Private Pilot Licence Examinations – 081 Principles of Flight Aeroplane

		Aeroplane		Helicopter	
Syllabus Reference	**Syllabus details & Associated Learning Objective**	**PPL**	**Bridge Course**	**PPL**	**Bridge Course**
080.00.00.00	**PRINICIPLES OF FLIGHT**				
081.00.00.00	**PRINCIPLES OF FLIGHT: AEROPLANE**				
081.01.00.00	**Subsonic aerodynamics**				
081.01.01.00	**Basics concepts, laws and definitions**				
081.01.01.01	Laws and definitions:	x	x		
	(a) conversion of units;	x	x		
	(b) Newton´s laws;	x	x		
	(c) Bernoulli's equation and venture;	x	x		
	(d) static pressure, dynamic pressure and total pressure;	x	x		
	(e) density;	x	x		
	(f) IAS and TAS.	x	x		
081.01.01.02	Basics about airflow:	x	x		
	(a) streamline;	x	x		
	(b) two-dimensional airflow;	x	x		
	(c) three-dimensional airflow.	x	x		
081.01.01.03	Aerodynamic forces on surfaces:	x	x		
	(a) resulting airforce;	x	x		
	(b) lift;	x	x		
	(c) drag;	x	x		
	(d) angle of attack.	x	x		
081.01.01.04	Shape of an aerofoil section:	x	x		
	(a) thickness to chord ratio;	x	x		
	(b) chord line;	x	x		
	(c) camber line;	x	x		
	(d) camber;	x	x		
	(e) angle of attack.	x	x		
081.01.01.05	The wing shape:	x	x		
	(a) aspect ratio;	x	x		
	(b) root chord;	x	x		
	(c) tip chord;	x	x		
	(d) tapered wings;	x	x		
	(e) wing planform.	x	x		
081.02.01.00	**The two-dimensional airflow about an aerofoil**				
081.02.01.01	Streamline pattern	x	x		
081.02.01.02	Stagnation point	x	x		
081.02.01.03	Pressure distribution	x	x		
081.02.01.04	Centre of pressure	x	x		
081.02.01.05	Influence of angle of attack	x	x		
081.02.01.06	Flow separation at high angles of attack	x	x		
081.02.01.07	The lift – α graph	x	x		
081.03.01.00	**The coefficients**				
081.03.01.01	The lift coefficient Cl: the lift formula	x	x		
081.03.01.02	The drag coefficient Cd: the drag formula	x	x		
081.04.01.00	**The three-dimensional airflow round a wing and a fuselage**				
081.04.01.01	Streamline pattern:	x	x		

	(a) span-wise flow and causes;	x	x		
	(b) tip vortices and angle of attack;	x	x		
	(c) upwash and downwash due to tip vortices;	x	x		
	(d) wake turbulence behind an aeroplane (causes, distribution and duration of the phenomenon).	x	x		
081.04.01.02	Induced drag:	x	x		
	(a) influence of tip vortices on the angle of attack;	x	x		
	(b) the induced local α;	x	x		
	(c) influence of induced angle of attack on the direction of the lift vector;	x	x		
	(d) induced drag and angle of attack.	x	x		
081.05.01.00	**Drag**				
081.05.01.01	The parasite drag:	x	x		
	(a) pressure drag;	x	x		
	(b) interference drag;	x	x		
	(c) friction drag.	x	x		
081.05.01.02	The parasite drag and speed	x	x		
081.05.01.03	The induced drag and speed	x	x		
081.05.01.04	The total drag	x	x		
081.06.01.00	**The ground effect**				
081.06.01.01	Effect on take off and landing characteristics of an aeroplane	x	x		
081.07.01.00	**The stall**				
081.07.01.01	Flow separation at increasing angles of attack:	x	x		
	(a) the boundary layer:	x	x		
	(1) laminar layer;	x	x		
	(2) turbulent layer;	x	x		
	(3) transition.	x	x		
	(b) separation point;	x	x		
	(c) influence of angle of attack;	x	x		
	(d) influence on:	x	x		
	(1) pressure distribution;	x	x		
	(2) location of centre of pressure;	x	x		
	(3) CL;	x	x		
	(4) CD;	x	x		
	(5) pitch moments.	x	x		
	(e) buffet;	x	x		
	(f) use of controls.	x	x		
081.07.01.02	The stall speed:	x	x		
	(a) in the lift formula;	x	x		
	(b) 1g stall speed;	x	x		
	(c) influence of:	x	x		
	(1) the centre of gravity;	x	x		
	(2) power setting;	x	x		
	(3) altitude (IAS);	x	x		
	(4) wing loading;	x	x		
	(5) load factor n:	x	x		
	(i) definition;	x	x		
	(ii) turns;	x	x		
	(iii) forces.	x	x		
081.07.01.03	The initial stall in span-wise direction:	x	x		
	(a) influence of planform;	x	x		
	(b) geometric twist (wash out);	x	x		
	(c) use of ailerons.	x	x		

081.07.01.04	Stall warning:	x	x		
	(a) importance of stall warning;	x	x		
	(b) speed margin;	x	x		
	(c) buffet;	x	x		
	(d) stall strip;	x	x		
	(e) flapper switch;	x	x		
	(f) recovery from stall.	x	x		
081.07.01.05	Special phenomena of stall:	x	x		
	(a) the power-on stall;	x	x		
	(b) climbing and descending turns;	x	x		
	(c) t-tailed aeroplane;	x	x		
	(d) avoidance of spins:	x	x		
	(1) spin development;	x	x		
	(2) spin recognition;	x	x		
	(3) spin recovery.	x	x		
	(e) ice (in stagnation point and on surface):	x	x		
	(1) absence of stall warning;	x	x		
	(2) abnormal behaviour of the aircraft during stall.	x	x		
081.08.01.00	**CL augmentation**				
081.08.01.01	Trailing edge flaps and the reasons for use in take-off and landing:	x	x		
	(a) influence on CL - α-graph;	x	x		
	(b) different types of flaps;	x	x		
	(c) flap asymmetry;	x	x		
	(d) influence on pitch movement.	x	x		
081.08.01.03	Leading edge devices and the reasons for use in take-off and landing	x	x		
081.09.01.00	**The boundary layer**				
081.09.01.01	Different types:	x	x		
	(a) laminar;	x	x		
	(b) turbulent.	x	x		
081.10.00.00	**Special circumstances**				
081.10.00.01	Ice and other contamination:	x	x		
	(a) ice in stagnation point;	x	x		
	(b) ice on the surface (frost, snow and clear ice);	x	x		
	(c) rain;	x	x		
	(d) contamination of the leading edge;	x	x		
	(e) effects on stall;	x	x		
	(f) effects on loss of controllability;	x	x		
	(g) effects on control surface moment;	x	x		
	(h) influence on high lift devices during takeoff, landing and low speeds.	x	x		
081.11.00.00	**Stability**				
081.11.01.00	**Condition of equilibrium in steady horizontal flight**				
081.11.01.01	Precondition for static stability	x	x		
081.11.01.02	Equilibrium:	x	x		
	(a) lift and weight;	x	x		
	(b) drag and thrust.	x	x		
081.12.00.00	**Methods of achieving balance**				
081.12.01.01	Wing and empennage (tail and canard)	x	x		
081.12.01.02	Control surfaces	x	x		
081.12.01.03	Ballast or weight trim	x	x		
081.13.00.00	**Static and dynamic longitudinal stability**				

081.13.01.01	Basics and definitions:	x	x		
	(a) static stability, positive, neutral and negative;	x	x		
	(b) precondition for dynamic stability;	x	x		
	(c) dynamic stability, positive, neutral and negative.	x	x		
081.13.01.02	Location of centre of gravity:	x	x		
	(a) aft limit and minimum stability margin;	x	x		
	(b) forward position;	x	x		
	(c) effects on static and dynamic stability.	x	x		
081.14.00.00	**Dynamic lateral or directional stability**				
081.14.01.01	Spiral dive and corrective actions	x	x		
081.15.00.00	**Control**				
081.15.01.00	**General**				
081.15.01.01	Basics, the three planes and three axis	x	x		
081.15.01.02	Angle of attack change	x	x		
081.16.01.00	**Pitch control**				
081.16.01.01	Elevator	x	x		
081.16.01.02	Downwash effects	x	x		
081.16.01.03	Location of centre of gravity	x	x		
081.17.01.00	**Yaw control**				
081.17.01.01	Pedal or rudder	x	x		
081.17.02.00	**Roll control**				
081.17.02.01	Ailerons: function in different phases of flight	x	x		
081.17.02.02	Adverse yaw	x	x		
081.17.02.03	Means to avoid adverse yaw:	x	x		
	(a) frise ailerons;	x	x		
	(b) differential ailerons deflection.	x	x		
081.18.01.00	**Means to reduce control forces**				
081.18.00.01	Aerodynamic balance:	x	x		
	(a) balance tab and anti-balance tab;	x	x		
	(b) servo tab.	x	x		
081.19.01.00	**Mass balance**				
081.19.00.00	Reasons to balance: means	x	x		
081.20.01.00	**Trimming**				
081.20.01.01	Reasons to trim	x	x		
081.20.01.02	Trim tabs	x	x		
081.21.00.00	**Limitations**				
081.21.01.00	**Operating limitations**				
081.21.01.01	Flutter	x	x		
081.21.01.02	Vfe	x	x		
081.21.01.03	Vno, Vne	x	x		
081.22.01.00	**Manoeuvring envelope**				
081.22.01.01	Manoeuvring load diagram:	x	x		
	(a) load factor;	x	x		
	(b) accelerated stall speed;	x	x		
	(c) Va;	x	x		
	(d) manoeuvring limit load factor or certification category.	x	x		
081.22.01.02	Contribution of mass	x	x		
081.23.01.00	**Gust envelope**				
081.23.01.01	Gust load diagram	x	x		
081.23.01.02	Factors contributing to gust loads	x	x		
081.24.00.00	**Propellers**				
081.24.01.00	**Conversion of engine torque to thrust**				
081.24.01.01	Meaning of pitch	x	x		

081.24.01.02	Blade twist	x	x		
081.24.01.03	Effects of ice on propeller	x	x		
081.25.01.00	**Engine failure or engine stop**				
081.25.01.01	Windmilling drag	x	x		
081.26.01.00	**Moments due to propeller operation**				
081.26.01.01	Torque reaction	x	x		
081.26.01.02	Asymmetric slipstream effect	x	x		
081.26.01.03	Asymmetric blade effect	x	x		
081.27.00.00	**Flight mechanics**				
081.27.01.00	**Forces acting on an aeroplane**				
081.27.01.01	Straight horizontal steady flight	x	x		
081.27.01.02	Straight steady climb	x	x		
081.27.01.03	Straight steady descent	x	x		
081.27.01.04	Straight steady glide	x	x		
081.27.01.05	Steady coordinated turn:	x	x		
	(a) bank angle;	x	x		
	(b) load factor;	x	x		
	(c) turn radius;	x	x		
	(d) rate one turn.	x	x		
	(a) the atmosphere and International Standard Atmosphere;			x	x
	(b) density;			x	x
	(c) influence of pressure and temperature on density.			x	x
	(a) Newton’s second law: Momentum equation;			x	x
	(b) Newton’s third law: action and reaction.			x	x
	(a) steady airflow and unsteady airflow;			x	x
	(b) Bernoulli’s equation;			x	x
	(c) static pressure, dynamic pressure, total pressure and stagnation point;			x	x
	(d) TAS and IAS;			x	x
	(e) two-dimensional airflow and three-dimensional airflow;			x	x
	(f) viscosity and boundary layer.			x	x
	(a) aerofoil section;			x	x
	(b) chord line, thickness and thickness to chord ratio of a section;			x	x
	(c) camber line and camber;			x	x
	(d) symmetrical and asymmetrical aerofoils sections.			x	x
	(a) angle of attack;			x	x
	(b) pressure distribution;			x	x
	(c) lift and lift coefficient			x	x
	(d) relation lift coefficient: angle of attack;			x	x
	(e) profile drag and drag coefficient;			x	x
	(f) relation drag coefficient: angle of attack;			x	x
	(g) resulting force, centre of pressure and pitching moment.			x	x
	(a) boundary layer and reasons for stalling;			x	x
	(b) variation of lift and drag as a function of angle of attack;			x	x
	(c) displacement of the centre of pressure and pitching moment.			x	x
	(a) ice contamination;			x	x
	(b) ice on the surface (frost, snow and clear ice).			x	x
	(a) planform, rectangular and tapered wings;			x	x
	(b) wing twist.			x	x

	(a) span wise flow on upper and lower surface;			x	x
	(b) tip vortices;			x	x
	(c) span-wise lift distribution.			x	x
	(a) components of a fuselage;			x	x
	(b) parasite drag;			x	x
	(c) variation with speed.			x	x
	(a) speed of sound;			x	x
	(b) subsonic, high subsonic and supersonic flows.			x	x
	(a) compressibility and shock waves;			x	x
	(b) the reasons for their formation at upstream high subsonic airflow;			x	x
	(c) their effect on lift and drag.			x	x
	(a) autogyro;			x	x
	(b) helicopter.			x	x
	(a) general lay-out, fuselage, engine and gearbox;			x	x
	(b) tail rotor, fenestron and NOTAR;			x	x
	(c) engines (reciprocating and turbo shaft engines);			x	x
	(d) power transmission;			x	x
	(e) rotor shaft axis, rotor hub and rotor blades;			x	x
	(f) rotor disc and rotor disc area;			x	x
	(g) teetering rotor (two blades) and rotors with more than two blades;			x	x
	(h) skids and wheels;			x	x
	(i) helicopter axes and fuselage centre line;			x	x
	(j) roll axis, pitch axis and normal or yaw axis;			x	x
	(k) gross mass, gross weight and disc loading.			x	x
	(a) circumferential velocity of the blade sections;			x	x
	(b) induced airflow, through the disc and downstream;			x	x
	(c) downward fuselage drag;			x	x
	(d) equilibrium of rotor thrust, weight and fuselage drag;			x	x
	(e) rotor disc induced power;			x	x
	(f) relative airflow to the blade;			x	x
	(g) pitch angle and angle of attack of a blade section;			x	x
	(h) lift and profile drag on the blade element;			x	x
	(i) resulting lift and thrust on the blade and rotor thrust;			x	x
	(j) collective pitch angle changes and necessity of blade feathering;			x	x
	(k) required total main rotor-torque and rotor-power;			x	x
	(l) influence of the air density.			x	x
	(a) force of tail rotor as a function of main rotor-torque;			x	x
	(b) anti-torque rotor power;			x	x
	(c) necessity of blade feathering of tail rotor blades and yaw pedals.			x	x
	(a) total power required and power available;			x	x
	(b) maximum hover altitude as a function of pressure altitude and OAT.			x	x
	(a) climb velocity VC, induced and relative velocity and angle of attack;			x	x
	(b) collective pitch angle and blade feathering.			x	x
	(a) induced power, climb power and profile power;				
	(b) total main rotor power and main rotor torque;			x	x
	(c) tail rotor power;			x	x
	(d) total power requirement in vertical flight.			x	x

	(a) assumption of uniform inflow distribution on rotor disc;			x	x
	(b) advancing blade (90°) and retreating blade (270°);			x	x
	(c) airflow velocity relative to the blade sections, area of reverse flow;			x	x
	(d) lift on the advancing and retreating blades at constant pitch angles;			x	x
	(e) necessity of cyclic pitch changes;			x	x
	(f) compressibility effects on the advancing blade tip and speed limitations;			x	x
	(g) high angle of attack on the retreating blade, blade stall and speed limitations;			x	x
	(h) thrust on rotor disc and tilt of thrust vector;			x	x
	(i) vertical component of the thrust vector and gross weight equilibrium;			x	x
	(j) horizontal component of the thrust vector and drag equilibrium.			x	x
	(a) thrust reversal and increase in rotor thrust;			x	x
	(b) increase of rotor RPM on non governed rotor.			x	x
	(a) induced power as a function of helicopter speed;			x	x
	(b) rotor profile power as a function of helicopter speed;			x	x
	(c) fuselage drag and parasite power as a function of forward speed;			x	x
	(d) tail rotor power and power ancillary equipment;			x	x
	(e) total power requirement as a function of forward speed;			x	x
	(f) influence of helicopter mass, air density and drag of additional external equipment;			x	x
	(g) translational lift and influence on power required.			x	x
	(a) airflow through the rotor, low and moderate descent speeds;			x	x
	(b) vortex ring state, settling with power and consequences.			x	x
	(a) collective lever position after failure;			x	x
	(b) up flow through the rotor, auto-rotation and anti-autorotation rings;			x	x
	(c) tail rotor thrust and yaw control;			x	x
	(d) control of rotor RPM with collective lever;			x	x
	(e) landing after increase of rotor thrust by pulling collective and reduction in vertical speed.			x	x
	(a) descent speed and up flow through the disc;			x	x
	(b) the flare, increase in rotor thrust, reduction of vertical speed and ground speed.			x	x
	(a) turning;			x	x
	(b) flare;			x	x
	(c) autorotative landing;			x	x
	(d) height or velocity avoidance graph and dead man’s curve.			x	x
	(a) centrifugal force on the blade and attachments;			x	x
	(b) limits of rotor RPM;			x	x
	(c) lift on the blade and bending stresses on a rigid attachment;			x	x
	(d) the flapping hinge of the articulated rotor and flapping hinge offset;			x	x
	(e) the flapping of the hinge less rotor and flexible element.			x	x

	(a) lift and centrifugal force in hover and blade weight negligible			x	x
	(b) flapping, tip path plane and disc area.			x	x
	(a) aerodynamic forces on the advancing and retreating blades without cyclic feathering;			x	x
	(b) periodic forces and stresses, fatigue and flapping hinge;			x	x
	(c) phase lag between the force and the flapping angle (about 90°);			x	x
	(d) flapping motion of the hinged blades and tilting of the cone and flap back of rotor;			x	x
	(e) rotor disc attitude and thrust vector tilt.			x	x
	(a) necessity of forward rotor disc tilt and thrust vector tilt;			x	x
	(b) flapping and tip path plane, virtual rotation axis or no flapping axis and plane of rotation;			x	x
	(c) shaft axis and hub plane;			x	x
	(d) cyclic pitch change (feathering) and rotor thrust vector tilt;			x	x
	(e) collective pitch change, collective lever, swash plate, pitch link and pitch horn;			x	x
	(f) cyclic stick, rotating swash plate and pitch link movement and phase angle.			x	x
	(a) forces due to the Coriolis effect because of the flapping;			x	x
	(b) alternating stresses and the need of the drag or lag hinge.			x	x
	(a) the drag hinge in the fully articulated rotor;			x	x
	(b) the lag flexure in the hinge less rotor;			x	x
	(c) drag dampers.			x	x
	(a) blade lag motion and movement of the centre of gravity of the blades and the rotor;			x	x
	(b) oscillating force on the fuselage;			x	x
	(c) fuselage, undercarriage and resonance.			x	x
	(a) three hinges arrangement;			x	x
	(b) bearings and elastomeric hinges.			x	x
	(a) low rotor RPM and effect of adverse wind;			x	x
	(b) minimising the danger;			x	x
	(c) droop stops.			x	x
	(a) origins of the vibrations: in plane and vertical;			x	x
	(b) blade tracking and balancing.			x	x
	(a) two-blades tail rotors with teetering hinge;			x	x
	(b) rotors with more than two blades;			x	x
	(c) feathering bearings and flapping hinges;			x	x
	(d) dangers to people and to the tail rotor, rotor height and safety.			x	x
	(a) induced airflow and tail rotor thrust;			x	x
	(b) thrust control by feathering, tail rotor drift and roll;			x	x
	(c) effect of tail rotor failure and vortex ring.			x	x
	(a) forces and equilibrium conditions;			x	x
	(b) helicopter pitching moment and pitch angle;			x	x
	(c) helicopter rolling moment and roll angle.			x	x
	(a) forces and equilibrium conditions;			x	x
	(b) helicopter moments and angles;			x	x
	(c) effect of speed on fuselage attitude.			x	x
	(a) fully articulated rotor;			x	x
	(b) hinge less rotor;			x	x

	(c) teetering rotor.			x	x
	(a) power available;			x	x
	(b) effects of density altitude.			x	x
	(a) power available;			x	x
	(b) effects of ambient pressure and temperature.			x	x
	(a) power required and power available;			x	x
	(b) OGE and IGE maximum hover height;			x	x
	(c) influence of AUM, pressure, temperature and density.			x	x
	(a) maximum speed;			x	x
	(b) maximum rate of climb speed;			x	x
	(c) maximum angle of climb speed;			x	x
	(d) range and endurance;			x	x
	(e) influence of AUM, pressure, temperature and density.			x	x
	(a) load factor;			x	x
	(b) bank angle and number of g's;			x	x
	(c) manoeuvring limit load factor.			x	x
	(a) operating with limited power;			x	x
	(b) over pitch and over torque.			x	x