SECTION 1.2 General aeronautical knowledge (AK)

Unit 1.2.1 RARO: RPL aeronautical radio operator

1. Reserved

2. Aeronautical radio telephony

2.1 Operation of aeronautical radio systems

2.1.1 Meets the English language to Aviation English language standard (AEL).

2.1.2 Recall the phonetic alphabet and the method of transmitting numerals.

2.1.3 Recall the correct use of aircraft call-signs.

2.1.4 State standard radio procedures for outside controlled airspace (OCTA).

2.1.5 State how transmission of time is conducted.

2.1.6 State how to listening to the radio.

2.1.7 State how to establish and maintain communications.

2.1.8 State the hazards of clipped transmissions and the consequences.

2.1.9 Correct procedure for the conduct of a routine pre-flight test of an aircraft radio-telephone, including the following:

(a) use of radio transmit and receive selector switches;

(b) turning radio on;

(c) selecting correct frequencies;

(d) use of squelch control;

(e) selection of radio navigation equipment;

(f) correct use of a microphone;

(g) use of intercom and public address system;

(h) voice activated systems.

2.1.10 Describe the correct procedure for routine fault finding and correction.

2.1.11 State the standard phraseology to be used to report aircraft positions in the circuit and the required calls for local flights.

2.1.12 State the responsibilities of an aeronautical radio operator in relation to the following:

(a) secrecy of communications;

(b) unauthorised transmissions.

2.1.13 Describe the function of each of the following components of an aeronautical radio system:

(a) power source/battery switch;

(b) radio master;

(c) fuses and circuit breakers;

(d) microphone;

(e) transmitter;

(f) receiver;

(g) antenna;

(h) headphones and speaker.

2.1.14 Describe the difference between a distress and an emergency message and the standard phrases used in both cases.

2.1.15 Accurately extract radio failure procedures from ERSA.

2.1.16 In relation to the use of an aeronautical radiotelephone, describe the controls used to transmit and receive, including audio panel selections.

2.2 Radio waves

2.2.1 Describe the basic principles and characteristics of radio waves, wave propagation, transmission and reception for the following:

(a) radio frequency band ranges (MF, HF, VHF, UHF);

(b) properties of radio waves and the effective range of transmissions;

(c) propagation of paths of radio waves:

(i) ground waves;

(ii) sky waves;

(d) factors affecting the propagation of radio waves and reception:

(i) terrain;

(ii) ionosphere;

(iii) sun spot activity;

(iv) interference from electrical equipment;

(v) thunderstorms;

(vi) power attenuation;

(e) radio antennas:

(i) characteristics of antennas;

(ii) use of antennas.

2.2.2 Describe the limitations of VHF and HF signals and factors affecting quality of reception and range of signal.

Unit 1.2.2 PAKC: PPL aeronautical knowledge – all aircraft categories

1. Reserved

2. Power plants and systems

2.1 Piston engines

2.1.1 Describe the meaning of full throttle height.

2.1.2 Describe the effect of increasing altitude and temperature on engine performance.

2.1.3 Describe the effect of the following factors on engine performance:

(a) fuel/air mixture strength;

(b) density height and altitude for:

(i) normally aspirated engines; and

(ii) turbocharged/supercharged engines.

2.2 Supercharging

2.2.1 Describe the purpose of supercharging.

2.2.2 Describe the common methods used to achieve supercharging.

2.2.3 Describe the device(s) used to limit supercharging of the intake system.

2.2.4 Describe the actions a pilot should take if engine limits are exceeded due to supercharging.

2.3 Flight instruments

2.3.1 Explain the following terms:

(a) pitot-static system;

(b) pitot pressure static pressure;

(c) alternate static source;

(d) pressure error;

2.3.2 Describe the meaning of the following airspeeds:

(a) indicated (IAS);

(b) calibrated (CAS);

(c) true (TAS).

2.3.3 For the following pressure instruments, state the effect of the factors listed under each instrument on the accuracy of the indications for that instrument:

(a) ASI:

(i) blockage/leaks (pitot or static);

(ii) manoeuvre induced errors (for example, sharp pull out from a dive);

(b) VSI:

(i) blockage of the static source;

(ii) lag;

(iii) the benefits of a IVSI;

(c) Altimeter:

(i) blockage of the static source;

(ii) lag;

(iii) incorrect subscale settings;

(iv) errors due to changes in atmospheric temperature and pressure.

2.3.4 For a direct reading magnetic compass, describe the principles of construction in relation to the following:

(a) magnetic needles point to magnetic north;

(b) fluid decreases oscillations and friction;

(c) fluid in the compass should not contain bubbles;

(d) pendulosity of magnet systems causes errors.

2.3.5 State the effect of the following errors on compass indications in the southern hemisphere:

(a) turning errors;

(b) acceleration errors.

2.3.6 State the purpose and use of a compass correction card to determine magnetic heading.

2.3.7 Describe the methods used to determine the serviceability of the primary flight instruments before commencing a flight.

3. Aeronautical radio telephony

3.1 Operation of aeronautical radio systems

(a) recall the phonetic alphabet and the method of transmitting numerals;

(b) recall the correct use of aircraft call-signs;

(c) state standard radio procedures for OCTA;

(d) state how time is transmitted in a message;

(e) state how to effectively listen to the radio;

(f) state how to establish and maintain communications;

(g) state the hazards of clipped transmissions and the consequences.

3.2 Routine pre-flight test of an aircraft radio-telephone

(a) for the following, describe the correct technique and procedure for conducting a routine pre-flight test of an aircraft radio telephone:

(i) use of radio transmit and receive selector switches;

(ii) turning radio on;

(iii) selecting correct frequencies;

(iv) use of squelch control;

(v) selection of radio nav equipment;

(vi) correct use of a microphone;

(vii) use of intercom and public address system;

(viii) voice activated systems.

3.3 Fault finding and corrective action

3.3.1 State the correct procedure for routine fault finding and the corrective actions a pilot should take in relation to a fault.

3.4 Reporting position in circuit and for local flights

3.4.1 State the standard phraseology to be used to report the position of an aircraft in the circuit and required calls for local flights.

3.5 Responsibilities of an aeronautical radio operator

3.5.1 State the responsibility of an aeronautical radio operator for the following:

(a) secrecy of communications;

(b) unauthorised transmissions.

3.6 State the function of the following components of an aeronautical radio system

(a) power source/battery switch;

(b) radio master;

(c) fuses and circuit breakers;

(d) microphone;

(e) transmitter;

(f) receiver;

(g) antenna;

(h) headphones and speaker.

3.7 Distress and emergency messages

3.7.1 Describe the difference between a distress and emergency message and the standard phrases used.

3.8 Radio failure procedures

3.8.1 Extract and use the radio failure procedures from ERSA.

3.9 Radiotelephone controls

3.9.1 In relation to the use of an aeronautical radiotelephone, describe the controls used to transmit and receive, including audio panel selections.

3.10 Radio waves

3.10.1 Describe the basic principles and characteristics of radio waves, wave propagation, transmission and reception:

(a) radio frequency band ranges (MF, HF, VHF, UHF);

(b) properties of radio waves and the effective range of transmissions;

(c) propagation of paths of radio waves:

(i) ground waves;

(ii) sky waves.

(d) factors affecting the propagation of radio waves and reception:

(i) terrain;

(ii) ionosphere;

(iii) sun spot activity;

(iv) interference from electrical equipment;

(v) thunderstorms;

(vi) power attenuation;

(e) radio antennas:

(i) characteristics of antennas;

(ii) use of antennas.

3.10.2 Describe the limitations of VHF and HF signals and factors affecting quality of reception and range of signal.

Unit 1.2.3 GNSSC: Basic GNSS and en route GPS navigation principles – all categories

1. Reserved

2. Global navigation satellite system (GNSS)

2.1 GNSS operation

2.1.1 Describe the principles of operation, performance limitations and errors of a GNSS system, including the following:

(a) methods of position fixing using a GNSS system;

(b) the GNSS operating procedures which provide safeguards against navigational error and loss of situational awareness;

(c) GNSS operating procedures for typical navigational tasks using a specific type of aircraft equipment;

(d) indications of waypoint passage;

(e) GNSS operational and serviceability checks;

(f) the human factors limitations associated with the use of GNSS equipment;

(g) the requirements applicable to pilots and equipment for GNSS operations.

Unit 1.2.4 PAKA: PPL aeronautical knowledge – aeroplane

1. Reserved

2. Power plants and systems

2.1 Propellers

2.1.1 List reasons for propeller overspeed in aeroplanes fitted with a fixed pitch propeller and state the remedial action a pilot should take in the event of an overspeed.

2.2 Aircraft systems

2.2.1 Describe or state the function of the following typical components installed in aeroplanes, including the possibility of 'overpowering the system and associated precautions a pilot should take:

(a) stall warning devices;

(b) auto-pilot components, including the following:

(i) roll attitude heading pitch controls;

(ii) trim indicator;

(iii) cut-out mechanisms.

3. Take-off and landing performance

Note: Use of take-off and landing charts is included in 'Type' training.

3.1.1 State the effect (increase/decrease) of the following factors on take-off, landing, and take-off climb performance:

(a) strength of headwind/tailwind component;

(b) air temperature;

(c) QNH;

(d) density height (non-standard conditions);

(e) airfield elevation;

(f) runway slope;

(g) surface conditions, including the following:

(i) wet runway;

(ii) dry runway;

(iii) slushy runway;

(h) ground effect and windshear;

(i) frost on an aircraft.

3.1.2 Differentiate between pressure height and density height.

3.1.3 Describe how to use an altimeter to obtain the following:

(a) local QNH at an aerodrome;

(b) pressure height of an aerodrome;

(c) elevation of an aerodrome.

3.1.4 Explain the following terms:

(a) maximum structural take-off and landing weight;

(b) climb weight limit.

3.1.5 State the likely results of exceeding aircraft weight limits.

Unit 1.2.5 PAKH: PPL aeronautical knowledge – helicopter

1. Reserved

2. Aircraft general knowledge

2.1 Engine and transmission systems

2.1.1 Describe the actions a pilot should take in the event of a malfunction of an exhaust driven supercharger or waste gate and the likely indication of the malfunction.

2.1.2 Reserved.

Unit 1.2.6 PAKG: PPL aeronautical knowledge – gyroplane

1. Reserved

2. Power plants and systems

2.1 Propellers

2.1.1 List reasons for propeller overspeed in gyroplanes fitted with a fixed pitch propeller and state the associated remedial pilot action.

2.2 Aircraft systems

2.2.1 Describe or state the function of the stall warning devices installed in gyroplanes.

3. Take-off and landing performance

3.1.1 State the effect (increase/decrease) of the following factors on take-off, landing, and take-off climb performance:

(a) strength of headwind/tailwind component;

(b) air temperature;

(c) QNH;

(d) density height (non-standard conditions);

(e) airfield elevation;

(f) runway slope and surface, including wet and slushy runways;

(g) ground effect and windshear;

(h) frost on an aircraft.

3.1.2 Differentiate between pressure height and density height.

3.1.3 Describe how to use an altimeter to obtain:

(a) local QNH at an aerodrome;

(b) pressure height of an aerodrome;

(c) elevation of an aerodrome.

3.1.4 Explain the following terms:

(a) maximum structural take-off and landing weight;

(b) climb weight limit.

3.1.5 State the likely results of exceeding aircraft weight limits.

Unit 1.2.7 PAKP: PPL aeronautical knowledge – powered-lift – *Reserved*

Unit 1.2.8 PAKS: PPL aeronautical knowledge – airship – *Reserved*

Unit 1.2.9 CAKC: CPL aeronautical knowledge – all aircraft categories

1. Reserved

2. Aircraft general knowledge

2.1 Power plants

2.1.1 Describe the purpose and principle of operation of a simple carburettor in terms of the following:

(a) idling jets;

(b) main jets;

(c) acceleration jets.

2.1.2 State the precautions to be observed to avoid detonation when operating a supercharged engine.

2.1.3 Supercharging

(a) state the purpose of supercharging;

(b) list the types of superchargers for the following:

(i) geared (mechanically driven:

(ii) turbo (exhaust driven);

(c) state the purpose and function of the following components:

(i) geared superchargers:

(ii) impeller;

(A) diffuser;

(iii) turbo-chargers

(A) compressor;

(B) waste gate (fixed, manual and automatic).

2.2 Aircraft systems

2.2.1 Explain the function of the following typical components mentioned in pilot operating handbooks:

(a) fuel system components, including the following:

(i) auxiliary/booster pump;

(ii) fuel drain;

(iii) fuel pressure gauge;

(iv) fuel flow gauge;

(v) check valves;

(b) lubrication system, including the following:

(i) by-pass valves;

(ii) oil cooler;

(iii) wet sump system;

(iv) dip stick;

(c) electrical and ignition systems, including the following:

(i) alternator generator;

(ii) voltage regulator overvoltage relay;

(iii) ammeter voltmeter;

(iv) circuit breaker fuse;

(v) battery ampere hours;

(vi) bus bar battery master switch;

(vii) starter motor starter relay;

(viii) dual ignition distributor ignition switch;

(ix) external power receptacle, ground/flight switch;

(d) hydraulic system components, including the following:

(i) accumulator;

(ii) actuators;

(iii) check valve restrictors;

(e) typical fire protection detectors, including the following:

(i) overheat – thermal switches;

(ii) rate of temperature rise – thermocouple;

(iii) flame;

(f) typical fire protection warning devices, including the following:

(i) lights;

(ii) audio;

(g) types of fire extinguisher and usage;

(h) engine cooling devices, including the following:

(i) fins;

(ii) baffles;

(iii) cowl flaps.

2.2.2 Describe or state the function of the typical retractable undercarriage system components mentioned in pilot operating handbooks, including the following:

(a) uplocks/downlocks;

(b) anti-retraction devices;

(c) aural/visual warning devices;

(d) emergency systems;

(e) free fall;

(f) electric, hydraulic, pneumatic.

2.2.3 Describe or state the function of the following typical components mentioned in pilot operating handbooks, including considering the possibility of overpowering the system and the associated precautions pilots should take when operating these system:

(a) fuel system components, including the following:

(i) auxiliary/booster pump;

(ii) fuel drain;

(iii) fuel pressure gauge;

(iv) fuel flow gauge;

(v) check valves.

(b) lubrication system, including the following:

(i) by-pass valves;

(ii) oil cooler;

(iii) wet sump system;

(iv) dip stick.

(c) stall warning devices;

(d) electrical and ignition systems, including the following:

(i) alternator generator;

(ii) voltage regulator overvoltage relay;

(iii) ammeter voltmeter;

(iv) circuit breaker fuse;

(v) battery ampere hours;

(vi) bus bar battery master switch;

(vii) starter motor starter relay;
(viii) dual ignition distributor ignition switch;
(ix) external power receptacle, ground/flight switch;

(e) hydraulic system, including the following:
(i) accumulator;
(ii) actuators;
(iii) brake master cylinder;
(iv) check valve restrictors.

(f) auto-pilot, including the following:
(i) roll attitude heading pitch controls;
(ii) trim indicator;
(iii) cut-out mechanisms.

(g) typical fire protection detectors, including the following:
(i) overheat – thermal switches;
(i) rate of temperature rise – thermocouple;
(ii) flame;

(h) typical fire protection warning devices, including the following:
(i) lights;
(ii) audio;

(i) types of fire extinguishers and usage;

(j) engine cooling devices, including the following:
(i) fins;
(ii) baffles;
(iii) cowl flaps.

2.3 Barometric flight instruments

2.3.1 Explain the relationship between the following airspeeds:
(a) indicated (IAS);
(b) calibrated (CAS);
(c) true (TAS);
(d) equivalent (EAS).

2.3.2 Explain the basic principle of operation and construction of the following instruments:
(a) ASI;
(b) VSI;
(c) altimeter;
(d) artificial horizon;
(e) direction indicator;
(f) rate of turn indicator;
(g) turn coordinator.

2.3.3 State the effect of the following factors on the accuracy of pressure instrument indications:
(a) ASI:
(i) blockage/leaks (pitot or static); and
(ii) manoeuvre induced errors (for example, sharp pull out from a dive);
(b) VSI:
(i) blockage of the static source; and
(ii) lag;

Note: Student should be aware that an IVSI compensates for lag errors.

(c) altimeter:

(i) blockage of the static source; and

(ii) lag; and

(iii) incorrect subscale settings; and

(iv) errors due to changes in atmospheric temperature and pressure.

2.4 Gyroscopic flight instruments

2.4.1 Explain the gyroscopic properties of rigidity and precession.

2.4.2 In relation to gyroscopic flight instruments:

(a) compare the advantages and disadvantages of air driven and electrically driven gyroscopes;

(b) state the effect on a directional indicator of the following:

(i) apparent wander/drift;

(ii) maximum at the poles, zero at the equator;

(iii) transport wander;

(c) describe the advantages of a directional indicator fitted with a flux valve.

2.5 Direct reading magnetic compass

2.5.1 Describe the principle of construction of a magnetic compass.

2.5.2 Explain how needles point to magnetic north.

2.5.3 Describe how fluid decreases oscillations and friction and why the chamber should not contain air bubbles.

2.5.4 Explain how pendulosity of magnet systems causes errors.

2.6 Aeronautical radio telephony

2.6.1 Operation of aeronautical radio systems:

(a) recall the phonetic alphabet and the method of transmitting numerals;

(b) recall the correct use of aircraft call-signs;

(c) state standard radio procedures for OCTA;

(d) state how transmission of time is conducted;

(e) state how to listening to the radio;

(f) state how to establish and maintain communications;

(g) state the hazards of clipped transmissions and the consequences.

2.6.2 Correct procedure for the conduct of a routine pre-flight test of an aircraft radio-telephone in the following:

(a) use of radio transmit and receive selector switches;

(b) turning radio on;

(c) selecting correct frequencies;

(d) use of squelch control;

(e) selection of radio navigation equipment;

(f) correct use of a microphone;

(g) use of intercom and public address system;

(h) voice activated systems.

2.6.3 State procedure for routine fault finding and correction.

2.6.4 State the standard phraseology for positions in the circuit and required calls for local flights.

2.6.5 State the responsibilities of an aeronautical radio operator with respect to the following:

(a) secrecy of communications;

(b) unauthorised transmissions.

2.6.6 State the function of the following components of an aeronautical radio system:

(a) power source/battery switch, radio master, fuses and circuit breakers;

(b) microphone;

(c) transmitter;

(d) receiver;

(e) antenna;

(f) headphones and speaker.

2.6.7 Describe the difference between a distress and emergency message and the standard phrases used.

2.6.8 Extract radio failure procedures from ERSA.

2.6.9 In relation to the use of an aeronautical radiotelephone describe the controls used to transmit and receive, including audio panel selections.

2.7 Radio waves

2.7.1 Describe the basic principles and characteristics of radio waves, wave propagation, transmission and reception:

(a) radio frequency band ranges (MF, HF, VHF, UHF);

(b) properties of radio waves and the effective range of transmissions;

(c) propagation of paths of the following types of radio wave:

(i) ground waves;

(ii) sky waves;

(d) factors affecting the propagation of radio waves and reception with respect to the following:

(i) terrain;

(ii) ionosphere;

(iii) sun spot activity;

(iv) interference from electrical equipment;

(v) thunderstorms;

(vi) power attenuation;

(e) the following types of radio antennas:

(i) characteristics of antennas;

(ii) use of antennas.

2.7.2 Describe the limitations of VHF and HF signals and factors affecting quality of reception and range of signal.

Unit 1.2.10 CAKA: CPL aeronautical knowledge – aeroplane

1. Reserved

2. Engine and systems

2.1 Propellers

2.1.1 Compare the performance characteristics of various propeller and engine systems, including the following:

(a) aeroplanes with fixed pitch propellers and those fitted with a variable pitch propeller;

(b) engine operation (within limits) at high MP/low RPM and low MP/high RPM;

(c) normally aspirated and turbocharged/supercharged engines.

2.1.2 Explain the following with regard to a variable pitch propeller adopting either a full fine or full coarse pitch when the propeller oil pressure is lost:

(a) centrifugal twisting moment (CTM) tends to reduce (fine) pitch;

(b) counter weights, when used, increase (coarsen) pitch;

(c) oil pressure is used to decrease pitch if counterweights are fitted;

(d) oil pressure is used to increase pitch if counterweights are not fitted.

2.1.3 Describe the following terms:

(a) blade angle, helix angle/pitch;

(b) propeller thrust and torque;

(c) thrust horsepower (THP);

(d) brake horsepower (BHP);

(e) asymmetric blade effect.

2.1.4 Describe how a propeller converts engine power into thrust and explain what is meant by fine and course pitch stops.

2.2 Constant speed units (CSU)

2.2.1 Explain the principle of operation of a CSU.

2.2.2 Describe the effect of a CSU malfunction on engine operation.

2.2.3 Explain the method of using engine controls in the event of a malfunction of a CSU.

2.2.4 Describe the cockpit indications in an aeroplane fitted with a variable pitch propeller which could signify:

(a) the presence of engine ice; and

(b) when engine ice has been cleared after application of ‘carb heat’.

2.2.5 Explain the effect of using carburettor heat on aeroplanes fitted with a CSU.

2.2.6 Describe how power output is controlled when operating aeroplanes fitted with a variable pitch propeller and describe how engine instruments are used to monitor power.

2.2.7 List the precautions necessary if operating a variable pitch propeller when:

(a) conducting ground checks; and

(b) changing power (i.e. use of throttle/RPM levers).

2.3 Undercarriage system

(a) describe the purpose and function of the following:

(i) oleos/shock struts;

(ii) shimmy dampers;

(iii) nose wheel steering/castering;

(b) describe the purpose and function of the following retractable undercarriage components:

(i) uplocks/downlocks;

(ii) anti-retraction devices;

(iii) aural/visual warning devices;
(iv) emergency systems;
(v) free fall;
(vi) electric, hydraulic, pneumatic.

Unit 1.2.11 CAKH: CPL aeronautical knowledge – helicopter

1. Reserved

2. Helicopter general knowledge

2.1 Engine and transmission systems

2.1.1 For each of the following systems, explain its function and that of the major components listed below the system and state the indications that a pilot would observe if the system or one of the components malfunctioned:

(a) exhaust driven supercharger systems (turbochargers):

(i) compressors;

(ii) turbines;

(iii) waste gates;

(b) main and tail rotor systems:

(i) abnormal vibrations from main and tail rotor systems;

(ii) flight control systems;

(iii) trimming devices;

(iv) stabilisers;

(c) transmissions:

(i) clutches;

(ii) free-wheel units;

(iii) rotor brakes;

(d) oil systems:

(i) reservoirs;

(ii) pressure pumps and filters;

(iii) pressure gauges;

(iv) temperature gauges;

(v) scavenge pumps;

(vi) oil coolers;

(vii) pressure relief valves;

(viii) oil cooler by-pass valves;

(ix) dipsticks.

Unit 1.2.12 CAKG: CPL aeronautical knowledge – gyroplane – *Reserved*

Unit 1.2.13 CAKP: CPL aeronautical knowledge – powered-lift – *Reserved*

Unit 1.2.14 CAKS: CPL aeronautical knowledge – airship – *Reserved*