SECTION 3.05

SYLLABUS OF BASIC AERONAUTICAL KNOWLEDGE

LEVELS OF KNOWLEDGE AND APPLICATION

The following syllabus specifies the **MINIMUM** standard of knowledge required. Qualifying letters are used to indicate the specific levels of knowledge necessary for each individual item within a particular subject, as follows:

A A **basic** understanding of the subject matter, sufficient, with some assistance from an RA-Aus instructor, for the solution of simple practical problems either by calculation or by the exercise of judgment.

B A **sound** understanding of the subject matter, sufficient, without assistance, for the solution of more advanced practical problems either by calculation or by the exercise of judgment.

C A **thorough** understanding of the subject matter, achieving without assistance, a first attempt accuracy of 80% in the solution of advanced practical problems either by calculation or by the exercise of judgment.

P- **Basic** practical application of relevant procedures

P+ **Thorough** practical application of relevant procedures

Note The pass mark for the examinations set to this syllabus is 80%.

1 PRICIPLES OF FLIGHT

1.1- AERODYNAMICS		Standard Prior to: Solo	P/Cert
1.1.1	**Terminology**		
	Identify descriptions/drawings of the following terms:		
	(a) aerofoil; span; chord; camber; thickness/chord ratio	A	B
	(b) relative airflow; angle of attack	A	B
	(c) total reaction; lift; drag	A	B
1.1.2	**Design features**		
	State the purpose of the following design features/controls:		
	(a) dihedral; aspect ratio; sweepback; wash-out	A	B
	(b) flaps	A	B
	(c) trim tabs	A	B
1.1.3	**Lift and drag**		
	Define the relationship between the following factors in the production of lift by an aerofoil;	A	B
	(a) Air density		
	(b) Surface area		
	(c) Angle of attack		
	(d) Velocity		
	Define the relationship between the following factors in the production of drag by an aerofoil;	A	B
	(a) Angle of attack		
	(b) Velocity		
	(c) Shape		

	(d) Effect of damage to an aerofoil surface State whether lift and drag of an aerofoil will increase or decrease with changes in: (a) airspeed; (b) angle of attack; (c) flap setting. List the types of drag, which affect an aircraft in flight. ***Note:*** *Types are:* *(a) Parasite (zero lift):* *form, interference, skin friction;* *(b) Induced (lift dependent).* State how Total Drag varies with airspeed. ***Note:*** *Students should be aware that these values are representative only.*	A A A	B B B
1.1.4	**Straight and level flight** State the relationship between attitude, angle of attack and airspeed in level flight. ***Note:*** *Students should appreciate that this relationship is only true in level flight.*	A	B
1.1.5	**Changes in angle of attack** State/identify the effect of changes in angle of attack up to the stalling angle on: (a) pressure changes above and below the wing; (b) changes in airflow characteristics; streamlined to turbulent (c) lift and drag; Recall typical angles of attack at which a basic low speed aerofoil: (a) generates maximum lift (16 degrees); (b) is most efficient (best L/D : 4 degrees); and relate these angles to: i. stall speed; ii. best glide speed.	A A A	B B B

1.2 – STABILITY AND CONTROL		**Standard prior to:**	
		Solo	**P/Cert**
1.2.1	State the effect of the factors listed below on the stability and control of an aircraft in each of the three planes of movement: (a) longitudinal stability: i. position of CG; Ii. movement of centre of pressure; iii. changes in thrust; (b) lateral stability: i. high versus low set wings; ii. dihedral iii. sweepback. (c) directional stability: i. large fore/aft displacement of the CoG; ii. large versus small fin and rudder moment. Recognise statements/diagrams which describe static and dynamic stability. Explain the purpose of: (a) trim tabs (fixed and cockpit controlled); (b) balance tabs; (c) aerodynamic balance; (d) mass balance.	A A A A A	B B B B B

2 OPERATION OF AIRCRAFT

2.1- MANOEUVERING		**Standard prior to:**	
		Solo	**P/Cert**
2.1.1	Identify the forces of lift, weight, thrust and drag acting on an aircraft in: (a) "steady" level flight; (b) a "steady" climb; (c) a "steady" descent; (d) a balanced level turn.	B	C
	State why: (a) power must be applied to maintain speed in a level turn; (b) an aircraft tends to overbank in level and climbing turns and not in descending turns.	B	C/P
	State: (a) the effect of aileron drag on turn performance at low airspeed;	B	C
2.1.2	**Climbing**		
	Differentiate between rate and angle of climb.	B	C
	State the effect (increase/decrease) on climb rate and angle resulting from changes in: (a) weight; (b) power; (c) airspeed (changed from recommended); (d) flap deflection; (e) head/tailwind component, windshear; (f) bank angle; (g) altitude and density altitude.	B	C
2.1.3	**Descents:**		
	State the effect on rate, angle of descent and attitude resulting from changes in: (a) power - constant IAS; (b) flap - constant IAS.	B	C
	State the effect of head/tail wind on the glide path and glide distance (relevant to the earth's surface).	B	C
	Explain why a pilot should maintain the recommended glide speed, if undershooting an approach to land.	B	C
2.1.4	**Turning**		
	Describe what is meant by a balanced turn.	B	C
	Describe the terms "g"; wing loading; load factor.	B	C
	During a level turn, state the effect (increase/decrease) of bank angle on: (a) stall IAS; (b) the aircraft's structure (load factor).	A	C
	List reasons for avoiding steep turns: (a) shortly after take-off; (b) during a glide - particularly on approach.	B	C
2.1.5	**Stalling, spinning & spiral dives.**		
	Define stalling angle and describe: (a) the symptoms when approaching the stall; (b) the characteristics of a stall.	B	C
	Explain: (a) the effect of using ailerons when approaching and during the stall; (b) why an aircraft may stall at different speeds.	B	C
	List the effect (increase/decrease/nil) of the following variables on the level flight stall IAS:	B	C

	(a) power; (b) flap; (c) wind shear; vertical gusts; (d) manoeuvres;		
	(e) weight; (f) frost and ice; (g) altitude.		
2.1.6	**Taxi, take-off and landing**		
	Describe the stability and control characteristics, during ground operation of; (a) nose wheel aircraft (b) tail wheel aircraft	B	C
	Describe the result of the following factors on the controllability of an aircraft: (a) propeller torque and slipstream effect; (b) gyroscopic effect;	B	C
	Describe the term "ground effect" and its effect on aircraft performance.	B	C
	Cite situations which may cause an aircraft to "wheel barrow" and state the recommended pilot action in the event of such an occurrence.		
	List the advantages of taking-off and landing into wind.	B	C
	Compare a flapless approach to an approach with flap in terms of: (a) attitude during descent; (b) approach path angle; (c) landing roll.	B	C
	Describe the effect of wind shear (wind gradient) and ground effect on aerodynamic and flight characteristics and identify.	B	C
2.1.7	**Wake turbulence**		
	Note: *If a student is operating from an aerodrome where helicopters or heavy aircraft also operate, all 'B' items must be taught prior to pre-solo.*		
	List factors affecting the strength of vortex flow : (a) aircraft weight, speed, wing shape	B	C
	State the primary control hazard that may result from a vortex encounter. (a) approximate location of vortices (in still air) generated by a preceding aircraft during: i. cruise flight; ii. take-off and landing; (b) approximate take-off/touch-down points and flight profiles	B	C
	Caution: Students should be advised that heavy/med. aircraft are capable of steep climb gradients after take-off when operating at low take-off weights.		
	Recall that rotor downwash can be a hazard to a radius of approximately thrice the rotor diameter, and that this area should be avoided by light aircraft. ***Note:*** *Students should be aware of wake turbulence sep. standards in order to make value judgements to provide their own separation at non-controlled aerodromes.*	B	C

2.2 –AIRCRAFT PERFORMANCE CONSIDERATIONS		**Standard Prior to:**	
		Solo	**P/Cert**
2.2.1	Given that certain flight conditions remain constant, state the effect of: (a) changes in weight and altitude (height) on: i. angle of attack and IAS in level flight; ii. level flight range and endurance; iii. glide range and endurance. iv. rate of climb v. take off distance required. vi. landing distance required. (b) changes in head/tail wind component on:	B	C

	i. level flight range and endurance; ii. glide range and endurance. iii. take off distance required. iv. landing distance required.		
	Identify different types of climbs; (a) maximum angle climb (b) maximum rate climb (c) cruise climb	B	C
2.2.2	Take off techniques Explain the (a) into wind (b) cross wind (c) soft field (d) rough field Explain differences in aircraft performance from low density to high density altitude airstrips Explain the importance of pre-take off checks Explain the importance of pre-take off safety brief	B/P	C/P+
2.2.3	Explain landing techniques; (a) into wind (b) cross wind i. crabbed approach ii. wing into wind Explain differences in landing techniques; (a) nose wheel aircraft i. importance of reducing weight on nose wheel. (b) tail wheel aircraft i. three point ii. wheeler **Note:** Students must be able to explain the landing technique of their training aircraft thoroughly and must also have a sound understanding of other types of undercarriage differences.	B/P	C/P+
2.2.4	Circuit Operations; (a) legal requirements (b) circuit pattern, names of circuit legs (c) mandatory recommended radio calls (d) pre-landing checks	B/P	C/P+
2.2.5	Ground operations; (a) effect of wind on ground handling (b) braking and testing of brakes (c) differences in directional control between; i. nose wheel aircraft ii. tail wheel aircraft	B/P	C/P+
2.2.6	Emergency procedures (a) forced landings (b) engine failure on take off (c) engine failure in the circuit (d) missed approach/ go round	B/P	C/P+

2.3 – AIRCRAFT GENERAL KNOWLEDGE		**Standard prior to:**	
		Solo	**P/Cert**
2.3.1	**Terminology** With respect to the items listed below recall the standards abbreviations used and meet the objectives stated: **Direction:** (a) recall the following methods of expressing direction: i. as a three figure group; ii. as a two figure group for runways;	A A	B B

	iii. in the clock code; (b) define heading (HDG); (c) define True (T), Magnetic (M), and Compass North;		
	Distance, Speed and Velocity (a) state the units used for distance: i. navigation - nautical miles (NM); ii. visibility - metres (m), kilometres (km); (b) define wind velocity (W/V);	A	B
	Time: (a) mentally convert local time (EST, CST, WST) to UTC and vice versa;	A	B
	Vertical measurement. (a) state the unit used (ft) for vertical measurement and differentiate between: i. height; ii. altitude; iii. elevation;	A	B
	Other units. (a) state the units used for: i. runway dimensions; ii. temperature - degrees Celsius; iii. pressure - hectopascals (hPa), psi, iv. weight - kilograms (kg), pounds (lb); v. volume - litres (l), (b) given W/V and runway directions determine the appropriate runway for take-off/landing: i. the direction (left/right) of any cross wind component; ii. the value of crosswind component.	A	B
2.3.2	**Power plants and systems – Basics.** Demonstrate a basic understanding of the principle of operation of a two/four stroke cycle internal combustion engine and state the purpose of the following components: (a) cylinders; pistons; piston rings; inlet/exhaust valves; crank shaft; cam shaft; spark plugs.	A	B
	State the purpose of the following components/features: (a) carburettor; (b) throttle; (c) CDI, dual ignition; (d) regulator/rectifier; (e) battery, battery compartment vent; (f) propeller; (g) circuit breaker, fuse, bus bar; (h) oil cooler; (i) fuel tank vents.	A	B
	State the purpose of the following gauges: (a) RPM (Tachometer); (b) CHT, EGT; (c) voltmeter, ammeter; (d) fuel pressure; (e) oil temperature and pressure. ***Note:*** *"Purpose" means the importance in relation to monitoring the powerplant and systems.*	A	B
	State how the following affect the power output of an engine: (a) throttle position; (b) RPM; (c) air density.	A	B
	State the purpose of engine lubrication.	B	B

	Note: *"Purpose" means the reduction of friction and engine cooling.* Describe the effect of excessively rich and lean mixture strengths on engine operation.	A	B
2.3.3	**Fuels and Oils.**		
	List safety precautions when refuelling aircraft;	A	B
	List reasons why a fuel drain is done and when;	A	B
	List sources of fuel contamination;	A	B
	State the advantage of filling tanks prior to overnight parking;	A	B
	Explain the terms: (a) viscosity, oil sump, multi-grade oils; (b) octane rating; (c) Avgas, Avtur, ULP;	A	B
	and indicate how to identify Avtur, Avgas and ULP;	A	B
	List factors conducive to fuel vapourisation and identify procedures to minimise this phenomenon.	A	B
	Identify differences in fuel guage indications in tail and level flight attitudes in a tail wheel aircraft.	A	B
	Pre-mix requirements for two strokes	A	B
	Explain the fuel system terms; (a) gravity feed (b) pump feed (c) difference between electronic boost pumps and mechanical pumps (d) fuel tank vents and importance	A	C
2.3.4	**Engine Handling.**		
	List the causes and effect of detonation.	A	B
	State the effect on engine operation of: (a) using a mixture that is too rich or too lean.	B	C
	Give reasons for the following limitations/actions: (a) minimum oil pressure; (b) minimum/maximum oil temperature; (c) minimum/maximum CHT; (d) maximum RPM; (e) ignition checks: pre-takeoff and shutdown; (f) prolonged use of starter motor. (g) engine warm up on prolonged descents.	B	C
	Explain the significance of blue or black exhaust smoke.	A	B
2.3.5	**Malfunctions.**		
	With respect to a malfunction or a failure of the components listed in (a) to (h) below:		
	• identify cockpit indications which may suggest a malfunction	A	B
	• state pilot actions (if any) to rectify the problem	A	B
	• describe the consequences if the malfunction cannot be rectified.	A	B
	Components: (a) Regulator/rectifier; (b) CDI's or ignition modules; (c) battery; (d) gnition switch; (e) fuel vent (blockage), fuel/booster pump; (f) oil cooler; (g) hydraulic brakes		
	With respect to the following engine gauges:		
	• identify reasons for an abnormality	B	C

	• state pilot actions (if any) to rectify a problem	B	C
	• state the consequences if the problem cannot be rectified by the pilot	B	C
	Engine Guages: (a) oil temperature and pressure; (b) CHT; (c) fuel pressure; (d) tachometer; (e) ammeter; (f) voltmeter.		
2.3.6	**Engine Icing.** ***Note:*** *Students should be advised that the following material is general in nature and that the operational application of engine ice prevention/control varies between individual aircraft and engines. Pilots should therefore follow procedures recommended in the pilots' operating handbook.*		
	Describe the method for checking the operation of carburettor heat prior to take-off.	B/P	C/P+
	For aircraft fitted with a fixed pitch propeller, identify cockpit indications which would signify the presence of engine ice.	B	C
	Discuss the use of carburettor heat for: (a) anti-icing; (b) de-icing; (c) ground operation.	B	C
	State the effect of the application of carburettor heat on engine performance and engine instrument indications.	B	C
2.3.7	**Flight Instruments.** General:		
	(a) explain the following terms: i. pitot-static system; ii. pitot pressure; static pressure; iii. alternate static source; iv. pressure error;	A	B
	(b) explain the relationship between: i. IAS; TAS.	A	B
	(c) have a basic knowledge of the principle of operation and construction of the: i. ASI, VSI, altimeter;	A	B
	State the effect of the following factors on the accuracy of pressure instrument indications: (a) ASI: i. blockage/leaks (pitot or static); (b) VSI: i. blockage of the static source; ii. lag. (c) Altimeter: i. blockage of the static source; ii. lag; iii. incorrect sub-scale settings; iv. errors due to changes in atmospheric temperature and pressure.	A	B
	Magnetic compass Background knowledge Principle of construction:		
	• magnetic needles point to magnetic north	A	B
	• fluid decreases oscillations and friction	A	B
	• should not contain bubbles	A	B
	State the effect of the following errors on compass indications in the southern hemisphere: (a) turning errors;	A	B

	(b) acceleration errors. State the purpose of and use a compass correction card to determine magnetic heading. Interpret colour codes on an ASI.	A	B
	Note: *Pressure instruments are the:* • *ASI, altimeter, VSI.* State the effect of a blockage of the pitot or static source on the indications displayed by each pressure instrument listed above. State the effect of an incorrect sub-scale setting on the reading of an altimeter;	A A	B B
	State the effect of using an alternate static source located inside the cockpit, on the reliability of pressure instrument indications. Describe checks which would ensure the serviceability of a magnetic compass and the flight instruments mentioned above.	A A	B B

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