8.1.	**AIRFRAME AND SYSTEMS, ELECTRICS, POWERPLANT AND EMERGENCY EQUIPMENT**				
	System design, loads, stresses, maintenance				
	Loads and combination loadings applied to an aircraft's structure	x	x	x	x
	Airframe				
	Wings, tail surfaces and control surfaces				
	Design and constructions	x	x		
	Structural components and materials	x	x		
	Stresses	x	x		
	Structural limitations	x	x		
	Fuselage, doors, floor, wind-screen and windows				
	Design and constructions	x	x	x	x
	Structural components and materials	x	x	x	x
	Stresses	x	x	x	x
	Structural limitations	x	x	x	x
	Flight and control surfaces				
	Design and constructions			x	x
	Structural components and materials			x	x
	Stresses and aero elastic vibrations			x	x

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	Structural limitations			x	x
	Hydraulics				
	Hydromechanics: basic principles	x	x	x	x
	Hydraulic systems	x	x	x	x
	Hydraulic fluids: types and characteristics, limitations	x	x	x	x
	System components: design, operation, degraded modes of operation, indications and warnings	x	x	x	x
	Landing gear, wheels, tyres and brakes				
	Landing gear				
	Types and materials	x	x	x	x
	Nose wheel steering: design and operation	x	x		
	Brakes				
	Types and materials	x	x	x	x
	System components: design, operation, indications and warnings	x	x	x	x
	Wheels and tyres				
	Types and operational limitations	x	x	x	x
	Helicopter equipments			x	x
	Flight controls				
	Mechanical or powered	x	x	x	x
	Control systems and mechanical	x	x	x	x
	System components: design, operation, indications and warnings, degraded modes of operation and jamming	x	x	x	x
	Secondary flight controls				
	System components: design, operation, degraded modes of operation, indications and warnings	x	x		
	Anti-icing systems				
	Types and operation (pitot and windshield)	x	x	x	x
	Fuel system				
	Piston engine				
	System components: design, operation, degraded modes of operation, indications and warnings	x	x	x	x
	Turbine engine				
	System components: design, operation, degraded modes of operation, indications and warnings			x	x
	Electrics				
	Electrics: general and definitions				
	Direct current: voltage, current, resistance, conductivity, Ohm's law, power and work	x	x	x	x
	Alternating current: voltage, current, amplitude, phase, frequency and resistance	x	x	x	x
	Circuits: series and parallel	x	x	x	x
	Magnetic field: effects in an electrical circuit	x	x	x	x
	Batteries				
	Types, characteristics and limitations	x	x	x	x
	Battery chargers, characteristics and limitations	x	x	x	x
	Static electricity: general				
	Basic principles	x	x	x	x
	Static dischargers	x	x	x	x
	Protection against interference	x	x	x	x

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	Lightning effects	x	x	x	x
	Generation: production, distribution and use				
	DC generation: types, design, operation, degraded modes of operation, indications and warnings	x	x	x	x
	AC generation: types, design, operation, degraded modes of operation, indications and warnings	x	x	x	x
	Electric components				
	Basic elements: basic principles of switches, circuit-breakers and relays	x	x	x	x
	Distribution				
	General: (a) bus bar, common earth and priority; (b) AC and DC comparison.	x	x	x	x
	Piston engines				
	General				
	Types of internal combustion engine: basic principles and definitions	x	x	x	x
	Engine: design, operation, components and materials	x	x	x	x
	Fuel				
	Types, grades, characteristics and limitations	x	x	x	x
	Alternate fuel: characteristics and limitations	x	x	x	x
	Carburettor or injection system				
	Carburettor: design, operation, degraded modes of operation, indications and warnings	x	x	x	x
	Injection: design, operation, degraded modes of operation, indications and warnings	x	x	x	x
	Icing	x	x	x	x
	Air cooling systems				
	Design, operation, degraded modes of operation, indications and warnings	x	x	x	x
	Lubrication systems				
	Lubricants: types, characteristics and limitations	x	x	x	x
	Design, operation, degraded modes of operation, indications and warnings	x	x	x	x
	Ignition circuits				
	Design, operation, degraded modes of operation	x	x	x	x
	Mixture				
	Definition, characteristic mixtures, control instruments, associated control levers and indications	x	x	x	x
	Propellers				
	Definitions and general: (a) aerodynamic parameters; (b) types; (c) operating modes.	x	x		
	Constant speed propeller: design, operation and system components	x	x		
	Propeller handling: associated control levers, degraded modes of operation, indications and warnings	x	x		

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	Performance and engine handling				
	Performance: influence of engine parameters, influence of atmospheric conditions, limitations and power augmentation systems	x	x	x	x
	Engine handling: power and mixture settings during various flight phases and operational limitations	x	x	x	x
	Turbine engines				
	Definitions			x	x
	Coupled turbine engine: design, operation, components and materials			x	x
	Free turbine engine: design, operation, components and materials			x	x
	Fuel				
	Types, characteristics and limitations			x	x
	Main engine components				
	Compressor: (a) types, design, operation, components and materials; (b) stresses and limitations; (c) stall, surge and means of prevention.			x	x
	Combustion chamber: (a) types, design, operation, components and materials; (b) stresses and limitations; (c) emission problems.			x	x
	Turbine: (a) types, design, operation, components and materials; (b) stresses, creep and limitations.			x	x
	Exhaust: (a) design, operation and materials; (b) noise reduction.			x	x
	Fuel control units: types, operation and sensors			x	x
	Helicopter air intake: different types, design, operation, materials and optional equipments			x	x
	Additional components and systems				
	Helicopter additional components and systems: lubrication system, ignition circuit, starter, accessory gearbox, free wheel units: design, operation and components			x	x
	Performance aspects				
	Torque, performance aspects, engine handling and limitations: (a) engine ratings; (b) engine performance and limitations; (c) engine handling.			x	x
	Protection and detection systems				
	Fire detection systems				
	Operation and indications			x	X
	Miscellaneous systems				
	Rotor design			x	x
	Rotor heads				
	Main rotor				
	Types			x	x
	Structural components and materials, stresses and structural limitations			x	x

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	Design and construction			x	x
	Adjustment			x	x
	Tail rotor				
	Types			x	x
	Structural components and materials, stresses and structural limitations			x	x
	Design and construction			x	x
	Adjustment			x	x
	Transmission				
	Main gear box				
	Different types, design, operation and limitations			x	x
	Rotor brake				
	Different types, design, operation and limitations			x	x
	Auxiliary systems			x	x
	Drive shaft and associated installation			x	x
	Intermediate and tail gear box				
	Different types, design, operation and limitations			x	x
	Blades				
	Main rotor blade				
	Design and construction			x	x
	Structural components and materials			x	x
	Stresses			x	x
	Structural limitations			x	x
	Adjustment			x	x
	Tip shape			x	x
	Tail rotor blade				
	Design and construction			x	x
	Structural components and materials			x	x
	Stresses			x	x
	Structural limitations			x	x
	Adjustment			x	x
8.2.	**INSTRUMENTATION**				
	Instrument and indication systems				
	Pressure gauge				
	Different types, design, operation, characteristics and accuracy	x	x	x	x
	Temperature sensing				
	Different types, design, operation, characteristics and accuracy	x	x	x	x
	Fuel gauge				
	Different types, design, operation, characteristics and accuracy	x	x	x	x
	Flow meter				
	Different types, design, operation, characteristics and accuracy	x	x	x	x
	Position transmitter				
	Different types, design, operation, characteristics and accuracy	x	x	x	x
	Torque meter				
	Design, operation, characteristics and accuracy			x	x
	Tachometer				
	Design, operation, characteristics and accuracy	x	x	x	x
	Measurement of aerodynamic parameters				
	Pressure measurement				
	Static pressure, dynamic pressure, density and definitions	x	x	x	x

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	Design, operation, errors and accuracy	x	x	x	x
	Temperature measurement: aeroplane				
	Design, operation, errors and accuracy	x	x		
	Displays	x	x		
	Temperature measurement: helicopter				
	Design, operation, errors and accuracy			x	x
	Displays			x	x
	Altimeter				
	Standard atmosphere	x	x	x	x
	The different barometric references (QNH, QFE and 1013.25)	x	x	x	x
	Height, indicated altitude, true altitude, pressure altitude and density altitude	x	x	x	x
	Design, operation, errors and accuracy	x	x	x	x
	Displays	x	x	x	x
	Vertical speed indicator				
	Design, operation, errors and accuracy	x	x	x	x
	Displays	x	x	x	x
	Air speed indicator				
	The different speeds IAS, CAS, TAS: definition, usage and relationships	x	x	x	x
	Design, operation, errors and accuracy	x	x	x	x
	Displays	x	x	x	x
	Magnetism: direct reading compass				
	Earth magnetic field	x	x	x	x
	Direct reading compass				
	Design, operation, data processing, accuracy and deviation	x	x	x	x
	Turning and acceleration errors	x	x	x	x
	Gyroscopic instruments				
	Gyroscope: basic principles				
	Definitions and design	x	x	x	x
	Fundamental properties	x	x	x	x
	Drifts	x	x	x	x
	Turn and bank indicator				
	Design, operation and errors	x	x	x	x
	Attitude indicator				
	Design, operation, errors and accuracy	x	x	x	x
	Directional gyroscope				
	Design, operation, errors and accuracy	x	x	x	x
	Communication systems				
	Transmission modes: VHF, HF and SATCOM				
	Principles, bandwidth, operational limitations and use	x	x	x	x
	Voice communication				
	Definitions, general and applications	x	x	x	x
	Alerting systems and proximity systems				
	Flight warning systems				
	Design, operation, indications and alarms	x	x	x	x
	Stall warning				
	Design, operation, indications and alarms	x	x		
	Radio-altimeter				
	Design, operation, errors, accuracy and indications			x	x

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	Rotor or engine over speed alert system				
	Design, operation, displays and alarms			x	x
	Integrated instruments: electronic displays				
	Display units				
	Design, different technologies and limitations	x	x	x	x
9.	**NAVIGATION**				
9.1.	**GENERAL NAVIGATION**				
	Basics of navigation				
	The solar system				
	Seasonal and apparent movements of the sun	x		x	
	The earth				
	Great circle, small circle and rhumb line	x		x	
	Latitude and difference of latitude	x		x	
	Longitude and difference of longitude	x		x	
	Use of latitude and longitude co-ordinates to locate any specific position	x		x	
	Time and time conversions				
	Apparent time	x		x	
	UTC	x		x	
	LMT	x		x	
	Standard times	x		x	
	Dateline	x		x	
	Definition of sunrise, sunset and civil twilight	x		x	
	Directions				
	True north, magnetic north and compass north	x		x	
	Compass deviation	x		x	
	Magnetic poles, isogonals, relationship between true and magnetic	x		x	
	Distance				
	Units of distance and height used in navigation: nautical miles, statute miles, kilometres, metres and ft	x		x	
	Conversion from one unit to another	x		x	
	Relationship between nautical miles and minutes of latitude and minutes of longitude	x		x	
	Magnetism and compasses				
	General principles				
	Terrestrial magnetism	x		x	
	Resolution of the earth's total magnetic force into vertical and horizontal components	x		x	
	Variation-annual change	x		x	
	Aircraft magnetism				
	The resulting magnetic fields	x		x	
	Keeping magnetic materials clear of the compass	x		x	
	Charts				
	General properties of miscellaneous types of projections				
	Direct Mercator	x		x	
	Lambert conformal conic	x		x	
	The representation of meridians, parallels, great circles and rhumb lines				
	Direct Mercator	x		x	

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	Lambert conformal conic	x		x	
	The use of current aeronautical charts				
	Plotting positions	x		x	
	Methods of indicating scale and relief (ICAO topographical chart)	x		x	
	Conventional signs	x		x	
	Measuring tracks and distances	x		x	
	Plotting bearings and distances	x		x	
	DR navigation				
	Basis of DR				
	Track	x		x	
	Heading (compass, magnetic and true)	x		x	
	Wind velocity	x		x	
	Air speed (IAS, CAS and TAS)	x		x	
	Groundspeed	x		x	
	ETA	x		x	
	Drift and wind correction angle	x		x	
	DR position fix	x		x	
	Use of the navigational computer				
	Speed	x		x	
	Time	x		x	
	Distance	x		x	
	Fuel consumption	x		x	
	Conversions	x		x	
	Air speed	x		x	
	Wind velocity	x		x	
	True altitude	x		x	
	The triangle of velocities				
	Heading	x		x	
	Ground speed	x		x	
	Wind velocity	x		x	
	Track and drift angle	x		x	
	Measurement of DR elements				
	Calculation of altitude	x		x	
	Determination of appropriate speed	x		x	
	In-flight navigation				
	Use of visual observations and application to in-flight navigation	x		x	
	Navigation in cruising flight, use of fixes to revise navigation data				
	Ground speed revision	x		x	
	Off-track corrections	x		x	
	Calculation of wind speed and direction	x		x	
	ETA revisions	x		x	
	Flight log	x		x	
9.2.	**RADIO NAVIGATION**				
	Basic radio propagation theory				
	Antennas				
	Characteristics	x		x	
	Wave propagation				

		Aeroplane		Helicopter	
		PPL	Bridge course	PPL	Bridge course
	Propagation with the frequency bands	x		x	
	Radio aids				
	Ground DF				
	Principles	x		x	
	Presentation and interpretation	x		x	
	Coverage	x		x	
	Range	x		x	
	Errors and accuracy	x		x	
	Factors affecting range and accuracy	x		x	
	NDB/ADF				
	Principles	x		x	
	Presentation and interpretation	x		x	
	Coverage	x		x	
	Range	x		x	
	Errors and accuracy	x		x	
	Factors affecting range and accuracy	x		x	
	VOR				
	Principles	x		x	
	Presentation and interpretation	x		x	
	Coverage	x		x	
	Range	x		x	
	Errors and accuracy	x		x	
	Factors affecting range and accuracy	x		x	
	DME				
	Principles	x		x	
	Presentation and interpretation	x		x	
	Coverage	x		x	
	Range	x		x	
	Errors and accuracy	x		x	
	Factors affecting range and accuracy	x		x	
	Radar				
	Ground radar				
	Principles	x		x	
	Presentation and interpretation	x		x	
	Coverage	x		x	
	Range	x		x	
	Errors and accuracy	x		x	
	Factors affecting range and accuracy	x		x	
	Secondary surveillance radar and transponder				
	Principles	x		x	
	Presentation and interpretation	x		x	
	Modes and codes	x		x	
	GNSS				
	GPS, GLONASS OR GALILEO				
	Principles	x		x	
	Operation	x		x	
	Errors and accuracy	x		x	
	Factors affecting accuracy	x		x	