CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

# Advisory Circular
# AC61-5

**Revision 31**

**24 November 2017**

## Pilot Licences and Ratings— Commercial Pilot Licence

### General

Civil Aviation Authority advisory circulars contain guidance and information about standards, practices, and procedures that the Director has found to be an **acceptable means of compliance** with the associated rules and legislation.

However, the information in the advisory circular does not replace the requirement for participants to comply with their obligations under the Civil Aviation Rules, the Civil Aviation Act 1990 and other legislation.

An advisory circular reflects the Director's view on the rules and legislation. It expresses CAA policy on the relevant matter. It is not intended to be definitive. Consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices, or procedures are found to be acceptable they will be added to the appropriate advisory circular. Should there be any inconsistency between this information and the rules or legislation, the rules and legislation take precedence.

An advisory circular may also include **guidance material** generally, including guidance on best practice as well as guidance to facilitate compliance with the rule requirements. However guidance material should not be regarded as an acceptable means of compliance.

An advisory circular may also include **technical information** that is relevant to the rule standards or requirements.

### Purpose

This advisory circular provides information on the time flight experience and on the examination syllabus content that is acceptable to the Director for meeting the Civil Aviation Rule requirements for the issue of commercial pilot licences.

### Related Rules

This advisory circular relates to Civil Aviation Rule Part 61 Subpart E – Commercial Pilot Licences.

### Change Notice

Revision 31 introduces a revised and updated knowledge syllabus for the subject of Meteorology.

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# Rule 61.203 Eligibility Requirements

## Flight Time Experience

**Rules 61.203(4) and (5)** The flight time experience that is acceptable to the Director is set out in Appendixes I, II, V and VI of this advisory circular.

***Note**: Basic mountain flying training, including the PPL(A) terrain and weather awareness requirements, is compulsory for CPL(A) licence issue.*

## Written Examination Credit

**Rule 61.203(6)** requires an applicant for a CPL to have a valid written examination credit, or approved equivalents, that cover air law (A) or (H) is acceptable, flight navigation general or flight navigation (B) as appropriate, meteorology, principles of flight and aircraft performance (A), (H) or (G) as appropriate, general aircraft technical knowledge (A), (H) or (G) as appropriate, balloon technical knowledge and aerostatics (B) if appropriate, and human factors. The written examination credit comes into effect when all the written examinations have been passed in the qualifying period of 3 years and the written examination credit is valid for 3 years from the date of issue as detailed in rule 61.17(c) and (d).

An examination Knowledge Deficiency Report (KDR) is a report issued on completion of a written examination that details areas where questions were answered incorrectly. The applicant for a commercial pilot licence flight test must provide the flight examiner with written examination KDRs in accordance with rule 61.21(a)(5). These KDRs, with content acknowledged against the relevant rule reference(s), must be certified prior to the flight test by a Category A or B flight instructor that the applicant has been examined in these areas and their knowledge has improved. The flight examiner conducting the flight test will test the applicant's knowledge of the written examination subject areas including but not limited to items included in the KDRs.

The commercial pilot licence written examinations are based on the syllabuses detailed in Appendix III of this advisory circular.

## Approved Equivalent

A person holding a CPL(A), or an ATPL(A) and a PPL (H) issued under Part 61 who wishes to gain a CPL(H), is required to gain a pass in the written examination subjects CPL General Aircraft Technical Knowledge (Helicopter) and CPL Principles of Flight and Aircraft Performance (Helicopter). The holder's CPL(A) or ATPL(A) together with the CPL General Aircraft Technical Knowledge (Helicopter) and CPL Principles of Flight and Aircraft Performance (Helicopter) passes are an approved equivalent to the written examinations required for a CPL(H).

A person holding a CPL(H), or an ATPL(H) and a PPL (A) issued under Part 61 who wishes to gain a CPL(A), is required to gain a pass in the written examination subjects CPL General Aircraft Technical Knowledge (Aeroplane) and CPL Principles of Flight and Aircraft Performance (Aeroplane). The holder's CPL(H) or ATPL(H) together with the CPL General Aircraft Technical Knowledge (Aeroplane) and CPL Principles of Flight and Aircraft Performance (Aeroplane) passes are an approved equivalent to the written examinations required for a CPL(A).

A person holding a CPL(A), CPL(H), ATPL(A) or ATPL(H) issued under Part 61 who wishes to gain a CPL(B), is required to gain a pass in the written examination subject Balloon Technical Knowledge and Aerostatics (Balloon). The holders CPL(A), CPL(H), ATPL(A) or ATPL(H) together with the Balloon Technical Knowledge and Aerostatics(Balloon) passes are an approved equivalent to the written examinations required for a CPL(B).

In addition, if the original licence held by a person wishing to use the provision above was gained prior to 5 November 1992; the person is required to gain a pass in the CPL Human Factors written examination.

For a CPL(Glider) the following is recognised as equivalent to a CPL written examination credit:

1) passes in air law and CPL Human Factors written examinations based on the syllabuses detailed in Appendix III of this advisory circular

2) a pass in Flight Radiotelephony examination written examination based on the Subject 2 syllabus detailed in Appendix III of AC61-3 PPL

3) attainment of the FAI Gold Badge.

This is in accordance with the agreement between the CAA, and Gliding New Zealand on recognition of gliding qualifications and experience for the issue of a CPL(G).

Examination pass results gained by a RNZAF pilot who has successfully completed the NZDF ground and flight training for aeroplanes will be accepted as approved equivalents to the written examinations required by rule 61.203(6) for the issue of a CPL except for the required Air Law written examination. All applicants are required to pass a New Zealand CPL Air Law written examination.

Examination pass results gained by a RNZAF pilot who has successfully completed the NZDF ground and flight training for helicopters will be accepted as approved equivalents to the written examinations required by rule 61.203(6) for the issue of a CPL except for the required Air Law written examination. All applicants are required to pass a New Zealand CPL Air Law written examination.

## CPL Flight Test

**Rule 61.203(7)** requires an applicant for a CPL to demonstrate competence and knowledge to the Director in a flight test in the appropriate category of aircraft. The CPL flight test syllabus is detailed in Appendix IV of this advisory circular. The competencies and knowledge to be tested are set out in the *CPL Flight Test Standards Guide*, published by the Director. The flight tests are conducted by appropriately authorised flight examiners on behalf of the Director.

The privileges and limitations mentioned in rule 61.203(7)(ii) are those detailed in rule 61.205.

## Foreign CPL

A current CPL or higher licence issued by an ICAO Contracting State may be accepted as the basis for meeting the eligibility requirements under rule 61.203 for the issue of a New Zealand CPL.

For this to occur the following applies:

1) The foreign pilot licence holder must meet flight experience equivalent to that required under rule 61.203(4) as detailed in Appendix I of this advisory circular. Normally a current foreign CPL meets this requirement.

2) A current foreign CPL will normally be accepted as meeting all written examination passes for rule 61.203(6) except for air law, if the applicant also produces evidence of having completed at least 250 hours as pilot-in-command on commercial operations. This flight time must have been attained following the issue of the flight crew licence that has been presented for recognition and the experience is to have been gained in countries under the jurisdiction of the foreign authority that issued the licence. A foreign CPL holder who does not meet the post licence issue requirements as detailed is required to gain credits for all written examinations in accordance with rule 61.203(6).

3) The foreign pilot licence holder must successfully complete the flight test required by rule 61.203(7) for the issue of a CPL.

# Rule 61.205 Privileges and Limitations

## Multi-Pilot Operations

**Rule 61.205(a)(3)** allows a commercial pilot licence holder to act as pilot-in-command of an aircraft that is certificated for multi-pilot operation and is engaged on an operation for hire or reward but not for an air transport operation.

# Appendix I - Commercial Pilot Licence Experience Requirements

## Aeroplane

### Total flight experience

At least 200 hours in aeroplanes, or 150 hours in aeroplanes if a full course of approved training has been completed, with appropriate cross-crediting of experience as detailed below.

These times are to include at least the minimum flight time requirements that follow.

**Pilot-in-command:**

100 hours in aeroplanes.

**Cross-country navigation:**

30 hours in aeroplanes, which is to include 20 hours training and the cross-country flight test in accordance with the syllabus set out in Appendix II of this advisory circular. The holder of a CPL(H) applying for a CPL(A) is only required to complete 15 hours cross-country navigation in aeroplanes of which 10 hours is to be dual and 5 hours is to be solo cross-country navigation.

**Night flight time experience (Night flying):**

10 hours in aeroplanes which is to include 4 hours dual instruction and 5 hours (including 10 take-offs and 10 landings) as pilot-in-command.

Students must have at least 2 hours instrument flight time in aeroplanes including the following instrument flight manoeuvres before undertaking night flight training:

*Straight and level flight*: Maintain heading to a required accuracy of ± 5º, ± 100 feet altitude and in-balance.

*Medium & rate 1 turns:* At least 180º turns left and right, in-balance, to within ± 10º of pre-selected roll-out heading with a maximum altitude variation of ± 100 feet.

*Climbing and descending*: To pre-selected altitudes. Level flight to be re-established at the pre-selected altitude ± no more than 100 feet.

*Unusual attitude:* Prompt and correct recovery from unusual attitudes.

An applicant who does not meet this requirements does not comply with rule 61.203(5) and may not exercise the privileges of a commercial pilot by night.

**Instrument time:**

10 hours, of which —

- 5 hours is to be dual instrument flight time in aeroplanes; and
- 5 hours may be instrument time in an approved synthetic flight trainer.

**Basic mountain flying training:**

In addition to meeting the terrain and weather awareness requirements of PPL(A), have completed:

- A basic mountain flying ground theory course (refer to the *CAA Mountain Flying Training Standards Guide*); and
- 5 hours dual flying training to include at least:
  - 2 hours low flying; and
  - 2 hours basic mountain flying in accordance with Appendix V.

The following wording would be acceptable for certification:

*I certify that ..... has satisfactorily completed the syllabus of aeroplane basic mountain flying ground and flight training and has demonstrated competence.*

*Signed.....Date .....*

*Instructor Category .....Client number .....*

For other applicants who need to meet this requirement for the issue of a New Zealand licence:

Where an appropriately qualified instructor or flight examiner (terrain awareness/basic mountain flying endorsed), can determine from logbook evidence and flight assessment that competence in terrain and weather awareness/basic mountain flying exceeds the above minimum requirements, that instructor/examiner may certify the logbook accordingly.

In making this determination the instructor or examiner is to make three successful assessments:

(1) Assess the applicants logbook flight time for mountain flying experience to see that it exceeds the intent and standard for basic mountain flying required which includes the appropriate requirement for terrain and weather awareness.

(2) By oral questioning assess that the knowledge of mountain flying ground course content as listed in the *Mountain Flying Training Standards Guide* is satisfactory in lieu of doing the ground course.

(3) Assess by in flight demonstration of competence that knowledge, skill and attitude in basic mountain flying meets or exceeds the appropriate requirements.

The logbook must then be certified that this process has been completed satisfactorily by the instructor or examiner concerned.

## Cross-crediting

Where an applicant produces acceptable evidence of piloting experience in aircraft other than in aeroplanes, half the pilot-in-command time experienced within the immediately preceding 12 months, up to the maximums that follow, may be credited towards the total flight experience required, but not to the specific flight experiences.

*For helicopters:* 60 hours.

*For gliders or powered gliders:* 25 hours.

*For three-axis microlights:* 20 hours.

*For all the above categories combined:* 60 hours.

## Helicopter

### Total flight experience:

At least 150 hours in helicopters, or 125 hours in helicopters if a full course of approved training has been completed, with appropriate cross-crediting experience as detailed below. These times are to include at least the minimum flight time requirements that follow.

**Dual instruction:**

35 hours in helicopters. The applicant can accumulate the required flight experience in an amateur-built helicopter as long as they are the constructor or owner of the amateur-built helicopter.

**Pilot-in-command:**

35 hours in helicopters. The applicant can accumulate the required flight experience in an amateur-built helicopter as long as they are the constructor or owner of the amateur-built helicopter. Not more than 10 hours may be in amateur-built helicopters if the applicant is not the constructor or owner of the helicopter.

**Cross-country navigation:**

20 hours in helicopters which is to include 16 hours training and the cross-country flight test conducted in accordance with the syllabus set out in Appendix II of this advisory circular. At the discretion of the flight instructor who is carrying out the cross-country training this time may be reduced to not less than 4 hours in helicopters if the trainee is the holder of a CPL(A).

**Sling-load flight training:**

10 hours in helicopters which is to include 7 hours dual instruction.

**Mountain flying training:**

10 hours in helicopters flying in mountainous terrain that is to include helicopter basic mountain flying training.

The basic mountain flying training is to consist of at least 5 hours theory ground instruction and at least 5 hours flight experience conducted in accordance with the theory and flight components of the 'Helicopter Basic Mountain Flying Training Syllabus' set out in Appendix VI to this advisory circular. The flight experience is to include at least 3 hours dual instruction and 1 hour pilot-in-command flight time.

At least 1 dual flight should be conducted in inclement weather.

Each basic mountain flying training flight is to be clearly indicated in the "details" column of the pilot's logbook.

Flight experience gained in meeting other minimum requirements may not be cross-credited towards the basic mountain flying training requirement and vice versa.

Prior to commencing helicopter basic mountain flying training, a pilot who holds a helicopter private pilot licence issued after 31 August 2008 is to have completed mountainous terrain awareness training (as detailed in AC61-3).

At the successful completion of helicopter basic mountain flying training, a flight instructor is to certify in the pilot's log book that the pilot has demonstrated competence to:

- fly a pre-planned low altitude (not below 500' AGL) route through or within mountainous terrain following minor valleys or terrain features and crossing saddles and ridges; and

- at a rounded mountainous feature not above 5,000' AMSL and in a valley without a natural horizon, in wind conditions of 5 to 20 knots: perform a reconnaissance, determine the wind then plan and execute a constant-angle approach to a hover or landing as applicable, and take-off.

The following wording, which may be in the form of a stick-on label or a rubber stamp, would be acceptable for such certification:

*I certify that ..... has satisfactorily completed the syllabus of training for helicopter basic mountain flying and has demonstrated competence.*

*Signed.....Date .....*

*Instructor Category .....Licence number .....*

Helicopter basic mountain flying training is intended only as an introduction to mountainous terrain operations for commercial helicopter pilots or experienced private helicopter pilots.

More extensive mountain flying requires a higher level of knowledge, skill and experience and so requires additional theory and practical training before it can be conducted safely. Therefore, a person holding a commercial helicopter pilot licence issued after 31 August 2008 should not conduct advanced operations in mountainous terrain, including landing at, or making an approach to, any point above the height at which competence has been demonstrated without first completing further training.

**Night flying**

Students must have at least 2 hours instrument flight time in helicopters including the following instrument flight manoeuvres before undertaking night flight training:

*Straight and level flight*: Maintain heading to a required accuracy of ± 5º, ± 100 feet altitude and in-balance.

*Medium & rate 1 turns:* At least 180º turns left and right, in-balance, to within ± 10º of pre-selected roll-out heading with a maximum altitude variation of ± 100 feet.

*Climbing and descending*: To pre-selected altitudes. Level flight to be re-established at the pre-selected altitude ± no more than 100 feet.

*Unusual attitude:* Prompt and correct recovery from unusual attitudes.

*Emergencies:* Establish autorotation and turn into wind.

Helicopters used for the instrument flight training must have operational instruments consisting of at least an airspeed indicator, an altimeter, a turn and slip indicator, a magnetic compass and a VSI.

**For night operations within 25 nm of a lighted heliport or aerodrome:**

- 2 hours dual instrument flight instruction in helicopters; and
- 10 hours night flight time in helicopters including:
    - 5 hours dual instruction
    - 2 hours solo including 10 solo take-offs, translation circuits and landings at night.

However, where an applicant has completed 5 hours night flight time in helicopters including 2 hours dual instruction, 2 hours solo, and 2 hours dual instrument flight instruction in helicopters, the applicant may exercise the privileges of a PPL(H) at night.

**For night operations beyond 25 nm of a lighted heliport or aerodrome (night cross-country):**

- 10 hours dual instrument instruction in helicopters of which no more than 5 hours may be instrument time in a synthetic helicopter flight trainer; and
- 10 hours night flight time in helicopters including:
    - 5 hours dual instruction
    - 2 hours solo including 10 solo take-offs, translation circuits and landings at night
    - 3 hours night cross-country training which is to have been conducted in accordance with the syllabus set out in Appendix II of this advisory circular.

An applicant who does not meet these requirements does not comply with rule 61.203(5) and may not exercise those privileges of a CPL(H) at night beyond 25 nm of a lighted heliport or aerodrome.

## Cross crediting

Where an applicant produces acceptable evidence of piloting experience in aircraft other than in helicopters, half the pilot-in-command time experienced within the immediately preceding 12 months, up to the maximums that follow, may be credited towards the total flight experience required but not to the specific flight experiences.

*For aeroplanes:* 50 hours, except that if the pilot-in-command time is in aerial work or air transport operations - 70 hours.

*For gliders or powered gliders:* 15 hours.

*For the above categories combined:* 70 hours.

## Glider

### Total flight experience

At least 150 hours total flight experience in gliders (except for allowable cross-crediting experience). This time is to include at least the minimum flight time requirements that follow:

**Pilot-in-command:**

75 hours in gliders.

**Cross-country navigation:**

20 hours in gliders, other than on aero-tow, which includes:

- 5 hours dual instruction;
- 1 flight of 5 hours duration as pilot-in-command;
- 1 flight of 30 nm in a straight line as pilot-in-command; and
- 5 paddock landings as pilot-in-command at places which are not licensed airfields or recognised glider launching sites.

**Launches:**

50 launches as pilot-in-command.

To exercise CPL(G) privileges using a specific launch method (winch, aero-tow or auto-tow), the pilot must have performed 25 launches by that method as pilot-in-command and this must be certified in the pilot's logbook.

**Instrument flight instruction:**

5 hours in aircraft.

### Cross-crediting

Where an applicant produces acceptable evidence of piloting experience in aircraft other than in gliders, half the pilot-in-command time experienced within the immediately preceding 12 months up to the maximums that follow, may be credited towards the total flight experience required, but not to the specific flight experiences.

*For aeroplanes:* 60 hours.

*For helicopters:* 25 hours.

*For permit to fly aircraft:* 25 hours.

*For all the above categories combined:* 60 hours.

**Alternative flight experience for issue of CPL(G):**

In accordance with the agreement between the CAA and Gliding New Zealand, the following is accepted as an alternative to meeting the flight experience specified above for the issue of a CPL(G):

- hold either a Qualified Glider Pilot certificate issued by a Gliding Organisation, or a Private Pilot Licence(Glider) issued in accordance with Part 61; and
- hold a FAI Gold Badge.

## Balloon

### Total flight experience

At least 50 hours total flight experience in balloons, except for allowable cross-crediting experience.

This time is to include at least the following minimum flight requirements:

*10 flights:* of which 2 flights are to have been carried out solo

*2 flights:* each of which were of at least 1 hour's flight time

*1 cross-country flight:* of not less than 25 nm from the departure aerodrome; and

*1 ascent:* to at least 5,000 feet above the take-off point.

### Cross-crediting

Where an applicant produces acceptable evidence of piloting experience in aeroplanes, helicopters, gliders or powered gliders, half the pilot-in-command time experienced within the immediately preceding 12 months up to a maximum of 15 hours may be credited towards the total flight experience required, but not to the specific flight experiences.

# Appendix II - Commercial Pilot Licence Navigation Syllabus

## Aeroplane

An applicant for the issue of a CPL(A) is to have satisfactorily completed the following syllabus of cross-country navigation flight training prior to completing the cross-country navigation flight test.

The cross-country navigation flight training syllabus set out below should be adhered to. However, if a flight training organisation wishes, perhaps as a result of terrain or airspace restrictions, to submit specific shorter routes, it may do so. These routes will be evaluated by the Director as to their suitability, having regard to the organisation's overall CPL cross-country navigation training syllabus, and may be approved for use by that organisation.

A maximum of 4 hours of dual cross-country navigation flight instruction, received towards the PPL experience requirements, may be credited towards the 30 hours cross-country flight time requirement, but not towards the 20-hour training requirement. However, if a trainee has completed a full 150-hour course of integrated pilot training all cross-country training may be counted towards the total requirement, of 30 hours, provided that such training was carried out in accordance with this syllabus from the outset.

The syllabus of CPL cross-country navigation flight training is to conform to good teaching practice by commencing with a dual cross-country navigation exercise, followed by dual and pilot-in-command exercises, interspersed at the supervising flight instructor's discretion.

Cross-country flight time may not be accredited simultaneously with instrument or night flying, in any combination, for the purposes of meeting the 30-hour cross-country experience required for CPL issue.

The same route may not be used more than once, for the purposes of meeting the 20-hour cross-country navigation training syllabus, however a route may be flown in the reverse direction.

The 20-hour cross-country navigation training syllabus followed by the cross-country flight test is to be completed within a maximum of 12 months from the first dual cross-country navigation exercise carried out, in accordance with this syllabus, as certified in the pilot's logbook by the supervising flight instructor.

The syllabus of cross-country navigation training is to be carried out by day under VFR.

### Navigation flight training syllabus

**Dual and pilot-in-command navigation exercises**

All dual and pilot-in-command cross-country navigation training exercises are to be carried out in accordance with the following:

The pilot may select, under supervision of a Category B or A flight instructor, the route for each flight; and

All flights undertaken to meet the requirements of the 20-hour training syllabus are to be:

- Greater than 100 nm in a straight line from the aerodrome of departure, incorporating 2 landings; or
- Greater than 200 nm over a route incorporating at least 3 landings; and
- At least 1 flight, either a dual or pilot-in-command, of the 20-hour training syllabus, is to meet the ICAO requirement of a route distance not less than 300 nm and incorporating full-stop landings at 2 different aerodromes, other than the aerodrome of departure.

The syllabus of cross-country navigation training is to include procedures to be followed in the event of en-route emergencies resulting in operational, bad weather, or low-level diversions, becoming lost and partial or total engine failure. It is to include precautionary landing considerations as a result of bad weather, low fuel state, mechanical failures, or fading daylight, and transponder use in emergencies.

Each cross-country navigation training flight, undertaken in accordance with this syllabus, is to be certified in the pilot's logbook, by the supervising flight instructor, as meeting the requirements of the CPL syllabus of cross-country navigation training.

**Hours of training**

At least 10 hours of dual cross-country navigation flight instruction; and

At least 10 hours of pilot-in-command cross-country navigation flight time.

**Pre-flight preparation:**

The pilot is to carry out, under the supervision of a Category B or A flight instructor, or a Category C flight instructor who is no longer under direct supervision:

- Map preparation, collection of and interpretation of relevant weather;
- Preparation of the flight log (to include track, heading, distance, ground speed, estimated time interval, and fuel calculations including reserves), consideration and application of NOTAM and AIP supplements;
- Preparation of the flight plan;
- Calculation of the aircraft's centre of gravity, completion of a load sheet where applicable;
- Calculation of take-off and landing distances and whether planned aerodromes meet those requirements;
- Consideration (on which the supervising flight instructor may question orally) of use of airspace, use of entry, transit and exit lanes through controlled airspace, departure procedure, lost procedures, use of permits to land; and
- Compliance with limitations of an operator's operating specifications and minimum equipment lists.

**In flight procedures:**

The pilot is to carry out, under the supervision of a Category B or A flight instructor, or a Category C flight instructor who is no longer under direct supervision:

Departure procedures, position reporting, map reading, correction for track error, revision of ETA:

Use of entry, transit, and exit lanes, and rejoining procedures at uncontrolled and controlled aerodromes (not necessarily on the same flight):

Diversions as dictated by weather or as required by the supervising flight instructor (dual exercises only):

Competent handling of en-route emergencies should they occur or as simulated by the supervising flight instructor (dual exercises only):

Flight in controlled and uncontrolled airspace, landings at controlled and uncontrolled aerodromes (not necessarily on the same flight):

Application of VFR to maintain VMC in all airspace, TAS checks, update weather reports and forecasts as required, use standard radiotelephone procedures and phraseology, transponder use:

Request of NOTAM and AIP supplements for unplanned diversion aerodromes and confirmation that landing distance requirements are met:

Demonstration, as required by the supervising flight instructor, of flight at various percentage-power settings and fuel check calculations to maintain legal reserves.

**Post flight procedures:**

The pilot is to carry out, under the supervision of a Category B or A flight instructor, or a Category C flight instructor who is no longer under direct supervision:

- Termination of flight plan, aircraft inspection, the recording of flight time (including aircraft logbooks if appropriate), recording and notification to operator of defects, picketing, refuelling and hangarage; and
- In addition, after a flight as pilot-in-command, the pilot is to submit map, flight plans, relevant weather, completed load sheets where applicable, and completed flight log (from which the flight can be reconstructed). The intention of this is to show corrections of track and ETA to the supervising flight instructor before the pilot's flying log book entry is certified, by the supervising flight instructor, as meeting the requirements of the CPL cross-country navigation training syllabus.

### CPL(A) cross-country flight test

On completion of the foregoing syllabus, and within 12 months of commencement, a cross-country flight test is to be conducted by the holder of a Category B or A flight instructor rating (A) who is employed by the organisation at which the student is undergoing his or her training.

The candidate may be given the route to fly in advance and will then be expected to complete all pre-flight navigation preparation within approximately 1 hour.

The flight test is to be at least 2 hours and 30 minutes in duration and may be counted as part of the 30-hour cross-country experience required for CPL issue, but not as part of the 20-hour training syllabus of this appendix.

**The cross-country flight test is to include the following:**

- flight over varied terrain; and
- flight in controlled airspace; and
- a standard overhead rejoin (preferably at an uncontrolled aerodrome); and
- a low-level diversion requiring flight at 500 feet above ground level and including a simulated precautionary landing from the bad weather configuration; and
- a simulated total or partial engine failure en-route; and
- a simulated engine failure after take-off, preferably not at the home base.

**The candidate will be assessed on:**

**Pre-flight preparation:**

Choice of track and altitude, map preparation, use of relevant weather, preparation of the navigation log to include tracks, headings, distance, ground speed, ETA and fuel calculations, centre of gravity calculations, take-off and landing distance calculations, preparation of a loadsheet, application of NOTAM and AIP supplements, completion and filing of the flight plan, aircraft pre-flight inspection and passenger brief.

**General knowledge:**

*Relating directly to the proposed flight test on which the flight examiner will question orally.* Interpretation of weather reports and forecasts, aircraft performance and calculation of take-off and landing distances, load sheet requirements, aircraft loading, and lost procedures.

**In flight procedures:**

Departure and arrival procedures including a standard overhead rejoin, use of entry, transit and exit lanes, flight in controlled airspace (with unauthorised flight in controlled airspace to incur automatic failure), application of VFR to maintain VMC, holding heading and maintaining track, map reading, calculations to regain track and revise ETA, TAS checks, position reporting, awareness of fuel burnt and in reserve, use of transponders, standard radiotelephony phraseology, pilot-in-command decision-making and subsequent actions when given a scenario requiring a diversion, updating weather, choice of field and course of action for the engine failures and precautionary landing.

**Post flight procedures:**

Termination of flight plan, aircraft inspection, recording of flight time, recording and notification of defects, reconstruction of the flight from the flight navigation log.

**Log book certification**

When the cross-country navigation flight training, including a successful flight test, has been satisfactorily completed, the flight examiner is to endorse that fact in the applicant's log book. The following wording, which may be in the form of a stick-on label or a rubber stamp, would be acceptable:

*I hereby certify that .....has satisfactorily completed the cross-country navigation flight training for the CPL(A) and passed the flight test.*

*Signed .....Date .....*
*Instructor Category …..… Licence number .....*

## Helicopter

An applicant for the issue of a CPL(H) is to have available, for inspection by the flight examiner, log book certification by the supervising flight instructor that the applicant has satisfactorily completed the cross-country navigation flight training.

A maximum of 4 hours of dual cross-country navigation flight instruction received towards the PPL experience requirements may be credited towards the 20 hours of cross-country flight time requirement but not towards the 16-hour training requirement. However, if a trainee has completed a full 125-hour course of integrated pilot training, all cross-country training may be counted towards the total requirement of 20 hours provided that such training was carried out in accordance with this syllabus from the outset.

Cross-country flight time may not be accredited simultaneously with instrument or night flying, in any combination, for the purposes of meeting the 20-hour cross-country experience required for CPL issue.

The same route may not be used more than once for the purposes of meeting the 16-hour cross-country navigation training syllabus, however a route may be flown in the reverse direction.

The 16-hour cross-country navigation training syllabus followed by the cross-country flight test is to be completed within a maximum of 12 months from the first dual cross-country navigation exercise carried out in accordance with this syllabus as certified in the pilot's logbook by the supervising flight instructor.

### Navigation flight training syllabus

#### Dual and pilot-in-command navigation exercises

At least one dual cross-country navigation flight and one pilot-in-command cross-country navigation flight is to be to a point at least 100 NM in a straight line from the point of departure and involve landings at two or more different points.

***Note**:It may be advantageous, for CPL pilots intending to become flight instructors, to make the pilot-in-command cross-country navigation flight at least 300 NM in total to meet Category C cross-country navigation requirements.*

Flight training organisations may submit cross-country navigation routes less than 100 NM from the departure point. These routes will be evaluated by the Director as to their suitability, having regard to the organisation's overall CPL cross-country navigation training syllabus, and may be approved for use by that organisation.

Emphasis in training is to be placed on low level (not below 500ft AGL) navigation techniques, including mental dead-reckoning (DR), track-crawling, grid references and locating point features on a 1:50,000 chart. This requirement does not constitute authority to fly below the minimum safe heights.

Emphasis for routes flown at medium level should be placed on preparation of flight plan, departure procedure, position reporting procedure, map reading, correction for track error, revision of ETA, use of entry, transit and exit lanes through controlled airspace, en-route emergencies, and landing at a controlled aerodrome.

#### Hours of training

At least 8 hours dual cross-country navigation flight instruction; and

At least 8 hours pilot-in-command cross-country navigation flight time.

**Pre-flight preparation:**

The pilot is to carry out, under the supervision of a Category B or A flight instructor, or a Category C flight instructor who is no longer under direct supervision:

- Map preparation: selection and marking of appropriate scale maps;
- Flight log preparation: preparation of a suitable log for in-flight use;
- Flight plan: preparation and filing of an ATC flight plan;
- ATC considerations: clearance requirements, use of entry, transit and exit lanes if applicable;
- NOTAM, AIP supplements and airspace restrictions: checked and considered;
- Weather: appropriate information obtained and correctly interpreted;
- Fuel planning: accurately calculated and correctly interpreted;
- Aircraft loading and centre of gravity calculation: in accordance with flight manual; and
- Performance considerations: requirements for takeoff, enroute, and landing.

**In-flight procedures:**

The pilot is to carry out, under the supervision of a Category B or A flight instructor, or a Category C flight instructor who is no longer under direct supervision:

- Pre-departure systems checks: aircraft systems required for flight checked;
- Departure: set heading procedure, time noted;
- Position reporting: standard, timely;
- Map reading: regular fixing of position, competence in reading maps at medium and low-level (by day) and at medium level (by night);
- Log keeping: regular recording of position and time;
- Use of communications facilities: appropriate use of aircraft equipment to obtain relevant flight information, and ATIS;
- Use of navaids: appropriate use without over-reliance, correctly identified;
- Tracking techniques: use of 1-in-60 rule, drift lines, line features, heading and time as appropriate. For low level: maintaining ground track, following line features, and use of cross-track features;
- Flying accuracy for medium level routes: adherence to planned heading (± 10º), IAS (± 5 knots), altitude (± 100 feet). For low level routes: IAS (+/- 5 knots), altitude (+/- 100 feet but NOT BELOW 500 feet AGL); and
- ETA revision: At least 1 per leg.

**Turning point procedures:**

ETA achievement: Within ± 3 minutes.

Identification of turning points: related to topography, spot heights, rivers, streams, roads, and tracks.

**En route landing:**

Performance considerations, circuit, approach, landing, take-off.

**Diversion:**

Decision: prompt and appropriate after being given a hypothetical weather or fuel situation by the flight examiner.

Track and distance estimation: correctly calculated from a positive fix of position.

ETA revision: calculated within 10 minutes of set headings on diversion.

Fuel considerations: landing fuel calculated.

**Airmanship considerations**

Pilot judgement: whole flight considered, confident, competent handling of the flight with appropriate decisions made based on sound information.

Lookout: an effective look-out maintained for wires, other obstacles, and traffic.

Radiotelephone and ATS procedures: standard.

Lost procedures: oral discussion on ground.

Emergencies: oral discussion on ground.

**Post flight procedures:**

The pilot is to carry out, under the supervision of a Category B or A flight instructor, or a Category C flight instructor who is no longer under direct supervision:

Termination of flight plan, aircraft inspection, the recording of flight time (including aircraft logbooks if appropriate), recording and notification to operator of defects, picketing, refuelling and hangarage; and

In addition, after a flight as pilot-in-command, the pilot is to submit map, flight plans, relevant weather, completed load sheets where applicable, and completed flight log (from which the flight can be reconstructed). The intention of this is to show corrections of track and ETA to the supervising flight instructor before the pilot's flying log book entry is certified, by the supervising flight instructor, as meeting the requirements of the CPL cross-country navigation training syllabus.

### CPL(H) cross-country flight test (day)

This test is to be carried out by a Category B or A flight instructor. The candidate will be given the route to fly but will be expected to carry out all of the pre-flight preparation. The test flight is to be of at least 2 hours in duration and will be flown both at medium and low level. The candidate will be expected to use current Visual Navigation Charts (VNC).

### CPL(H) cross-country navigation training (night)

Completion of the equivalent night cross-country syllabus and flight test at PPL(H) level meets the night cross-country requirement at CPL(H) level.

Prior to undertaking night cross-country training the applicant is to have completed the day navigation training and flight test.

The minimum night cross-country navigation flight time is to be at least 2 hours dual flight instruction; and 1 hour solo flight time.

### CPL(H) cross-country flight test (night)

This test is to be carried out by an appropriately night qualified Category B or A flight instructor. The candidate will be given the route to fly but will be expected to carry out all of the pre-flight preparation. The flight test is to be of at least 1 hour duration and flown at medium level. The candidate will be expected to use current Visual Navigation Charts (VNC).

## Log book certification

When the cross-country navigation flight training, including a successful flight test, has been satisfactorily completed, the flight examiner is to endorse that fact in the applicants' log book. The following wording, which may be in the form of a stick-on label or a rubber stamp, would be acceptable:

*I hereby certify that .....has satisfactorily completed the cross-country navigation flight training for the CPL(H) and passed the flight test by day\night (as applicable)*

*Signed .....Date .....*
*Instructor Category .....Licence number .....*

# Appendix III - Commercial Pilot Licence Written Examination Syllabus

## Air Law Syllabus Matrix:

| **Sub-Heading** | **PPL** | **CPL** | **IR** | **ATPL(A)** | **ATPL(H)** |
|---|---|---|---|---|---|
| | **Subject # 4** | **Subject # 16** | **Subject # 52** | **Subject # 36** | **Subject # 37** |
| **General** | | | | | |
| Aviation Legislation | 4.2 | 16.2 | 52.2 | 36.2 | 37.2 |
| Definitions | 4.4 | 16.4 | 52.4 | 36.4 | 37.4 |
| Abbreviations | 4.6 | 16.6 | 52.6 | 36.6 | 37.6 |
| | | | | | |
| **Personnel Licensing** | | | | | |
| Requirements for Licences and Ratings | 4.10 | 16.10 | 52.10 | 36.10 | 37.10 |
| Eligibility, Privileges and Limitations | 4.12 | 16.12 | 52.12 | 36.12 | 37.12 |
| Competency, Currency and Recency | 4.14 | 16.14 | 52.14 | 36.14 | 37.14 |
| Medical Requirements | 4.16 | 16.16 | 52.16 | 36.16 | 37.16 |
| | | | | | |
| **Airworthiness of Aircraft and Aircraft Equipment** | | | | | |
| Documentation | 4.20 | 16.20 | 52.20 | 36.20 | 37.20 |
| Aircraft Maintenance | 4.22 | 16.22 | 52.22 | 36.22 | 37.22 |
| Instruments and Avionics | 4.24 | 16.24 | 52.24 | 36.24 | 37.24 |
| Equipment | 4.26 | 16.26 | 52.26 | 36.26 | 37.26 |
| | | | | | |
| **General Operating and Flight Rules** | | | | | |
| General Operating Requirements | 4.30 | 16.30 | 52.30 | 36.30 | 37.30 |
| General Operating Restrictions | 4.32 | 16.32 | 52.32 | 36.32 | 37.32 |
| General Meteorological Requirements and Restrictions | 4.34 | 16.34 | | | 37.34 |

| | | | | | |
|---|---|---|---|---|---|
| Carriage of Dangerous Goods | 4.36 | 16.36 | | 36.36 | 37.36 |
| Helicopter External Load Operations | | 16.38 | | | 37.38 |
| | | | | | |
| **Air Operations** | | | | | |
| Air Operations Crew Requirements | | 16.40 | | 36.40 | 37.40 |
| Air Operations Requirements and Restrictions | | 16.42 | | 36.42 | 37.42 |
| Air Operations Meteorological Requirements and Restrictions | | 16.44 | | 36.44 | 37.44 |
| Air Operations Performance Requirements | | 16.46 | | 36.46 | 37.46 |
| Air Operations Weight and Balance Requirements | | | | | 37.48 |
| | | | | | |
| **Flight Planning and Preparation** | | | | | |
| Flight Preparation | 4.50 | 16.50 | 52.50 | 36.50 | 37.50 |
| Alternate Requirements | | | 52.52 | 36.52 | 37.52 |
| Fuel Requirements | 4.54 | 16.54 | 52.54 | 36.54 | 37.54 |
| Flight Plans | 4.56 | 16.56 | 52.56 | 36.56 | 37.56 |
| Enroute Limitations | | 16.58 | | 36.58 | |
| | | | | | |
| **Air Traffic Services** | | | | | |
| Communications | 4.60 | 16.60 | 52.60 | 36.60 | 37.60 |
| Clearances | 4.62 | 16.62 | 52.62 | 36.62 | 37.62 |
| Separation | 4.63 | 16.63 | 52.63 | 36.63 | 37.63 |
| Terrain Clearance | | | 52.64 | 36.64 | 37.64 |
| Weather Avoidance | | | 52.65 | 36.65 | 37.65 |
| Radar Services | 4.66 | 16.66 | 52.66 | 36.66 | 37.66 |
| Oceanic Procedures | | | | 36.67 | |
| Global Navigation Satellite System | | 16.68 | 52.68 | 36.68 | 37.68 |

| | | | | | |
|---|---|---|---|---|---|
| **Airspace; Aerodromes; and Heliports** | | | | | |
| Altimetry | 4.70 | 16.70 | 52.70 | 36.70 | 37.70 |
| Cruising Levels | 4.72 | 16.72 | 52.72 | 36.72 | 37.72 |
| Transponders | 4.74 | 16.74 | 52.74 | 36.74 | 37.74 |
| Airspace | 4.75 | 16.75 | 52.75 | 36.75 | 37.75 |
| Aerodromes and Heliports | 4.76 | 16.76 | 52.76 | 36.76 | 37.76 |
| Aerodrome Lighting | 4.78 | 16.78 | 52.78 | 36.78 | 37.78 |
| | | | | | |
| **Emergencies; Incidents; and Accidents** | | | | | |
| Responsibilities of Operators and Pilots | 4.80 | 16.80 | | 36.80 | 37.80 |
| Communications and Equipment | 4.82 | 16.82 | 52.82 | 36.82 | 37.82 |
| | | | | | |
| **Instrument Departures and Approaches** | | | | | |
| Departure Procedures | | | 52.90 | 36.90 | 37.90 |
| Holding Procedures | | | 52.92 | 36.92 | 37.92 |
| Approach Procedures | | | 52.94 | 36.94 | 37.94 |
| Communications and Navigation Aid Failure | | | 52.96 | 36.96 | 37.96 |

## Subject No. 16 CPL Air Law (Aeroplane and Helicopter)

Each subject has been given a subject number and each topic within that subject a topic number. These reference numbers will be used on knowledge deficiency reports and will provide valuable feedback to the examination candidate. These topic reference numbers may be common across the subject levels and therefore may not be consecutive within a specific syllabus.

| Sub Topic | Syllabus Item |
|---|---|
| | **General** |
| **16.2** | **Aviation Legislation** |
| 16.2.2 | Describe the requirements to hold an aviation document, as laid down in CA Act 1990 S7. |
| 16.2.4 | Describe the criteria for the fit and proper person test, as laid down in CA Act 1990 S10. |
| 16.2.6 | Describe the duties of the pilot-in-command, as laid down in CA Act 1990 S13 and 13A. |
| 16.2.8 | Describe the responsibilities of a licence holder with respect to changes in their medical condition, as laid down in CA Act 1990 S27. |
| 16.2.10 | Describe the responsibilities of a licence holder with respect to the surrender of a medical certificate as laid down in CA Act 1990 S27. |
| 16.2.12 | Describe the responsibilities of a licence holder with respect to safety offences, as laid down in CA Act 1990 S43 and 44. |
| **16.4** | **Definitions** |
| | CAR Part 1 (unless otherwise noted) |
| | State the definition of: |
| | (a) accelerate-stop distance available; |
| | (b) accident; |
| | (c) Act; |
| | (d) aerobatic flight; |
| | (e) aerodrome control service; |
| | (f) aerodrome operational area; |
| | (g) aerodrome traffic circuit; |
| | (h) aeronautical information circular; |
| | (i) AIP supplement; |
| | (j) aircraft category; |
| | (k) air traffic control (ATC) service; |
| | (l) air transport operation; |

| Sub Topic | Syllabus Item |
|---|---|
| | (m) air operation; |
| | (n) airworthiness certificate; |
| | (o) airworthiness directive; |
| | (p) airworthy condition; |
| | (q) alerting service; |
| | (r) altitude; |
| | (s) area control; |
| | (t) ATC clearance; |
| | (u) ATC instruction; |
| | (v) aviation event; |
| | (w) AWIB service; |
| | (x) basic weather report; |
| | (y) ceiling; |
| | (z) certificated organisation; |
| | (aa) Class 3.1A Flammable liquid; |
| | (bb) Class 3.1C Flammable liquid; |
| | (cc) Class 3.1D Flammable liquid; |
| | (dd) Class B cargo or baggage compartment; |
| | (ee) clearance limit; |
| | (ff) clearway; |
| | (gg) command practice; |
| | (hh) commercial transport operation; |
| | (ii) controlled airspace; |
| | (jj) controlled flight; |
| | (kk) co-pilot; |
| | (ll) cost sharing flight; |
| | (mm) crew member; |
| | (nn) dangerous goods; |
| | (oo) day; |

| Sub Topic | Syllabus Item |
|---|---|
| | (pp) dual flight time; |
| | (qq) emergency locator transmitter; |
| | (rr) final reserve fuel; |
| | (ss) fit and proper person; |
| | (tt) flight examiner; |
| | (uu) flight attendant; |
| | (vv) flight crew member; |
| | (ww) flight information service; |
| | (xx) flight level; |
| | (yy) flight manual; |
| | (zz) flight plan; |
| | (aaa) flight time; |
| | (bbb) height; |
| | (ccc) heliport (Helicopter candidates only); (AIP GEN) |
| | (ddd) hover taxi (Helicopter candidates only); (AIP GEN) |
| | (eee) incident; |
| | (fff) landing area; (AIP GEN) |
| | (ggg) landing distance available; |
| | (hhh) night; |
| | (iii) NOTAM; |
| | (jjj) passenger; |
| | (kkk) pilot-in-command; |
| | (lll) rating; |
| | (mmm) regular air transport passenger service; |
| | (nnn) SARTIME; |
| | (ooo) serious incident; |
| | (ppp) simultaneous operations; (AIP GEN) |
| | (qqq) takeoff distance available; |
| | (rrr) takeoff run available; |

**Sub Topic** **Syllabus Item**

(sss) takeoff weight;

(ttt) Technical Instructions;

(uuu) threshold; (CAR 121.3)

(vvv) transition altitude; (AIP GEN)

(www) transition layer; (AIP GEN)

(xxx) transition level; (AIP GEN)

(yyy) type;

(zzz) unlawful interference;

(aaaa) UNICOM service;

(bbbb) VFR flight;

(cccc) vicinity of an aerodrome; (AIP GEN)

(dddd) visibility;

(eeee) visual meteorological conditions;

(ffff) visual reference. (AIP GEN)

**16.6 Abbreviations**

CAR Part 1 (unless otherwise noted)

State the meaning of the following abbreviations:

(a) AD;

(b) ADF;

(c) AEDRS;

(d) AGL;

(e) AIREP; (AIP GEN)

(f) AMSL;

(g) ATIS;

(h) AWS; (AIP GEN)

(i) BWR; (AIP GEN)

(j) CAR;

(k) CGL; (AIP GEN)

(l) DME

| Sub Topic | Syllabus Item |
|---|---|
| | (m) ELT; |
| | (n) FATO (Helicopter candidates only); (AIP GEN) |
| | (o) GNSS; (19.203) |
| | (p) ME1; |
| | (q) ME2; |
| | (r) MEL; |
| | (s) OGE (Helicopter candidates only); |
| | (t) PLA; |
| | (u) QFE; |
| | (v) QNH; |
| | (w) TALO (Helicopter candidates only); (AIP GEN) |
| | (x) TLOF (Helicopter candidates only); (AIP GEN) |
| | **(y)** VOR. |
| | **Personnel Licensing** |
| **16.10** | **Requirements for Licences and Ratings** |
| 16.10.2 | State the requirements for holding a pilot licence. CAR 61 |
| 16.10.4 | State the requirements for a pilot-in-command to hold a type rating on the type of aircraft being flown. CAR 61 |
| 16.10.6 | State the requirements for entering flight details into a pilot logbook. CAR 61 |
| **16.12** | **Eligibility, Privileges and Limitations** |
| 16.12.2 | Describe the allowance for a person who does not hold a current pilot licence to fly dual with a flying instructor. CAR 61 |
| 16.12.4 | State the solo flight requirements on a person who does not hold a current pilot licence. CAR 61 |
| 16.12.6 | State the limitations on a person who does not hold a current pilot licence.CAR 61 |
| 16.12.8 | State the eligibility requirements for the issue of a commercial pilot licence. CAR 61 |
| 16.12.10 | State the privileges of holding a commercial pilot licence. CAR 61 |
| 16.12.12 | State the limitations on the holder of a commercial pilot licence. CAR 61 |
| **16.14** | **Competency, Currency and Recency** |
| 16.14.2 | State the recent experience requirements of a pilot-in-command, by day and by night, who is the holder of a commercial pilot licence. CAR 61 |

| Sub Topic | Syllabus Item |
|---|---|
| 16.14.4 | State the requirements for the completion of a biennial flight review. CAR 61 |
| 16.14.6 | Explain the use of a lower licence or rating. CAR 61 |
| 16.14.8 | State the period within which a pilot-in-command of an aircraft engaged on an air operation under CAR Part 135 must have passed a check of route and aerodrome proficiency. |
| 16.14.10 | State the period within which a pilot, acting as a flight crew member of an aircraft engaged on a CAR Part 135 air operation under VFR, must have passed a check of normal, abnormal and emergency procedures in the same aircraft type. |
| 16.14.12 | State the period within which a pilot of an aircraft engaged on an air operation under CAR Part 135 must have completed a written or oral test of their knowledge in aircraft systems, performance and operating procedures. |
| 16.14.14 | State the CAR Part 135 crew member grace provisions. |
| **16.16** | **Medical Requirements** |
| 16.16.2 | State the requirements for holding a medical certificate. CAR 61 |
| 16.16.4 | State the requirements on a person applying for a medical certificate. CAR 67 |
| 16.16.6 | State the requirements for maintaining medical fitness following the issue of a medical certificate. CA Act 1990 S27C |
| 16.16.8 | State the normal currency period of the Class 1 medical certificate for a CPL holder who is under the age of 40. CAR 67 |
| 16.16.10 | State the normal currency period of the Class 1 medical certificate for a CPL holder who is 40 years of age or more on the date that the certificate is issued. CAR 67 |
| | **Airworthiness of Aircraft and Aircraft Equipment** |
| **16.20** | **Documentation** |
| 16.20.2 | State the documents which must be carried in aircraft operated in New Zealand. CAR 91 |
| **16.22** | **Aircraft Maintenance** |
| 16.22.2 | Describe the maintenance requirements of an aircraft operator. CAR 91 |
| 16.22.4 | State the requirement for annual and 100 hour inspections. CAR 91 |
| 16.22.6 | State the requirement for a review of airworthiness. CAR 91 |
| 16.22.8 | State the requirements for maintenance records. CAR 91 |
| 16.22.10 | State the requirements for the retention of maintenance records. CAR 91 |
| 16.22.12 | State the requirements for and contents of a technical log. CAR 91 |
| 16.22.14 | State the requirements for entering defects into a technical log. CAR 91 |
| 16.22.16 | State the requirements for clearing defects from a technical log. CAR 91 |

| Sub Topic | Syllabus Item |
|---|---|
| 16.22.18 | State the limitations and requirements on a person undertaking 'pilot maintenance'. CAR 43 |
| 16.22.20 | State the requirements for conducting an operational flight check on an aircraft. CAR 91 |
| 16.22.22 | State the requirements for acting as a test pilot. CAR 19 |
| 16.22.24 | State the inspection period for radios. CAR 91 |
| 16.22.26 | State the inspection period for altimeters. CAR 91 |
| 16.22.28 | State the inspection period for transponders. CAR 91 |
| 16.22.30 | State the normal inspection period for the ELT. CAR 91 |
| **16.24** | **Instruments and Avionics** |
| 16.24.2 | State the minimum instrument requirements for a day VFR flight. CAR 91 |
| 16.24.4 | State the minimum instrument requirements for a night VFR flight. CAR 91 |
| 16.24.6 | State the radio equipment requirements for a VFR flight. CAR 91 |
| 16.24.8 | State the communications and navigation equipment requirements for a VFR over water flight. CAR 91 |
| **16.26** | **Equipment** |
| 16.26.2 | State the equipment requirements for a night VFR flight. CAR 91 |
| 16.26.4 | State the equipment requirements for flight over water. CAR 91 & 135 |
| 16.26.6 | State the requirements for indicating the time in flight. CAR 91 |
| 16.26.8 | State the requirements for emergency equipment. CAR 91 & 135 |
| 16.26.10 | State the requirements for night flight. CAR 91 |
| 16.26.12 | State the CAR Part 135 requirements for night flight. |
| 16.26.14 | State the CAR Part 135 requirements for a cockpit voice recorder. |
| 16.26.16 | State the CAR Part 135 requirements for a flight data recorder. |
| 16.26.18 | State the requirements for an ELT. CAR 91 |
| | **General Operating and Flight Rules** |
| **16.30** | **General Operating Requirements** |
| 16.30.2 | Describe the requirements of passengers to comply with instructions and commands. CAR 91 |
| 16.30.4 | Explain the requirements for maintaining daily flight records. CAR 91 |
| 16.30.6 | Explain the requirements for the carriage of flight attendants. CAR 91 |

| Sub Topic | Syllabus Item |
|---|---|
| 16.30.8 | State the requirements for operating an aircraft in simulated instrument flight. CAR 91 |
| 16.30.10 | State the requirements of a pilot-in-command with respect to the safe operation of an aircraft. CAR 91 |
| 16.30.12 | Describe the authority of the pilot-in-command. CAR 91 |
| 16.30.14 | State the requirements for crew occupation of seats and wearing safety belts. CAR 91 |
| 16.30.16 | State the requirements for the occupation of seats and wearing of restraints. CAR 91 |
| 16.30.18 | State the requirements for the use of oxygen equipment. CAR 91 |
| 16.30.20 | State the requirements for briefing passengers prior to flight. CAR 91 |
| 16.30.22 | State the requirements for familiarity with operating limitations and emergency equipment. CAR 91 |
| 16.30.24 | State the requirements for carrying appropriate aeronautical publications and charts in flight. CAR 91 |
| 16.30.26 | State the requirements for operating on and in the vicinity of an aerodrome. CAR 91 |
| 16.30.28 | Describe the standard overhead joining procedure, and state when it should be used. AIP AD |
| 16.30.30 | State and describe the application of the right of way rules. CAR 91 |
| 16.30.32 | Explain the requirement for aircraft lighting. CAR 91 |
| 16.30.34 | State the requirements for the pilot of an aircraft, being flown for the purpose of demonstrating eligibility for the issue of an airworthiness certificate. CAR 91 |
| 16.30.36 | State the requirements for wearing/holding identity documentation in certain areas. CAR 19 |
| **16.32** | **General Operating Restrictions** |
| 16.32.2 | State the restrictions on smoking in an aircraft. CA Act 1990 S65N |
| 16.32.4 | State the restrictions associated with the abuse of drugs and alcohol. CAR 91 and CAR 19 |
| 16.32.6 | State the restrictions on the use of portable electronic devices in flight. CAR 91 |
| 16.32.8 | State the restrictions on the carriage and discharge of firearms on aircraft. CAR 91 |
| 16.32.10 | Explain the restrictions on stowage of carry-on baggage. CAR 91 |
| 16.32.12 | Explain the restrictions on the carriage of cargo. CAR 91 |
| 16.32.14 | State the restrictions applicable to aircraft flying near other aircraft. CAR 91 |
| 16.32.16 | State the restrictions on the dropping of objects from an aircraft in flight. CAR 91 |
| 16.32.18 | State the speed limitation on aircraft operating under VFR. CAR 91 |
| 16.32.20 | State the minimum heights for VFR flights (A) or (H) under CAR Part 91. |

| Sub Topic | Syllabus Item |
|---|---|
| 16.32.22 | State the restrictions when operating VFR in icing conditions. CAR 91 |
| 16.32.24 | State the restrictions applicable to operating an aircraft in aerobatic flight. CAR 91 |
| 16.32.26 | State the restrictions applicable to parachute-drop operations. CAR 91 |
| 16.32.28 | State the restrictions applicable to aircraft towing gliders. CAR 91 |
| 16.32.30 | State the restrictions applicable to aircraft towing objects other than gliders. CAR 91 |
| **16.34** | **General Meteorological Requirements and Restrictions** |
| 16.34.2 | State the met minima for VFR flight (A) or (H) in various airspace. CAR 91 |
| 16.34.4 | State the restrictions and met minima for Special VFR flight (A) or (H). CAR 91 |
| **16.36** | **Carriage of Dangerous Goods** |
| 16.36.2 | Describe the limitation of CAR Part 92 with respect to members of the Police. |
| 16.36.4 | Describe the allowance for the carriage of dangerous good for the recreational use of passengers. CAR 92 |
| 16.36.6 | State the restriction for the carriage of dangerous goods in an aircraft cabin occupied by passengers, or on the flight deck of an aircraft. CAR 92 |
| 16.36.8 | State the requirements for the carriage of non-dangerous goods in an aircraft. CAR 92 |
| 16.36.10 | State the requirement for the notification of the pilot-in-command when dangerous goods are carried. CAR 92 |
| 16.36.12 | State the requirement for a dangerous goods training programme. CAR 92 |
| 16.36.14 | State the dangerous goods recurrent training programme requirements. CAR 92 |
| **16.38** | **Helicopter External Load Operations (Helicopter candidates only)** |
| 16.38.2 | State the definition of:<br>(a) helicopter external load operation;<br>(b) helicopter external load towing operation;<br>(c) helicopter sling load operation; and,<br>(d) OGE. CAR 133 |
| 16.38.4 | State the pilot licence requirements for performing a helicopter external load operation. CAR 133 |
| 16.38.6 | Describe the minimum height requirements when performing a helicopter external load operation. CAR 133 |
| 16.38.8 | State the restrictions on the carriage of persons inside a helicopter on a helicopter external load towing operation. CAR 133 |
| 16.38.10 | State the restrictions on the carriage of persons inside a helicopter on a helicopter sling load operation. CAR 133 |

| Sub Topic | Syllabus Item |
|---|---|
| 16.38.12 | State the restrictions on the carriage of persons inside a helicopter on a winching, rappelling, or human sling load operation. CAR 133 |
| 16.38.14 | State the third party risk restrictions when carrying a load suspended beneath a helicopter. CAR 133 |
| 16.38.16 | State the weight limitation for a helicopter performing a helicopter external load operation. CAR 133 |
| 16.38.18 | State the flight rules restriction for a helicopter performing a helicopter external load operation. CAR 133 |
| 16.38.20 | Describe the restrictions on helicopter external load operations at night. CAR 133 |
| 16.38.22 | Describe the flight characteristics requirements for a helicopter performing a helicopter external load operation. CAR 133 |
| 16.38.24 | Explain the requirements for performing a helicopter external load operation over congested areas. CAR 133 |
| 16.38.26 | Describe the general requirements for performing an operation involving the suspension of a person beneath a helicopter. CAR 133 |
| 16.38.28 | State the requirements for performing a helicopter winch operation. CAR 133 |
| 16.38.30 | State the requirements for the carriage of an injured person beneath a helicopter in a harness or stretcher. CAR 133 |
| 16.38.32 | State the requirements for performing a helicopter rappelling operation. CAR 133 |
| 16.38.34 | Explain the requirements for the carriage of a supplementary crew member on a helicopter performing a helicopter external load operation. CAR 133 |
| 16.38.36 | Explain the requirements for ensuring crew member competency to carryout winching, rappelling, or human sling load operations. CAR 133 |
| 16.38.38 | Describe the external load equipment requirements on a helicopter performing a helicopter external load operation. CAR 133 |
| 16.38.40 | Describe the requirements for quick release devices on a helicopter performing a helicopter external load operation. CAR 133 |
| 16.38.42 | Explain the requirements for the maintenance of external load equipment. CAR 133 |
| | **Air Operations** |
| **16.40** | **Air Operations Crew Requirements** |
| 16.40.2 | State the CAR Part 135 crew qualification and experience requirements. |
| 16.40.4 | State the CAR Part 135 flight and duty time limitations on flight crew members. |
| 16.40.6 | State the normal minimum rest period required following any duty period. AC119-2 |
| 16.40.8 | State the maximum number of flight hours that a pilot may fly as crew in an aircraft which carries two pilots on an internal air operation. AC119-2 |

| Sub Topic | Syllabus Item |
|---|---|
| **16.42** | **Air Operations Requirements and Restrictions** |
| 16.42.2 | State the airworthiness requirements for aircraft used on air operations. CAR 135 |
| 16.42.4 | State the CAR Part 135 minimum heights for VFR flights. |
| 16.42.6 | State the CAR Part 135 operating restriction on single-engine air operations under IFR (SEIFR). |
| 16.42.8 | State the requirement to keep a daily flight record. CAR 135 |
| 16.42.10 | State the CAR Part 135 requirement for a maintenance review. |
| 16.42.12 | State the CAR Part 135 requirement for passenger safety and the carriage of certain passengers. |
| 16.42.14 | State the CAR Part 135 restrictions when refuelling. |
| 16.42.16 | State the CAR Part 135 restrictions on the manipulation of an aircraft's controls. |
| 16.42.18 | State the CAR Part 135 requirement for helicopter operations over congested areas. (Helicopter candidates only) |
| 16.42.20 | State the restrictions on helicopter sling loads on an air operation. CAR 135 (Helicopter candidates only) |
| **16.44** | **Air Operations Meteorological Requirements and Restrictions** |
| 16.44.2 | State the CAR Part 135 meteorological conditions and requirements for an air operation under VFR. |
| **16.46** | **Air Operations Performance Requirements** |
| 16.46.2 | State the CAR Part 135 performance requirements for takeoff distance. |
| 16.46.4 | State the CAR Part 135 performance requirements for landing distance. |
| 16.46.6 | State the CAR Part 135 performance requirements for landing on wet and contaminated runways. |
| 16.46.8 | State the meaning of a performance-class 1 helicopter. CAR Part 1 (Helicopter candidates only) |
| | **Flight Planning and Preparation** |
| **16.50** | **Flight Preparation** |
| 16.50.2 | Explain the requirements for the obtaining and considering relevant information prior to flight. CAR 91 |
| 16.50.4 | Describe the publications and their content that provide operational route and aerodrome information. |
| 16.50.6 | Derive operational information from charts and publications that provide route and aerodrome information. |

| Sub Topic | Syllabus Item |
|---|---|
| **16.54** | **Fuel Requirements** |
| 16.54.2 | State the fuel reserve (A) or (H) required for a day VFR flight. CAR 91 |
| 16.54.4 | State the fuel reserve (A) or (H) required for a night VFR flight. CAR 91 |
| **16.56** | **Flight Plans** |
| 16.56.2 | State the CAR Part 135 requirements for the filing of a flight plan. |
| 16.56.4 | State the requirements for the notification of changes to the filed flight plan. CAR 91 |
| 16.56.6 | State the requirements for terminating a flight plan. CAR 91 |
| 16.56.8 | Describe the difference between ETA and SARTIME. CAR 91 |
| 16.56.10 | State the time search and rescue action would be initiated if a flight plan is not terminated before SARTIME. AIP ENR |
| **16.58** | **Enroute Limitations** |
| 16.58.2 | State the CAR Part 135 enroute limitations for two engine aeroplanes. |
| | **Air Traffic Services** |
| **16.60** | **Communications** |
| 16.60.2 | Derive from operational publications, the required radio frequency for communicating with specified ATC units. |
| 16.60.4 | State the requirements for making position reports to an ATS unit. CAR 91 & AIP ENR |
| 16.60.6 | State the content of a VFR position report. AIP ENR |
| 16.60.8 | State the purpose of Universal Communications Services (UNICOM). AIP GEN |
| 16.60.10 | State the purpose of an Aerodrome Frequency Response Unit (AFRU). AIP GEN |
| 16.60.12 | State the purpose of Aerodrome and Weather Information Broadcasts (AWIB). AIP GEN |
| 16.60.14 | State the meaning of the various light signals from a control tower. CAR 91 & AIP AD |
| 16.60.16 | State the communications requirements when TIBA procedures are in force. AIP ENR |
| **16.62** | **Clearances** |
| 16.62.2 | State the requirements for complying with ATC clearances and instructions. CAR 91 & AIP ENR |
| 16.62.4 | State the requirements for coordinating with an aerodrome flight information service. CAR 91 |
| 16.62.6 | State the requirements for receiving an ATC clearance prior to entering various types of airspace, and ground manoeuvring area. CAR 91 & AIP ENR |

| Sub Topic | Syllabus Item |
|---|---|
| 16.62.8 | State the requirements for receiving an ATC clearance prior to re-entering controlled airspace. CAR 91 & AIP ENR |
| **16.63** | **Separation** |
| 16.63.2 | Describe the method of passing traffic information using the clock code. |
| 16.63.4 | Describe the situations where Air Traffic Control is responsible for the provision of separation between VFR, SVFR and IFR traffic. AIP ENR |
| 16.63.6 | Describe the situations where the pilot-in-command is responsible for maintaining separation from other traffic. AIP ENR |
| 16.63.8 | Describe the normal separation standards applied by ATC. AIP ENR |
| 16.63.10 | Describe the situations where the normal separation may be reduced. AIP ENR |
| 16.63.12 | State the wake turbulence separation requirements for light aircraft in non-radar environment. AIP AD |
| **16.66** | **Radar Services** |
| 16.66.2 | Describe the radar services available to VFR flights. AIP ENR |
| **16.68** | **Global Navigation Satellite System** |
| 16.68.2 | State the equipment required by aircraft within the New Zealand flight information region, using GPS as a primary means navigation system. CAR 19 |
| 16.68.4 | State the actions required of pilots, using GPS equipment as a primary means navigation system, if system degradation occurs. CAR 19 |
| | **Airspace, Aerodromes and Heliports** |
| **16.70** | **Altimetry** |
| 16.70.2 | Explain the altimeter setting requirements for flight under VFR. CAR 91 & AIP ENR |
| 16.70.4 | State the procedure to use to obtain an altimeter setting when QNH is not available prior to takeoff and the requirement to obtain a QNH once in flight. AIP ENR |
| 16.70.6 | Describe QNH zones and state when zone QNH should be used. AIP ENR |
| 16.70.8 | Describe the transition altitude, layer and level. AIP ENR |
| **16.72** | **Cruising Levels** |
| 16.72.2 | State the altitude requirements when cruising VFR within the New Zealand FIR. CAR 91 & AIP ENR |
| 16.72.4 | Describe situations where ATC may assign cruising altitudes not in accordance with the VFR table of cruising altitudes. AIP ENR |
| **16.74** | **Transponders** |
| 16.74.2 | State the requirements for the operation of transponders within the New Zealand FIR. CAR 91 & AIP ENR |

| Sub Topic | Syllabus Item |
|---|---|
| 16.74.4 | Describe the procedures required of pilots operating transponders. AIP ENR |
| 16.74.6 | State the requirements and limitations on an aircraft operating under VFR in transponder mandatory airspace without an operating transponder. CAR 91 & AIP ENR |
| **16.75** | **Airspace** |
| 16.75.2 | State the rules pertaining to operating VFR in the various classes of airspace. CAR 91 & AIP ENR |
| 16.75.4 | Describe the vertical limits and purpose of control zones (CTR). CAR 71 |
| 16.75.6 | Describe the vertical limits and purpose of control areas (CTA). CAR 71 |
| 16.75.8 | State the status and conditions relating to flight in VFR transit lanes. AIP ENR |
| 16.75.10 | Describe the status and purpose of a general aviation area (GAA). CAR 91 & AIP ENR |
| 16.75.12 | Describe visual reporting points. |
| 16.75.14 | Describe the status of controlled airspace when ATC go off duty. AIP GEN |
| 16.75.16 | State the restrictions on operating an aircraft in a restricted area. CAR 91 & AIP ENR |
| 16.75.18 | State the restrictions on operating an aircraft in a military operating area (MOA). CAR 91 & AIP ENR |
| 16.75.20 | State the restrictions and operating considerations relating to operating an aircraft in a mandatory broadcast zone (MBZ). CAR 91 & AIP ENR |
| 16.75.22 | State the restrictions and operating considerations relating to operating an aircraft in a volcanic hazard zone (VHZ). CAR 91 & AIP ENR |
| 16.75.24 | State the restrictions and operating considerations relating to operating an aircraft in a danger area. CAR 91 & AIP ENR |
| 16.75.26 | State the restrictions and operating considerations relating to operating an aircraft in a designated low flying zone (LFZ). CAR 91 & AIP ENR |
| 16.75.28 | State the operating considerations relating to operating an aircraft in a common frequency zone (CFZ). AIP ENR |
| 16.75.30 | State the operating considerations relating to operating an aircraft over or close to temporary hazards/airspace. AIP ENR |
| 16.75.32 | Interpret airspace information on aeronautical charts used for VFR flights. |
| **16.76** | **Aerodromes and Heliports** |
| 16.76.2 | Describe the limitations on the use of a place as an aerodrome or heliport. CAR 91 |
| 16.76.4 | Describe the method of runway designation. AIP AD |
| 16.76.6 | Describe the movement area of an aerodrome. CAR 1 |
| 16.76.8 | Describe the meaning of the various aerodrome ground signals. |

| Sub Topic | Syllabus Item |
|---|---|
| 16.76.10 | Interpret information on aerodrome/heliport charts. AIP GEN & AIP Volume 4 |
| 16.76.12 | Interpret runway, taxiway, apron, and stand signs and markings. |
| **16.78** | **Aerodromes Lighting** |
| 16.78.2 | Describe the lighting intensity classifications. |
| 16.78.4 | Describe the following lighting systems:<br>(a) Runway edge lighting (REDL);<br>(b) Runway landing threshold lighting (RTHL);<br>(c) Runway end lighting (RENL);<br>(d) Runway centreline lighting system (RCLL);<br>(e) Runway end identifier lighting (REIL);<br>(f) Circling guidance lighting (CGL);<br>(g) Runway lead in lighting (RLLS);<br>(h) Pilot activated lighting (PAL); and<br>(i) Precision approach path indicators (PAPI). |
| 16.78.6 | Describe aerodrome beacons. |
| 16.78.8 | Describe the indication of above, on and below slope for:<br>(a) PAPIs;<br>(b) VASIS; and<br>(c) T-VASIS. |
| | **Emergencies; Incidents; and Accidents** |
| **16.80** | **Responsibilities of Operators and Pilots** |
| 16.80.2 | State the requirement for the notification of accidents. CAR 12 |
| 16.80.4 | State the requirement for the notification of incidents. CAR 12 |
| 16.80.6 | State the extent to which a pilot may deviate from the CA Act or rules in an emergency situation. CA Act 1990 S13A (2) |
| 16.80.8 | State the pilot action required following deviation from the CA Act or rules in an emergency situation. CA Act 1990 S13A (6) |
| **16.82** | **Communications and Equipment** |
| 16.82.2 | State the transponder code a pilot should set to indicate an emergency condition. AIP ENR |

| Sub Topic | Syllabus Item |
|---|---|
| 16.82.4 | State the transponder code a pilot should set to indicate a loss of communications. AIP ENR |
| 16.82.6 | State the transponder code a pilot should set to indicate that the aircraft is being subjected to unlawful interference. AIP ENR |
| 16.82.8 | Describe the means by which ATC will verify the transmission of an emergency SSR transponder code. AIP ENR |
| 16.82.10 | Describe the use of the speechless technique using unmodulated transmissions. AIP ENR |
| 16.82.12 | Describe and interpret ground-air visual signal codes. AIP GEN |
| 16.82.14 | Describe the procedures for directing a surface craft to a distress incident. AIP GEN |
| 16.82.16 | State the procedures for the emergency activation of an ELT. AIP GEN |
| 16.82.18 | State the pilot action required following the inadvertent transmission of an ELT. AIP GEN |
| 16.82.20 | State the requirements for the operational testing of an ELT. AIP GEN |
| 16.82.22 | State the procedures to be followed on receiving an ELT signal. AIP GEN |

| Flight Navigation Syllabus Matrix | | | | | | |
|---|---|---|---|---|---|---|
| - | - | **Topic No.** | **PPL** | **CPL** | **IR** | **ATPL** |
| - | - | | **6** | **18** | **54** | **38** |
| **Fundamentals of Air Navigation** | Form of the Earth | 2 | √ | √ | | √ |
| | Direction on the Earth | 4 | √ | √ | | √ |
| | Distance on the Earth | 6 | √ | √ | | √ |
| | Speed/Velocity | 8 | √ | √ | | √ |
| | Position Referencing | 10 | √ | √ | | √ |
| | Altimetry | 12 | √ | √ | √ | √ |
| | Principles and Terminology | 14 | √ | | | |
| | Time | 16 | √ | √ | | √ |
| | Twilight | 18 | √ | | | |
| | Visibility | 20 | | | | √ |
| | | | | | | |
| **Aeronautical charts** | Properties and Principles | 22 | √ | √ | √ | √ |
| | Scale | 24 | | | | √ |
| | Chart Reading | 26 | √ | √ | √ | √ |
| | | | | | | |
| **Circular Slide Rule** | Computations | 28 | √ | √ | | √ |
| | Relative velocity | 30 | | | | √ |
| | Wind Components | 32 | √ | | | |
| | Triangle of Velocities | 34 | √ | √ | | √ |
| | 1:60 Rule | 36 | √ | √ | | |
| | | | | | | |
| **Deduced Reckoning** | In Flight Revisions | 38 | √ | | | |
| | | | | | | |

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|---|---|---|---|---|---|---|
| **Flight Planning** | Route Selection | 40 | √ | √ | √ | |
| | Chart Preparation | 42 | √ | √ | | |
| | Plan Preparation | 44 | √ | √ | √ | |
| | Fuel Planning | 46 | √ | √ | √ | |
| | | | | | | |
| **Navigation Procedures - VFR** | VFR Flight Navigation | 48 | √ | √ | | |
| | Special Procedures | 50 | √ | √ | | |
| | | | | | | |
| **Navigation Procedures - IFR** | Properties and Principles | 52 | | | √ | |
| | Chart Plotting | 54 | | | √ | √ |
| | Chart reading | 56 | | | √ | |
| | Enroute Diversion Calculation | 58 | | √ | √ | √ |
| | | | | | | |
| **Flight Management** | Flight Management | 60 | √ | | | √ |
| | Fuel Management | 62 | √ | | | |
| | | | | | | |
| **Radio Aids** | ADF | 64 | | | √ | |
| | VOR | 66 | | | √ | |
| | DME | 68 | | | √ | |
| | | | | | | |
| **GNSS** | Global Navigation Satellite System | 70 | √ | √ | √ | √ |
| | | | | | | |
| **Radar** | Procedures | 72 | √ | | | |

## Subject No. 18 Flight Navigation General

***Note:*** *This syllabus is principally based on New Zealand VFR navigation with basic instrument backup as applicable to visually navigating a piston-engine light twin aeroplane.*

Each subject has been given a subject number and each topic within that subject a topic number. These reference numbers will be used on knowledge deficiency reports and will provide valuable feedback to the examination candidate. These reference numbers are common across the subject levels and therefore may not be consecutive.

This syllabus presupposes a knowledge and understanding already attained at PPL level.

| Sub Topic | Syllabus Item |
|---|---|
| | **Fundamentals of Air Navigation** |
| **18.2** | **Form of the Earth** |
| 18.2.2 | Define and identify, on a diagram of the earth: |
| | (a) great circles; |
| | (b) small circles; |
| | (c) rhumb lines; |
| | (d) parallels of latitude; |
| | (e) meridians of longitude; |
| | (f) Greenwich (Prime) Meridian. |
| **18.4** | **Direction on the Earth** |
| 18.4.2 | Define: |
| | (a) relative bearing; |
| | (b) back bearing. |
| 18.4.4 | Explain the processes, cautions and limitations when deriving track distances and bearings from a chart. |
| **18.6** | **Distance on the Earth** |
| 18.6.2 | Define the various units of distance used in aviation and the application of each. |
| 18.6.4 | Measure distances up to 1000nm (± 1%) on an appropriate chart. |
| **18.8** | **Speed and Velocity** |
| 18.8.2 | Define: |
| | (a) a knot (kt); |
| | (b) ground speed (GS); |
| | (c) indicated airspeed (IAS); |
| | (d) calibrated airspeed (CAS); |

| Sub Topic | Syllabus Item |
|---|---|
| | (e) equivalent airspeed (EAS); |
| | (f) true airspeed (TAS). |
| 18.8.4 | Explain how TAS is affected by changes in pressure altitude, air temperature and air density. |
| 18.8.6 | State the speed provided by a GNSS and inertial system. |
| **18.10** | **Position Referencing** |
| 18.10.2 | Define a waypoint (WPT). |
| 18.10.4 | Describe and apply the following position reference methods: |
| | (a) place/ bearing/distance; |
| | (b) latitude and longitude; |
| | (c) earth based navigation aids. |
| 18.10.6 | Plot and reference a position (± 0.5 of a minute) on a current published New Zealand Aeronautical Chart. |
| 18.10.8 | Locate a position on a chart. |
| | (a) from an NDB given magnetic direction to and distance from; |
| | (b) from a VOR given radial and DME distance. |
| **18.12** | **Altimetry** |
| 18.12.2 | Define: |
| | (a) indicated altitude; |
| | (b) true altitude; |
| | (c) pressure altitude (PA); |
| | (d) density altitude (DA); |
| | (e) flight level (FL); |
| | (f) transition altitude; |
| | (g) transition layer; |
| | (h) transition level; |
| | (i) QNH; |
| | (j) QFE. |
| 18.12.4 | Explain and apply the VFR table of cruising levels below and above transition. |
| 18.12.6 | Explain how true and indicated altitudes are affected by changes in air pressure and air temperature. |

| Sub Topic | Syllabus Item |
|---|---|
| 18.12.8 | Explain how true and indicated altitudes are related when using flight levels. |
| **18.16** | **Time** |
| 18.16.2 | Define Local Mean Time (LMT). |
| 18.16.4 | Calculate the LMT at a given location. |
| 18.16.6 | Convert between LMT, UTC, NZST and/or NZDT. |
| | **Aeronautical Charts** |
| **18.22** | **Properties and Principles** |
| 18.22.2 | Explain the difficulties associated with representing a spherical shape on a flat surface. |
| 18.22.4 | Describe the process of creating:<br>(a) a Mercator projection;<br>(b) a Lambert's conformal projection. |
| 18.22.6 | List and explain the properties of:<br>(a) a Mercator projection;<br>(b) a Lambert's conformal projection. |
| 18.22.8 | List and explain the uses of:<br>(a) a Mercator projection;<br>(b) a Lambert's conformal projection;<br>(c) the various New Zealand aeronautical charts;<br>(d) the aerodrome charts and associated operational data pages. |
| **18.26** | **Chart Reading** |
| 18.26.2 | On the appropriate New Zealand aeronautical charts;<br>(a) interpret the scale, legend, airspace, geographical features and symbols;<br>(b) describe the method of indicating relief;<br>(c) interpret information from aerodrome charts and associated operational data pages. |
| | **Circular Slide Rule** |
| **18.28** | **Computations** |
| 18.28.2 | Derive or compute TAS, given IAS, pressure altitude and air temperature in degrees Celsius. |
| 18.28.4 | Solve mathematical equations: |

| Sub Topic | Syllabus Item |
|---|---|
| | (a) multiplication (± 2%); |
| | (b) division (± 2%); |
| | (c) proportion (± 2%). |
| 18.28.6 | Calculate time, speed, or distance, given two factors. |
| 18.28.8 | Calculate fuel consumption, given the burn rate and time. |
| 18.28.10 | Calculate the fuel burn rate, given the consumption and time. |
| 18.28.12 | Calculate fuel endurance, given the fuel quantity and burn rate. |
| 18.28.14 | Convert between: |
| | (a) degrees Fahrenheit and Celsius; |
| | (b) nautical miles, statute miles and kilometre (± 1%); |
| | (c) metres and feet (± 2%); |
| | (d) pounds and kilograms (± 2%); |
| | (e) litres, imperial and US gallons (± 2%); |
| | (f) a volume of fuel (in litres, imperial or US gallons) and a mass of fuel (in pounds or kilograms) (± 2%). |
| **18.34** | **Triangle of Velocities** |
| 18.34.2 | Identify and label the three vectors of the triangle of velocities. |
| 18.34.4 | Using a navigation computer, solve triangle of velocity problems (given four of the six variables): |
| | (a) heading and track (± 2°); |
| | (b) TAS and GS (± 2kts); |
| | (c) wind velocity (± 3°/± 3kts); |
| | (d) drift (± 1°). |
| **18.36** | **The 1 in 60 Rule** |
| 18.36.2 | 1 in 60 rule computations. |
| | **Flight Planning** |
| **18.40** | **Route Selection** |
| 18.40.2 | List the factors to be considered when selecting a VFR cross-country navigation route. |
| 18.40.4 | List the factors to be considered when selecting altitudes at which to fly in the cruise. |
| 18.40.6 | List the factors to be considered when selecting alternate routes and destination alternates. |

| Sub Topic | Syllabus Item |
|---|---|
| **18.42** | **Chart Preparation** |
| 18.42.2 | Mark the following on a map:<br>(a) departure aerodrome, turning points, and destination aerodrome;<br>(b) tracks;<br>(c) heading change markings, either 1:60 or drift lines;<br>(d) ETA amendment markings. |
| **18.44** | **Plan Preparation** |
| 18.44.2 | Complete a navigation log / flight plan for a VFR cross-country, including calculating the following values:<br>(a) top of climb point;<br>(b) level cruise portion;<br>(c) top of descent point;<br>(d) CAS/TAS;<br>(e) tracks;<br>(f) estimated wind velocities;<br>(g) estimated temperatures;<br>(h) headings;<br>(i) groundspeeds;<br>(j) distances;<br>(k) EET;<br>(l) ETA;<br>(m) SARTIME. |
| **18.46** | **Fuel Planning** |
| 18.46.2 | Derive, from a sample *Aircraft Flight Manual*, the fuel consumption rate for a given leg. |
| 18.46.4 | Calculate the expected fuel burn on a given leg. |
| 18.46.6 | Calculate the minimum fuel required on a given VFR cross-country flight. |
| 18.46.8 | State the legal minimum fuel reserves required on a VFR cross-country flight. |
| 18.46.10 | Calculate the maximum holding time available for a given leg. |
| 18.46.12 | Calculate the latest time of departure for a given VFR cross-country flight or a given leg. |

| Sub Topic | Syllabus Item |
|---|---|
| | **Navigation Procedures – VFR** |
| **18.48** | **VFR Flight Navigation** |
| 18.48.2 | Describe the techniques and procedures for:<br>(a) setting heading;<br>(b) cruise routine/activity cycle;<br>(c) maintaining a flight log;<br>(d) turning points;<br>(e) approaching/rejoining at a destination aerodrome. |
| 18.48.4 | Describe techniques for:<br>(a) position fixing;<br>(b) changing heading to make good the desired track;<br>(c) changing heading to make good next turning point or destination;<br>(d) amending ETA. |
| 18.48.6 | Estimate and calculate a heading to make good a reciprocal track. |
| 18.48.8 | Estimate and calculate an aircraft's position given bearing and distance from an identified ground position. |
| 18.48.10 | Calculate the maximum holding duration prior to diversion to an alternate. |
| **18.50** | **Special Procedures** |
| 18.50.2 | Describe the techniques, requirements, and procedures for:<br>(a) re-establishing position if lost or unsure of position;<br>(b) diverting from the pre-planned route;<br>(c) navigating at low level when forced to do so by bad weather;<br>(d) amending SARTIMES. |
| **18.58** | **Enroute Diversion Calculations** |
| 18.58.2 | Define and calculate:<br>(a) time and distance to the point of no return (PNR);<br>(b) time and distance to a departure/destination equi-time point (ETP). |
| | **GNSS** |
| **18.70** | **GNSS Global Navigation Satellite System** |
| 18.70.2 | Explain the limitations of using GPS/GNSS to supplement normal visual navigation. |

| Sub Topic | Syllabus Item |
|---|---|
| 18.70.4 | Briefly describe the coordinate systems in common use by GPS/GNSS units. |
| 18.70.6 | Explain the significance of RAIM predictions. |

## Subject No. 19 Flight Navigation (Balloon)

Each subject has been given a subject number and each topic within that subject a topic number. These reference numbers will be used on knowledge deficiency reports and will provide valuable feedback to the examination candidate.

| Sub Topic | Syllabus Item |
|---|---|
| | **Fundamentals of Air Navigation** |
| **19.2** | **Form of the Earth** |
| 19.2.2 | Describe the general shape of the earth |
| 19.2.4 | Define and identify, on a diagram of the earth, and explain the meaning of the following: |
| | (a) axis and direction of rotation; |
| | (b) geographic poles; |
| | (c) great circles; |
| | (d) small circles; |
| | (e) rhumb lines; |
| | (f) the equator; |
| | (g) parallels of latitude; |
| | (h) meridians of longitude; |
| | (i) Greenwich (Prime) Meridian; |
| | (j) position. |
| **19.4** | **Direction on the Earth** |
| 19.4.2 | Describe the 360º method of indicating direction. |
| 19.4.4 | Describe the earth's magnetic field. |
| 19.4.6 | Define: |
| | (a) magnetic pole; |
| | (b) true north; |
| | (c) magnetic north; |
| | (d) compass north; |
| | (e) the cardinal directions of the earth; |
| | (f) the quadrantal directions of the earth; |
| | (g) true direction; |
| | (h) magnetic direction; |

| Sub Topic | Syllabus Item | |
|---|---|---|
| | (i) | compass direction; |
| | (j) | magnetic variation; |
| | (k) | an isogonal; |
| | (l) | compass deviation; |
| | (m) | true bearing; |
| | (n) | magnetic bearing; |
| | (o) | compass bearing; |
| | (p) | relative bearing; |
| | (q) | back bearing. |
| 19.4.8 | Convert between true, magnetic and compass directions. | |
| 19.4.10 | Convert between relative, true, magnetic and compass bearings. | |
| 19.4.12 | Plot and measure tracks and bearings (± 1º) on a current published New Zealand aeronautical chart 1:250 000 and (±100m) New Zealand topographical map 1:50 000. | |
| **19.6** | **Distance on the Earth** | |
| 19.6.2 | Define a: | |
| | (a) | statute mile; |
| | (b) | nautical mile (nm); |
| | (c) | kilometre. |
| 19.6.4 | Calculate the conversion between a statute mile, a nautical mile and a kilometre. | |
| 19.6.6 | Measure distances (± 1nm) on a current published New Zealand aeronautical chart and (±100m) on a current New Zealand topographical map. | |
| **19.8** | **Speed** | |
| 19.8.2 | Define: | |
| | (a) | a knot. |
| | (b) | ground speed (GS); |
| | (c) | kilometre per hour. |
| **19.10** | **Position Referencing** | |
| 19.10.2 | Define a: | |
| | (a) | ground position; |
| | (b) | air position; |

| Sub Topic | Syllabus Item | |
|---|---|---|
| | (c) | DR position; |
| | (d) | waypoint (WPT); |
| | (e) | pinpoint; |
| | (f) | fix; and, |
| | (g) | position line. |
| 19.10.4 | Describe and apply the following position reference methods: | |
| | (a) | place name; |
| | (b) | bearing and distance; |
| | (c) | latitude and longitude; |
| | (d) | eight and six figure grid reference. |
| 19.10.6 | Plot and reference a position (± 0.5 of a minute) on a current published New Zealand aeronautical chart and (±100m) on a current published New Zealand topographical map. | |
| 19.10.8 | Calculate the relative bearing of a position from a hot air balloon. | |
| 19.10.10 | Calculate the bearing of a hot air balloon from a position. | |
| **19.12** | **Altimetry** | |
| 19.12.2 | Define: | |
| | (a) | height; |
| | (b) | altitude; |
| | (c) | mean sea level (MSL); |
| | (d) | ground level; |
| | (e) | elevation; |
| | (f) | indicated altitude; |
| | (g) | calibrated altitude; |
| | (h) | true altitude; |
| | (i) | pressure altitude (PA); |
| | (j) | density altitude (DA); |
| | (k) | flight level (FL); |
| | (l) | transition altitude; |
| | (m) | transition level; |

| Sub Topic | Syllabus Item | |
|---|---|---|
| | (n) | transition layer; |
| | (o) | QNH; |
| | (p) | QFE; |
| | (q) | QNE. |
| 19.12.4 | Explain the effect of a change in mean sea level air pressure on the altimeter reading of a transiting hot air balloon. | |
| 19.12.6 | State and apply the altimeter setting rules in New Zealand. | |
| 19.12.8 | Explain and apply the table of cruising levels. | |
| 19.12.10 | Explain how true and indicated altitudes are affected by changes in air pressure and air temperature. | |
| **19.14** | **Principles and Terminology** | |
| 19.14.2 | Define: | |
| | (a) | *track required; |
| | (b) | true and magnetic track; |
| | (c) | *true heading; |
| | (d) | *magnetic heading; |
| | (e) | *compass heading; |
| | (f) | *track / TMG; |
| | (g) | *port; |
| | (h) | *starboard; |
| | (i) | *dead (deduced) reckoning; |
| | (j) | track error (TE); |
| | (k) | estimated time of departure (ETD); |
| | (l) | actual time of departure (ATD); |
| | (m) | estimated elapsed time (EET) / estimated time interval (ETI); |
| | (n) | estimated time of arrival (ETA); |
| | (o) | actual time of arrival (ATA). |
| 19.14.4 | Calculate the values marked with an * in Syllabus Item 19.14.2. | |
| **19.16** | **Time** | |
| 19.16.2 | Describe the six and ten figure systems of indicating date/time groups. | |

| Sub Topic | Syllabus Item |
|---|---|
| 19.16.4 | Explain the relationship between time and longitude. |
| 19.16.6 | Convert between arc and time. |
| 19.16.8 | Define Local Mean Time (LMT). |
| 19.16.10 | Calculate the LMT at a given location in New Zealand. |
| 19.16.12 | Define: |
| | (a) Co-ordinated Universal Time (UTC); |
| | (b) Standard Time (NZST); |
| | (c) Daylight Time (NZDT); |
| | (d) The International Dateline. |
| 19.16.14 | Convert between LMT; UTC; NZST; and/or NZDT. |
| **19.18** | **Twilight** |
| 19.18.2 | Define: |
| | (a) sunrise; |
| | (b) sunset; |
| | (c) daylight; |
| | (d) twilight; |
| | (e) morning civil twilight (MCT); |
| | (f) evening civil twilight (ECT). |
| 19.18.4 | Describe the factors that affect the times of sunrise and sunset (daylight). |
| 19.18.6 | Describe the factors that affect the duration of twilight. |
| 19.18.8 | Describe the factors that affect daylight conditions. |
| 19.18.10 | Derive or calculate the MCT and ECT at a given location in New Zealand. |
| | **Aeronautical Charts and Topographical Maps** |
| **19.20** | **Properties and Principles of Aeronautical Charts/Topographical Maps.** |
| 19.20.2 | Explain the difficulties associated with representing a spherical shape on a flat surface. |
| 19.20.4 | List the ideal properties of an aeronautical chart. |
| 19.20.6 | Describe the process of creating: |
| | (a) a Mercator projection; and, |
| | (b) a Lambert's conformal projection. |

| Sub Topic | Syllabus Item |
|---|---|
| 19.20.8 | List and explain the properties of:<br>(a) a Mercator projection; and,<br>(b) a Lambert's conformal projection. |
| 19.20.10 | List and explain the uses of:<br>(a) a Mercator projection;<br>(b) a Lambert's conformal projection;<br>(c) a NZ Visual Planning Chart (VPC) 1:500 000;<br>(d) a NZ Visual Navigation Chart (VNC) 1:250 000;<br>(e) a NZ Topographical Map 1:50 000;<br>(f) the Aerodrome Chart;<br>(g) a Sensitive Area Map. |
| 19.20.12 | Calculate earth distance and chart distance, given scale and one factor. |
| 19.20.14 | Calculate chart scale, given earth distance and chart distance. |
| **19.22** | **Map Reading** |
| 19.22.2 | Interpret the features and symbols of a NZ Visual Navigation Chart (VNC) and NZ Topographical Map. |
| 19.22.4 | Describe the method of indicating relief on a NZ Visual Navigation Chart (VNC) and NZ Topographical Map. |
| 19.22.6 | Interpret information from Aerodrome Charts and Operational Data pages in the AIPNZ Vol 4. |
| **19.24** | **Calculations** |
| 19.24.2 | Computations by electronic calculator. |
| 19.24.4 | Derive or compute density altitude, pressure altitude and air temperature in degrees Celsius. |
| 19.24.6 | Solve mathematical equations:<br>(a) multiplication;<br>(b) division;<br>(c) proportion. |
| 19.24.8 | Calculate time, speed, or distance, given two factors. |
| 19.24.10 | Calculate fuel consumption, given the burn rate and time. |
| 19.24.12 | Calculate fuel burn rate, given the consumption and time. |

| Sub Topic | Syllabus Item |
|---|---|
| 19.24.14 | Calculate fuel endurance, given the fuel quantity and burn rate. |
| 19.24.16 | Convert between:<br>(a) degrees Fahrenheit and Celsius;<br>(b) nautical miles, statute miles and kilometres;<br>(c) metres and feet;<br>(d) pounds and kilograms;<br>(e) litres, imperial and US gallons;<br>(f) a volume of fuel (in litres, imperial or US gallons) and a volume of fuel (in pounds or kilograms). |
| **19.26** | **Flight Planning** |
| 19.26.2 | Route selection;<br>(a) Explain the use of a Pi Ball (Pilot Balloon);<br>(b) Explain the relationship between Pi Ball, time and altitude, compass bearing and map direction. |
| 19.26.4 | List the factors to be considered when selecting a VFR cross-country navigation route. |
| 19.26.6 | List the factors to be considered when selecting altitudes at which to fly in the cruise, including compliance with ATC. |
| 19.26.8 | List the factors to be considered when selecting alternate routes and destination alternates, including the ability to maintain planned profile and comply with ATC. |
| **19.28** | **Map Preparation** |
| 19.28.2 | Mark the following on a map:<br>(a) departure field, aerodrome, turning points, and destination field;<br>(b) tracks;<br>(c) heading change markings;<br>(d) ETA amendment markings. |
| **19.30** | **Plan Preparation** |
| 19.30.2 | Complete a navigation log / flight plan for a 20km VFR cross-country, including calculating the following values:<br>(a) top of climb point;<br>(b) level cruise portion;<br>(c) top of descent point;<br>(d) groundspeeds; |

| Sub Topic | Syllabus Item | |
|---|---|---|
| | (e) | tracks; |
| | (f) | estimated wind velocities; |
| | (g) | estimated temperatures; |
| | (h) | headings; |
| | (i) | fuel consumption rates; |
| | (j) | distances; |
| | (k) | EETs; |
| | (l) | ETAs; |
| | (m) | entry into/out of control zones/areas CTRs/CTAs. |
| **19.32** | **Fuel Planning** | |
| 19.32.2 | Derive, from a hot air balloon flight manual, the fuel consumption rate for a given leg. | |
| 19.32.4 | Calculate the expected fuel burn on a given leg. | |
| 19.32.6 | Calculate the minimum fuel required on a given VFR cross-country flight. | |
| 19.32.8 | State the legal minimum fuel reserves required on a VFR cross-country flight. | |
| 19.32.10 | Calculate the maximum flying time available for a given leg. | |
| 19.32.12 | Calculate the latest time of departure for a given VFR cross-country flight or a given leg. | |
| 19.32.14 | Explain the use of fuel quantity/reserve versus speed and time; in the decision process when flying over un-landable areas (forests, city, no retrievable roads) (PNP equi-time/equidistance) | |
| **19.34** | **Load Planning** | |
| 19.34.2 | Calculate the take-off weight of a given hot air balloon on a VFR flight. | |
| 19.34.4 | Calculate the available payload of a given hot air balloon on a VFR flight. | |
| | **Visual Navigation Procedures** | |
| **19.36** | **Flight Management** | |
| 19.36.2 | Describe the techniques and procedures for: | |
| | (a) | setting heading; |
| | (b) | cruise routine / activity cycle; |
| | (c) | maintaining a flight log; |
| | (d) | turning points; |
| | (e) | approaching a destination field/aerodrome. |

| Sub Topic | Syllabus Item |
|---|---|
| 19.36.4 | Describe the techniques for map reading in flight. |
| 19.36.6 | Describe techniques for:<br>(a) pinpointing;<br>(b) changing heading with altitude to make good the desired track;<br>(c) changing heading with altitude to make good next turning point or destination;<br>(d) amending ETA. |
| 19.36.8 | Estimate and calculate a heading to make good a destination. |
| 19.36.10 | Estimate and calculate a hot air balloons position given bearing and distance from an identified ground position. |
| **19.38** | **Special Procedures** |
| 19.38.2 | Describe the techniques, requirements, and procedures for:<br>(a) re-establishing position if lost or unsure of position;<br>(b) diverting from the pre-planned route;<br>(c) navigating at low level when forced to do so by bad weather. |
| | **Radio Aids in Support of VFR Operations** |
| **19.40** | **Global Positioning System** |
| 19.40.2 | Explain the importance of using GPS only to supplement normal visual navigation. |
| 19.40.4 | Explain the importance of using GPS map datums; WGS 84, Geo Datum 49 etc and their relationship to various maps. |
| 19.40.6 | Explain the precautions to be taken when:<br>(a) inserting data with the keypad;<br>(b) operating/reading the unit while maintaining a proper lookout;<br>(c) operating/reading the unit in marginal weather conditions. |
| 19.40.8 | State the factors influencing GPS reliability. |
| **19.42** | **Radar** |
| 19.42.2 | State the two types of radar currently used in New Zealand. |
| 19.42.4 | Describe the principle of operation of each type of radar. |
| 19.42.6 | Explain what is meant by transponder Mode A and Mode C. |
| 19.42.8 | List and explain four radar services that may be available to VFR flights. |

## Meteorology Syllabus Matrix

| | | Topic No. | PPL | CPL | ATPL |
|---|---|---|---|---|---|
| | | | **8** | **20** | **42** |
| **Meteorological services reports and forecasts** | Domestic services, reports and forecasts | 2 | * | | |
| | Regional services, reports and forecasts | 2 | | * | |
| | International services, reports and forecasts | 2 | | | * |
| | | | | | |
| **Weather maps** | Interpretation of weather maps and charts | 4 | * | * | * |
| | | | | | |
| **Fundamentals of the Atmosphere** | The atmosphere | 6 | * | * | * |
| | Temperature and heat exchange processes | 8 | * | * | * |
| | Pressure and density | 10 | * | * | * |
| | Wind | 12 | * | * | * |
| | Local Winds | 14 | * | * | |
| | Water vapour | 16 | * | * | * |
| | Atmospheric stability | 18 | * | * | * |
| | Inversions | 20 | * | | |
| | Clouds | 22 | * | * | * |
| | Precipitation | 24 | * | * | |
| | Visibility and fog | 26 | * | * | |
| | | | | | |
| **Meteorological conditions** | Aircraft icing | 28 | * | * | * |
| | Thunderstorms | 30 | * | * | * |
| | Mountain weather | 32 | * | | |
| | Anticyclones | 34 | | * | |

| | | | | | |
|---|---|---|---|---|---|
| | Air masses, fronts and depressions | 36 | * | * | * |
| | Upper air meteorology | 38 | | | * |
| | Turbulence | 40 | * | * | * |
| | Other hazardous meteorological conditions | 42 | | * | * |
| | | | | | |
| **New Zealand weather** | New Zealand weather | 44 | * | | |
| | | | | | |
| **Regional and global meteorology** | The general circulation | 46 | | * | * |
| | Tropical meteorology | 48 | | * | * |
| | | | | | |
| **Satellite, radar and non-aviation-specific weather information** | Satellite, radar and non-aviation specific weather information | 50 | * | * | * |
| | Domestic meteorological services reports and forecasts | 52 | * | | |

## Subject No. 20 CPL Meteorology

***Notes: This syllabus is principally based on the regional meteorology as applicable to flying a twin engine aircraft IFR, within the South Pacific region at or below FL 250.***

***Detailed acronyms and service provider titles (e.g. SKC, METAR AUTO) are indicative of the area of knowledge required and do not limit the syllabus to those specifically listed.***

Each subject has been given a subject number and each topic within that subject a topic number. These reference numbers will be used on knowledge deficiency reports and will provide valuable feedback to the examination candidate. These reference numbers are common across the subject levels and therefore may not be consecutive.

This syllabus presupposes a thorough knowledge and understanding of the PPL Meteorology syllabus. Any item repeated here indicates a higher level of understanding or a wider scope is required.

### 20.2 Regional Meteorological Services, Reports and Forecasts

20.2.2 Explain in plain language the coded or pictorial information contained in:

(a) ARFOR;

(b) ROFOR;

(c) METAR;

(d) SPECI;

(e) METAR AUTO;

(f) TREND;

(g) TAF;

(h) SIGMET;

(i) ATIS;

(j) AWIB;

(k) BWR;

(l) VAA;

(m) PIREP;

(n) AIREP

(o) medium-level SIGWX;

(p) wind/temp charts.

20.2.4 Determine whether a particular meteorological product in para 20.2.2 (a) to (p) is valid for a flight.

20.2.6 Apply the information contained in the reports and charts in para 20.2.2 (a) to (p) to planning and conducting a flight.

20.2.8 Given a typical weather briefing, evaluate weather information applicable to the flight, and:

(a) assess likely changes (either improving or deteriorating) in weather during the flight;

(b) identify phenomena which may adversely affect the flight.

**20.4 Weather Maps**

20.4.2 State the difference between analysis and prognosis charts.

20.4.4 Describe the general weather feature or conditions associated with each of the following pressure systems:

(a) isobars;

(b) depression (or “low”);

(c) tropical cyclone (or “hurricane” or “typhoon”);

(d) trough of low pressure;

(e) anticyclone (or “high”);

(f) ridge of high pressure;

(g) col.

20.4.6 Describe the general flying conditions associated with:

(a) cold fronts;

(b) warm fronts;

(c) occluded fronts;

(d) stationary fronts.

20.4.8 Describe typical wind speeds and directions ahead of and behind these fronts in mid-latitudes.

20.4.10 Explain how subsidence and ascent of air influences the type of weather commonly associated with pressure systems.

20.4.12 Identify the general direction of movement of pressure systems in the mid-latitudes of the Southern Hemisphere.

20.4.14 Define the “westerly index” over New Zealand.

20.4.16 Identify ‘high’ and ‘low’ westerly indices on weather maps.

20.4.18 Explain the weather distribution across New Zealand in high and low westerly index situations.

20.4.20 Describe the significance of high and low westerly index situations across New Zealand to aviation.

20.4.22 Assess and interpret information presented on mean sea level analysis and prognosis weather charts covering the Southwest Pacific region.

## 20.6 The Atmosphere

20.6.2 Define the terms:

(a) troposphere;

(b) tropopause;

(c) stratosphere.

20.6.4 Explain how the following changes within the tropospheric column affect the height of the tropopause:

(a) surface pressure;

(b) temperature.

20.6.6 State the average tropopause heights and tropopause temperatures at:

(a) the equator;

(b) the poles;

(c) in mid-latitudes.

20.6.8 Explain:

(a) the sources of aerosols within the atmosphere;

(b) the effects of aerosols within the atmosphere;

(c) the importance of aerosols within the atmosphere.

20.6.10 In general terms, describe the effect of increasing height and/or latitude on water vapour and aerosol content within the atmosphere.

20.6.12 Explain the effects on temperature within the atmosphere due to:

(a) water vapour;

(b) carbon dioxide;

(c) ozone.

## 20.8 Temperature and Heat Exchange Processes

20.8.2 Describe the temperature reference points of the centigrade scale used in New Zealand aviation.

20.8.4 Explain the factors that influence the amount of solar radiation received at the earth's surface.

20.8.6 Explain the warming or cooling of the atmosphere with reference to solar and terrestrial radiation.

20.8.8 Describe the following:

(a) conduction;

(b) convection;

(c) advection.

20.8.10 Explain how the atmosphere is warmed or cooled by:

(a) conduction;

(b) convection;

(c) advection.

20.8.12 Define the term ‘specific heat’.

20.8.14 Define the term ‘albedo’.

20.8.16 Explain the significance in terms of heating at the earth’s surface of:

(a) specific heat;

(b) albedo;

(c) insolation.

**20.10 Pressure and Density**

20.10.2 Explain what is meant by the ‘partial pressure’ of a gas.

20.10.4 Explain the significance of air pressure with reference to:

(a) barometric tendency;

(b) altimetry.

20.10.6 Explain the effects of temperature changes within the troposphere on the pressure lapse rates.

20.10.8 Define ‘pressure gradient’.

20.10.10 Identify strong and weak pressure gradients on a weather map.

20.10.12 Given examples of ambient temperature at a stated altitude, calculate:

(a) the ISA temperature at that altitude;

(b) the ISA height at that temperature.

20.10.14 Define:

(a) QFE;

(b) QNH;

(c) QNE;

(d) pressure altitude;

(e) flight levels (FL).

20.10.16 Describe:

(a) QNE;

(b) pressure altitude;

(c) flight levels (FL).

20.10.18 Define the transition layer (as it applies in New Zealand), with reference to the:

(a) transition altitude;

(b) transition level;

(c) exceptions that apply to (a) and (b) above.

20.10.20 Explain why transition layers in other countries are found at lower or higher levels in the atmosphere.

20.10.22 Define ‘elevation’.

20.10.24 Explain what happens to an aircraft’s flight profile when the altimeter sub-scale is not reset during flights between areas with differing MSL pressures.

20.10.26 Describe how localised pressure changes occur in association with:

(a) lee troughs;

(b) thermal (or ‘heat’) lows;

(c) thunderstorms.

20.10.28 Describe ‘diurnal’ pressure variations.

20.10.30 State the latitudes where diurnal pressure variation is most significant.

20.10.32 Explain the effects of changes in the following elements on air density:

(a) pressure;

(b) temperature;

(c) altitude;

(d) moisture content of the air.

20.10.34 Define ‘density altitude’ (DA).

20.10.36 Calculate ‘density altitude’.

**20.12 Wind**

20.12.2 Describe the effect of the Coriolis force on moving air.

20.12.4 State the horizontal component of the Coriolis force equation.

20.12.6 State the:

(a) changes in the magnitude of Coriolis force with latitude;

(b) relationship between the wind speed and the Coriolis force;

(c) direction of the Coriolis force relative to the wind direction in the Southern Hemisphere.

20.12.8 Define the ‘geostrophic wind’ in the Southern Hemisphere.

20.12.10 Describe the ‘geostrophic wind’ in the Southern Hemisphere.

20.12.12 Describe the ‘gradient wind’ in the Southern Hemisphere with respect:

(a) anticyclonically curved isobars;

(b) cyclonically curved isobars.

20.12.14 Describe the ‘frictional wind balance’.

20.12.16 State typical wind direction deflections due to friction over:

(a) the sea;

(b) flat to undulating ground;

(c) mountainous regions.

20.12.18 Explain how the following affect the depth of the friction layer:

(a) atmospheric stability;

(b) wind strength;

(c) surface roughness.

**20.14 Local Winds – New Zealand and the South Pacific**

20.14.2 Describe the general characteristics of a mountain wave set-up with reference to:

(a) wave-lengths;

(b) position and rotation of any possible rotor zones;

(c) position and type of any possible cloud development;

(d) the heights of the friction layer;

(e) areas of probable severe turbulence;

(f) areas of possible severe airframe icing.

20.14.4 With reference to mountain waves:

(a) explain the factors that affect the wave amplitude;

(b) explain the factors that affect the wave-length;

(c) describe the flight conditions associated with mountain waves.

20.14.6 Explain the rotor streaming process.

20.14.8 Describe the flight conditions associated with rotor streaming.

20.14.10 Define the Föhn wind.

20.14.12 State the requirements for the development of a Föhn wind.

20.14.22 Describe the flight conditions when flying in Föhn conditions in the following positions:

(a) to windward of the mountain range;

(b) over the mountain range;

(c) on the lee side of the mountain range.

20.14.24 Describe the development of sea breezes about the islands of the sub-tropical SW Pacific.

20.14.26 Describe the south-east trade winds about the islands of the sub-tropical SW Pacific.

20.14.28 Describe:

(a) a katabatic wind;

(b) an anabatic wind.

20.14.30 Describe the conditions that support the development of:

(a) katabatic winds;

(b) anabatic winds.

**20.16 Water Vapour**

20.16.2 Explain the sources of water vapour in the atmosphere.

20.16.4 Describe 'vapour pressure' and 'saturation vapour pressure'.

20.16.6 Define 'latent heat'.

20.16.8 Describe the condensation process.

20.16.10 Describe the freezing and melting processes with reference to latent heat.

20.16.12 Describe the diurnal variation of relative humidity and dew point.

20.16.14 Describe the effects of moisture content on the density of the air.

**20.18 Atmospheric Stability**

20.18.2 Explain how atmospheric stability is determined.

20.18.4 Given plotted graphs of temperature (ELR) versus height, identify and describe:

(a) super-adiabatic temperature lapse-rates (steep ELRs);

(b) inversions and isothermal layers (shallow ELRs).

20.18.6 Calculate atmospheric stability by lifting parcels of air given assumed ELR's, dew point temperatures and mountain heights.

20.18.8 Describe the typical diurnal variation of stability.

**20.22 Cloud**

20.22.2 Describe the relationship between stability of air and cloud type.

20.22.4 List the vertical extents of the three main cloud layers in:

(a) mid-latitudes;

(b) tropical latitudes.

20.22.6 State the difference between the Lifting Condensation Level (LCL) and the Convective Condensation Level (CCL).

20.22.8 Demonstrate the use of simple formulae to calculate the LCL and CCL.

20.22.10 Describe the 10 main cloud types as defined by the WMO.

20.22.12 Describe typical conditions for each of the 10 main cloud types with respect to:

(a) turbulence;

(b) icing;

(c) precipitation.

20.22.14 Identify the following cloud sub-sets and outline the atmospheric conditions indicated by each:

(a) Asperitas;

(b) Mammatus;

(c) Altocumulus Lenticularis;

(d) Rotor Cloud;

(e) Kelvin Helmholtz waves;

(f) Altocumulus Castellanus;

(g) Banner cloud.

20.22.16 Explain the cloud dispersal processes of:

(a) direct warming;

(b) sinking of air;

(c) mixing with clear air.

**20.24 Precipitation**

20.24.2 Describe the Bergeron theory of rainfall development.

20.24.4 Describe the Coalescence theory of rainfall development.

20.24.6 List the factors that affect the fall rate of water droplets.

**20.26 Visibility and Fog**

20.26.2 Define runway visual range (RVR).

20.26.4 Explain the effect of altitude on visibility.

20.26.6 State the difference between fog, mist and haze.

20.26.8 Describe the principle of formation of radiation and advection fog with respect to:

(a) required meteorological conditions;

(b) factors affecting the extent of the fog;

(c) factors affecting the timing of the fog;

(d) factors affecting the dispersal of the fog.

**20.28 Aircraft Icing**

20.28.2 Define ‘super-cooled water droplets’.

20.28.4 Describe the formation process of:

(a) clear (glaze) ice;

(b) rime (opaque) ice;

(c) mixed ice;

(d) hoar frost;

(e) freezing rain.

20.28.6 With reference to clear, rime and mixed ice, describe the following:

(a) associated cloud types;

(b) temperature ranges;

(c) droplet size;

(d) height range relative to the freezing level;

(e) enhancing factors.

20.28.8 Explain the factors that influence the rate of ice accretion.

20.28.10 Describe the hazards of airframe icing to aircraft in flight.

20.28.12 List the intensity classifications of icing.

20.28.14 Describe the effect of different intensity classifications of icing on aircraft.

20.28.16 Explain methods of avoiding or mitigating airframe icing.

**20.30 Thunderstorms**

20.30.2 Describe the conditions required for the development of thunderstorms.

20.30.4 Describe the characteristics and development of:

(a) convective localised (stationary) thunderstorms;

(b) convective traveling thunderstorms;

(c) orographic thunderstorms;

(d) nocturnal tropical thunderstorms;

(e) frontal and convergence-type thunderstorms;

(f) surface trough and upper trough thunderstorms;

(g) warm front embedded thunderstorms.

20.30.6 With reference to flight in and around thunderstorms, describe the development, severity, and areas where the following are likely to be encountered:

(a) turbulence;

(b) icing;

(c) microbursts;

(d) first gust (or gust front);

(e) electrical phenomena;

(f) tornadoes (if any);

(g) hail;

(h) poor visibility.

20.30.8 Describe the characteristics of multi-cell thunderstorms.

20.30.10 Describe the use of radar to identify thunderstorms.

20.30.12 Explain the precautions that can be taken by pilots to avoid or minimise the effects of flying in the vicinity of thunderstorms.

**20.34 AnticyClones**

20.34.2 Describe anticyclones ('highs') with reference to:

(a) their formation processes;

(b) pressure patterns and wind flow;

(c) subsidence and subsidence inversions;

(d) typical associated weather conditions.

20.34.4 Describe the development of 'cold' highs.

20.34.6 Discuss the hazards associated with anticyclones.

**20.36 Fronts and Depressions**

20.36.2 Describe in terms of air-mass movement, the development of:

(a) cold fronts;

(b) warm fronts (warm sectors).

20.36.4 Describe:

(a) the wind and weather sequence associated with cold and warm fronts;

(b) the general movement of fronts and pressure systems across NZ.

20.36.6 Outline the characteristics of occluded and stationary fronts.

20.36.8 Outline the characteristics of:

(a) mid to high-latitude depressions ('lows');

(b) sub-tropical depressions;

(c) tropical cyclones.

20.36.10 Describe the development and the aspects of importance to aviation of:

(a) lee depressions;

(b) thermal lows;

(c) depressions crossing a mountain barrier.

**20.40 Turbulence**

20.40.2 Describe the four main formation mechanisms for turbulence:

(a) convection;

(b) mechanical processes;

(c) clear air turbulence (CAT);

(d) wake turbulence.

20.40.4 Describe the effects of the following enhancing factors on 20.40.2 (a), (b) and (c) from:

(a) atmospheric stability;

(b) surface roughness;

(c) wind speed/direction;

(d) vertical wind-shear.

20.40.6 Describe the cause(s) and factors involved with the effects of low-level wind-shear due to:

(a) surface friction;

(b) thunderstorms;

(c) temperature inversions;

(d) frontal activity;

(e) wake turbulence from fixed and rotary winged aircraft.

20.40.8 Describe the techniques used to avoid or minimize the effects of low-level wind-shear.

20.40.10 Describe, in accordance with the ICAO definitions, the characteristics of:

(a) light turbulence;

(b) moderate turbulence;

(c) severe turbulence.

**20.42 Other Hazardous Meteorological Conditions**

20.42.2 Explain the methods by which the aviation community is advised of volcanic eruptions within the New Zealand FIR.

20.42.4 Explain the hazards to aviation of volcanic ash encountered:

(a) in flight;

(b) during the take-off and landing phases on an ash contaminated runway.

20.42.6 Explain the development of, and the hazards associated with, flight in the following conditions:

(a) duststorms;

(b) blowing surface snow (blizzards);

(c) whiteout (visual illusion type).

**20.46 The General Circulation**

20.46.2 Explain what is meant by ‘the general circulation’.

20.46.4 Based on a diagram of the ‘general circulation’, explain why the following global weather features exist:

(a) polar highs;

(b) polar easterlies;

(c) polar lows;

(d) polar fronts;

(e) mid-latitude westerlies;

(f) mid-latitude anticyclones;

(g) sub-tropical trade winds;

(h) the equatorial trough.

**20.48 Tropical Meteorology**

20.48.2 State the approximate latitude limits of the tropics.

20.48.4 Describe the ‘Hadley cell’.

20.48.6 Describe what is meant by:

(a) horse latitudes;

(b) doldrums.

20.48.8 Describe the equatorial trough and the inter-tropical convergence zone (ITCZ).

20.48.10 State the:

(a) seasonal location of the equatorial trough and ITCZ;

(b) typical low and mid-level weather in an active and inactive ITCZ.

20.48.12 Explain the origin and common location of the South Pacific Convergence Zone (SPCZ).

20.48.14 Describe weather associated with the SPCZ.

20.48.16 With regard to the Trade Winds, describe the:

(a) mechanisms that drive the Trade Winds;

(b) approximate latitudinal and vertical limits;

(c) seasonal location and direction;

(d) commonly associated weather;

(e) winds and weather usually experienced above the Trade Winds;

(f) topographical influences on the Trade Winds.

20.48.18 Define ‘monsoon’.

20.48.20 Describe the mechanisms involved with regard to wet monsoons.

20.48.22 State the seasons during which the Australian monsoons occur.

20.48.24 Describe the requirements for the formation and development of tropical cyclones.

20.48.26 Describe the weather conditions associated with tropical cyclones.

20.48.28 Explain the factors causing:

(a) El Niño events;

(b) La Niña events.

20.48.30 Describe how El Niño and La Niña events influence the weather in New Zealand.

**20.50 Satellite and Radar Imagery**

20.50.2 With respect to NZ IFR operations, using given examples of satellite imagery, identify the following:

(a) areas of stable and unstable air;

(b) the processes causing each significant area or mass of cloud;

(c) likely cloud types and weather associated with each significant area of cloud.

20.50.4 With respect to NZ IFR operations, interpret radar imagery in terms of:

(a) precipitation types and intensity causing the radar echo;

(b) likely cloud types associated with the precipitation echo;

(c) speed of movement and timing of radar echoes, and the expected impact at given locations.

## Subject No. 22 Principles of Flight and Aircraft Performance (A)

Each subject has been given a subject number and each topic within that subject a topic number. These reference numbers will be used on knowledge deficiency reports and will provide valuable feedback to the examination candidate.

| Sub Topic | Syllabus Item |
|---|---|
| **22.2** | **Aeroscience** |
| 22.2.2 | Units of measurement. State;<br>(a) the International System (SI) units for length, mass, time, temperature (K and °C);<br>(b) the derivation of the SI units for force, pressure, power, and the non-SI units;<br>(c) foot, nautical mile, knot and horsepower. |
| 22.2.4 | Differentiate between scalar and vector quantities; and<br>(a) explain and or apply vector addition and subtraction;<br>(b) demonstrate understanding and ability to resolve vector diagrams or problems. |
| 22.2.6 | Define speed, velocity and acceleration. |
| 22.2.8 | Describe Newton's three laws of motion; and<br>(a) explain inertia;<br>(b) differentiate between mass and weight;<br>(c) state the value of the acceleration caused by the earth's gravity; and<br>(d) define momentum. |
| 22.2.10 | Describe motion on a curved path; and<br>(a) differentiate between centripetal force and centrifugal reaction;<br>(b) explain the factors affecting centripetal force and rate of turn. |
| 22.2.12 | Describe the trig functions for the sine, cosine and tangent of an angle. |
| 22.2.14 | Describe the moment of a force, and the moment of a couple. |
| 22.2.16 | Describe the conditions required for translational equilibrium and for rotational equilibrium. |
| 22.2.18 | Explain the meaning of centre of gravity (centre of mass). |
| 22.2.20 | Explain the meanings of work, power and energy; and describe kinetic energy and potential energy. |
| 22.2.22 | Interpret simple graphs. |

| Sub Topic | Syllabus Item |
|---|---|
| **22.4** | **The Atmosphere** |
| 22.4.2 | Explain the air density, and describe the effect of temperature, pressure and humidity on atmospheric density. |
| 22.4.4 | Describe the normal changes in pressure, temperature and density with increased altitude in the atmosphere. |
| 22.4.6 | State the ISA sea-level pressure and temperature conditions, and the approximate lapse rates in the lower atmosphere. |
| 22.4.8 | Describe the approximate altitude bands in which atmospheric pressure and density are reduced to 75, 50 and 25% of their normal sea level values. |
| 22.4.10 | Explain the meaning of density altitude (DA) and, in broad terms, the effect of pressure, temperature and humidity on DA and thus aerodynamic and engine performance. |
| 22.4.12 | Explain the term viscosity, when related to air. |
| **22.6** | **Basic Aerodynamic Theory** |
| 22.6.2 | Describe the terms freestream static pressure, dynamic pressure (including the term $\frac{1}{2}\rho V^2$) and total (or pitot) pressure. |
| 22.6.4 | Explain the principle of airspeed indication, and indicate the relationship between indicated, calibrated, equivalent and true airspeeds (IAS, CAS, EAS, and TAS). |
| 22.6.6 | With respect to aerofoils, describe the meanings of the following terms: section, leading edge, trailing edge, chord, chord line, thickness, thickness/chord ratio, camber. |
| 22.6.7 | Distinguish between high-lift, general purpose (GP) and high-speed aerofoil sections. |
| 22.6.8 | Define relative airflow and angle of attack ($a$). |
| 22.6.10 | State Bernoulli's theorem in simple terms, and describe streamline flow, turbulent flow, and the application of Bernoulli's theorem to the streamline flow around an aerofoil. |
| 22.6.12 | Describe a venturi and explain venturi effect. |
| 22.6.14 | Explain the changes to the airflow and pressure distribution around a typical aerofoil in a low- subsonic speed airflow as $a$ is increased from the zero-lift angle to beyond the stalling angle. |
| 22.6.16 | Explain the terms upwash and downwash in an airflow. |
| 22.6.18 | Explain the term centre of pressure (CP); and describe typical movement of the CP with increasing angle of attack ($a$). |
| 22.6.20 | Define the total aerodynamic reaction force (TR) of an aerofoil; |
| 22.6.22 | Describe how TR varies with increasing angle of attack ($a$). |
| 22.6.24 | Define the TR components lift and drag. |

| Sub Topic | Syllabus Item |
|---|---|
| **22.8** | **Lift** |
| 22.8.2 | Identify the factors affecting lift (low-subsonic speed airflow). |
| 22.8.4 | State the lift formula, and the three basic functions contained within it. |
| 22.8.6 | Describe the meaning of the term, coefficient of lift (CL). |
| 22.8.8 | Given a typical CL versus a curve for a GP-type aerofoil, identify:<br>(a) the zero lift angle;<br>(b) the angle for maximum CL (CLmax). |
| 22.8.10 | Explain the meaning of a high CLmax. |
| 22.8.12 | With respect to the CL curve, describe the effect of:<br>(a) increased camber;<br>(b) surface roughness (e.g. contamination). |
| 22.8.14 | Describe three-dimensional flow over a wing and explain how wingtip and trailing edge vortices are formed. |
| 22.8.16 | Explain the effect of induced downwash on a. |
| 22.8.18 | Define aspect ratio (AR) and describe the effect of AR on CL. |
| **22.10** | **Drag** |
| 22.10.2 | Identify and explain the components of total drag. |
| 22.10.4 | Explain the term boundary layer. |
| 22.10.6 | Describe:<br>(a) laminar boundary layer flow;<br>(b) turbulent boundary layer flow;<br>(c) transition point. |
| 22.10.8 | Explain skin-friction drag and state the factors affecting it. |
| 22.10.10 | Explain form drag and state the factors affecting it. |
| 22.10.12 | Describe the effect of streamlining in reducing form drag. |
| 22.10.14 | Describe interference drag and the measures for reducing it. |
| 22.10.16 | Explain the origin of induced drag; and<br>(a) list the factors affecting it;<br>(b) explain typical measures for reducing it. |
| 22.10.18 | State the meaning of the term coefficient of drag (CD); and describe the main features |

| Sub Topic | Syllabus Item |
|---|---|
| | of a typical curve of CD versus a. |
| 22.10.20 | State the drag formula, and the three basic functions contained within it. |
| 22.10.22 | Describe typical curves of induced drag, all other drag, and total drag versus IAS in straight and level flight. |
| 22.10.24 | From information provided or a diagram identify the speed for minimum drag and maximum lift/drag ratio. |
| 22.10.26 | Distinguish between graphs for CD and total drag. |
| 22.10.28 | Explain a typical graph for lift/drag (L/D) ratio versus a. |
| 22.10.30 | Explain from a typical graph the most efficient angle of attack, the zero lift position, and the stalling angle. |
| **22.12** | **Lift Augmentation** |
| 22.12.2 | Explain the basic purpose of lift augmentation devices. |
| 22.12.4 | Explain the basic principles of trailing and leading-edge flaps. |
| 22.12.6 | Explain the effects of lowering trailing edge flap on; CL, CD, L/D ratio, CP movement, angle-of-attack and nose attitude. |
| 22.12.8 | Distinguish between the effects of lowering leading-edge flap on angle-of-attack, nose attitude and movement of the CP with those of trailing-edge flap. |
| 22.12.10 | Given a description or diagram identify the main types of trailing-edge flap and compare their relative performance (in generating lift and drag). |
| 22.12.12 | Given a description or diagram identify the main types of leading-edge flap. |
| 22.12.14 | Explain the basic principles of slats and slots. |
| 22.12.16 | Explain the effect of operating leading-edge slats on CL, stalling angle and nose attitude. |
| 22.12.18 | Show understanding of the theory of spoilers and give examples of their use. |
| **22.14** | **Flight Controls** |
| 22.14.2 | Identify the three aircraft axes, movement about those axes, and primary flight controls. |
| 22.14.4 | Explain how control in pitch, roll, and yaw is achieved. |
| 22.14.6 | Identify and explain:<br>(a) the secondary effect of aileron;<br>(b) adverse yaw and methods used to counteract it;<br>(c) the secondary effect of rudder. |
| 22.14.8 | Describe the effects of airspeed and slipstream on control effectiveness. |

| Sub Topic | Syllabus Item |
|---|---|
| 22.14.10 | Explain the basic principles of trim tabs, and describe the correct method of using trim controls. |
| 22.14.12 | Explain the reason for aerodynamic balancing of control surfaces. |
| 22.14.14 | Describe the main methods for achieving control balance. |
| 22.14.16 | Differentiate between a balance tab and an anti-balance tab. |
| 22.14.18 | Explain the purpose for mass balancing. |
| 22.14.20 | Describe and explain flexural and torsional flutter. |
| 22.14.22 | Describe the methods of providing mass balance. |
| **22.16** | **Stalling and Spinning** |
| 22.16.2 | Explain the stalled condition of an aerofoil. |
| 22.16.4 | Explain basic stall speed and relate it to the lift formula. |
| 22.16.6 | Describe typical symptoms and other indications of the approach to the stall. |
| 22.16.8 | Describe the changes in the airflow over the wing, movement of the CP, and aircraft attitude as the point of stall is reached. |
| 22.16.10 | Explain the standard recovery from the stalled condition. |
| 22.16.12 | Describe how the following factors affect stalling speed:<br>(a) aircraft weight;<br>(b) load factor;<br>(c) power;<br>(d) altitude;<br>(e) the use of flaps and slats;<br>(f) contamination of the wing surfaces. |
| 22.16.14 | Describe the conditions which encourage a wing-drop at the stall. |
| 22.16.16 | Explain the design measures taken to reduce the tendency for wing-drop. |
| 22.16.18 | Explain the caution against using aileron near or at the stalling angle. |
| 22.16.20 | Describe the standard technique for recovery:<br>(a) from a stall which has resulted in a wing-drop;<br>(b) at the onset of the stall. |
| 22.16.22 | Explain the process of autorotation (leading to the spin). |
| 22.16.24 | Describe the characteristics of the upright spin, and explain: |

| Sub Topic | Syllabus Item |
|---|---|
| | (a) the instrument indications which confirm the fact and direction of a spin; |
| | (b) the difference between the spin and spiral dive; |
| | (c) the standard recovery technique. |
| **22.18** | **Straight and Level Flight** |
| 22.18.2 | Explain the four forces acting and the conditions required for steady straight and level flight. |
| 22.18.4 | For a conventional aeroplane configuration, describe: |
| | (a) the lift/weight and thrust/drag couples; |
| | (b) pitching moments and the tailplane stabilising moment; |
| | (c) pitching moments caused by power changes, undercarriage and flap extension. |
| 22.18.6 | Explain the power and attitude relationships at various airspeeds in straight and level flight. |
| 22.18.8 | For unaccelerated level flight: |
| | (a) state the power required formula (power = drag x TAS); |
| | (b) explain the difference between the drag curve and the power required curve; |
| | (c) distinguish between the minimum drag speed and the minimum power speed. |
| 22.18.10 | Given typical power available and power required curves, explain: |
| | (a) the maximum and minimum speeds for level flight; |
| | (b) the effects of increased weight and altitude. |
| **22.20** | **Climbing and Descending** |
| 22.20.2 | Identify the forces acting in a steady climb. |
| 22.20.4 | Given typical power required and power available curves, explain: |
| | (a) how a curve of excess power available (EP) can be derived; |
| | (b) where the speeds for maximum rate of climb, and maximum angle of climb occur on the EP curve. |
| 22.20.6 | State what the Vx and Vy speeds are and differentiate between these speeds and the normal climb speed. |
| 22.20.8 | Define absolute ceiling and service ceiling. |
| 22.20.10 | Explain the factors affecting climb performance (power applied, airspeed, flap and/or undercarriage extension, weight, altitude, temperature, manoeuvring, and wind - in relation to net flight path). |

| Sub Topic | Syllabus Item |
|---|---|
| 22.20.12 | Identify the forces acting in a glide and a steady power-on descent. |
| 22.20.14 | Explain the connection between L/D ratio, glide angle, airspeed and gliding range. |
| 22.20.16 | Describe the effect of:<br>(a) weight on glide angle and best glide speed;<br>(b) wind on net flight path. |
| **22.22** | **Turning** |
| 22.22.2 | Explain how the required turning (centripetal) force is generated. |
| 22.22.4 | Define load factor. |
| 22.22.6 | Describe how load factor increases with bank angle. |
| 22.22.8 | Explain the connection between load factor and percentage increase in stalling speed. |
| 22.22.10 | Explain the factors affecting rate and radius of turn. |
| 22.22.12 | Explain the conditions for a maximum rate/minimum radius turn. |
| 22.22.14 | Explain the effect of wind during:<br>(a) a constant-bank turn;<br>(b) a constant-radius turn around a ground feature. |
| 22.22.16 | In climbing and descending turns, describe:<br>(a) the effect on rate of climb/descent;<br>(b) the tendency to overbank/underbank. |
| 22.22.18 | Describe the forces acting during a manoeuvre in the looping plane; and |
| 22.22.20 | Identify the factors affecting the radius of a looping manoeuvre. |
| 22.22.22 | Describe design manoeuvre speed (Va) and explain the features of a typical V-n (or V-g) diagram. |
| **22.24** | **Propellers** |
| 22.24.2 | Define blade face, blade angle, pitch (or helix) angle, helical twist, angle of attack. |
| 22.24.4 | Describe the forces acting on a propeller blade; the rpm/airspeed relationship; and the most effective blade sections. |
| 22.24.6 | Explain how propeller pitch affects efficiency at different speeds. |
| 22.24.8 | Explain the purpose of the constant-speed (variable pitch) propeller. |
| 22.24.10 | Describe in broad terms the operation of the constant speed unit (CSU) with changes in power setting and airspeed. |
| 22.24.12 | Describe the correct procedure for handling manifold pressure and propeller controls. |

| Sub Topic | Syllabus Item |
|---|---|
| 22.24.14 | Describe the forces acting on a propeller when:<br>(a) windmilling;<br>(b) feathered;<br>(c) in reverse thrust. |
| 22.24.16 | Explain propeller centrifugal and aerodynamic twisting moments. |
| 22.24.18 | Describe asymmetric blade effect. |
| 22.24.20 | Explain the terms power absorption and propeller solidity. |
| **22.26** | **Stability** |
| 22.26.2 | Explain static stability and dynamic stability. |
| 22.26.4 | Differentiate between stability and controllability. |
| 22.26.6 | Define longitudinal stability and explain:<br>(a) the action of the tailplane in maintaining longitudinal stability;<br>(b) wing pitching moments;<br>(c) the effect of CG position. |
| 22.26.8 | Define directional stability and explain the factors affecting it. |
| 22.26.10 | Define lateral stability and explain the factors affecting it (dihedral, shielding, wing position, keel surface/fin area, sweepback). |
| 22.26.12 | Explain the requirement to match lateral and directional stability. |
| 22.26.14 | Explain the conditions of spiral instability, dutch roll, and snaking. |
| 22.26.16 | With respect to stability and control on the ground, explain:<br>(a) the importance of CG position;<br>(b) the differences between nosewheel and tailwheel configurations;<br>(c) handling of controls in strong crosswinds. |
| 22.26.18 | For a single-engine propeller aircraft, explain the factors affecting swing on take-off. |
| 22.26.20 | Describe cross-wind take-off and landing techniques. |
| 22.26.22 | Explain ground effect, and relate it to take-off and landing. |
| **22.28** | **Asymmetric Flight** |
| 22.28.2 | Explain the consideration involved in coping with asymmetric thrust/drag and reduced power. |
| 22.28.4 | Explain the factors affecting yawing and rolling moments. |

| Sub Topic | Syllabus Item |
|---|---|
| 22.28.6 | Define critical engine. |
| 22.28.8 | Recall immediate actions and techniques for identifying the failed engine. |
| 22.28.10 | Explain the three modes of constant-heading asymmetric flight. |
| 22.28.12 | Define Vmca and Vmcg. |
| **22.30** | **Range and Endurance** |
| 22.30.2 | Define specific air range (SAR) and specific fuel consumption (SFC). |
| 22.30.4 | State the general conditions for achieving maximum SAR. |
| 22.30.6 | Explain the airframe and engine considerations of flying for range (piston engine). |
| 22.30.8 | Apply performance tables or graphs from an aircraft manual to determine best SAR under given conditions. |
| 22.30.10 | Define flying for endurance and differentiate between range flying and endurance flying (piston engine). |
| 22.30.12 | State the factors affecting endurance and explain practical endurance flying techniques. |
| **22.32** | **Performance** |
| 22.32.2 | Define:<br>(a) Take-off distance required (TODR), take-off safety speed, and screen height (or barrier);<br>(b) Take-off distance available (TODA) and clearway;<br>(c) Take-off run available (TORA);<br>(d) Accelerate-stop distance available (ASDA) and stopway;<br>(e) Gradient and gross and net flight paths;<br>(f) Landing distance available (LDA), landing distance required (LDR) and landing threshold;<br>(g) Dry, wet, and contaminated (in relation to runway surface);<br>(h) Drift down. |
| 22.32.4 | Explain the factors affecting take-off and landing performance. |
| 22.32.6 | Given an elevation, QNH and ambient temperature, calculate pressure altitude and density altitude. |
| 22.32.8 | Express an ambient temperature as a deviation from ISA temperature (and vice versa). |
| 22.32.10 | Demonstrate an ability to use wind-component graphs, and to apply runway slope and surface correction factors. |

| Sub Topic | Syllabus Item |
|---|---|
| 22.32.12 | Demonstrate an ability to calculate take-off and landing performance in accordance with CAR Part 135 Subpart D using representative aeroplane take-off and landing performance charts (P-charts). |
| 22.32.14 | Demonstrate an ability to calculate en-route engine inoperative performance using a representative single-engine service ceiling graph. |

## Subject No. 24 Principles of Flight and Aircraft Performance (H)

Each subject has been given a subject number and each topic within that subject a topic number. These reference numbers will be used on knowledge deficiency reports and will provide valuable feedback to the examination candidate.

| Sub Topic | Syllabus Item |
|---|---|
| **24.2** | **Aeroscience** |
| 24.2.2 | State the International System (SI) unit used to express: |
| | (a) length; |
| | (b) time; |
| | (c) mass; |
| | (d) temperature (K and ºC). |
| 24.2.4 | State the derivation of the SI units for: |
| | (a) force; |
| | (b) pressure; |
| | (c) power. |
| 24.2.6 | State the derivation of the non-SI units for: |
| | (a) length - foot and nautical mile; |
| | (b) speed - knot; and, |
| | (c) work - horsepower. |
| 24.2.8 | Differentiate between scalar and vector quantities. |
| 24.2.10 | Explain vector addition and subtraction. |
| 24.2.12 | Resolve a single vector into two components at right angles. |
| 24.2.14 | Describe Newton’s three laws of motion. |
| 24.2.16 | Explain the meaning of: |
| | (a) speed; |
| | (b) velocity; |
| | (c) acceleration; |
| | (d) equilibrium; |
| | (e) momentum; |
| | (f) inertia. |
| 24.2.18 | Differentiate between mass and weight. |
| 24.2.20 | State the value of the acceleration caused by the earth’s gravity. |

| Sub Topic | Syllabus Item |
|---|---|
| 24.2.22 | Describe motion on a curved path, and differentiate between centripetal force and centrifugal reaction. |
| 24.2.24 | State the factors affecting centripetal force and rate of turn. |
| 24.2.26 | Describe the trig functions for the sine, cosine and tangent of an angle. |
| 24.2.28 | Describe the moment of a force, and the moment of a couple. |
| 24.2.30 | Describe the conditions required for translational equilibrium, and for rotational equilibrium. |
| 24.2.32 | Explain the meaning of Centre of Gravity (centre of mass). |
| 24.2.34 | Explain the meaning of work, power and energy; and describe kinetic energy and potential energy. |
| **24.4** | **The Atmosphere** |
| 24.4.2 | Define air density. |
| 24.4.4 | Describe the effect of temperature, pressure and humidity on air density. |
| 24.4.6 | Describe the normal changes in pressure, temperature and density with increased altitude. |
| 24.4.8 | Describe the International Standard Atmosphere. |
| 24.4.10 | State the ISA sea level pressure and temperature conditions, and the approximate lapse rates in the lower atmosphere. |
| 24.4.12 | Describe the approximate altitude bands in which atmospheric pressure and density are reduced to 75, 50 and 25% of their normal sea level values. |
| 24.4.14 | Explain the meaning of density altitude (DA) and, in broad terms, the effect of pressure, temperature and humidity on DA and thus aerodynamic and engine performance. |
| 24.4.16 | Explain the term viscosity, when related to air. |
| **24.6** | **Basic Aerodynamic Theory** |
| 24.6.2 | Describe:<br>(a) free stream static pressure;<br>(b) dynamic pressure (including the term $\frac{1}{2}\rho V^2$);<br>(c) total (or pitot) pressure. |
| 24.6.4 | Explain the principle of airspeed indication, and indicate the relationship between indicated, calibrated, equivalent and true airspeeds (IAS, CAS, EAS and TAS). |
| 24.6.6 | With respect to aerofoils, explain the meaning of:<br>(a) section; |

| Sub Topic | Syllabus Item | |
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| | (b) | leading edge; |
| | (c) | trailing edge; |
| | (d) | chord; |
| | (e) | chord line; |
| | (f) | thickness; |
| | (g) | thickness/chord ratio; |
| | (h) | camber. |
| 24.6.8 | Distinguish between symmetrical and non-symmetrical aerofoil section. | |
| 24.6.10 | With the aid of a diagram, identify and explain the meaning of: | |
| | (a) | relative air flow; |
| | (b) | angle of attack. |
| 24.6.12 | State Bernoulli's Theorem in simple terms. | |
| 24.6.14 | Describe streamline flow, turbulent flow, and the application of Bernoulli's Theorem to the streamline flow around an aerofoil. | |
| 24.6.16 | Describe a venturi and explain venturi effect. | |
| 24.6.18 | Explain the changes to the airflow and pressure distribution around a typical symmetrical aerofoil as the angle of attack is increased from the zero-lift angle of attack to the stalling angle. | |
| 24.6.20 | Explain the terms upwash and downwash in an airflow. | |
| 24.6.22 | Explain the term centre of pressure (CP) and describe typical movement of the CP with increasing angle of attack with a symmetrical aerofoil section and with a non-symmetrical aerofoil section. | |
| 24.6.24 | Define aerodynamic centre. | |
| 24.6.26 | Describe the total aerodynamic reaction force (TR) of an aerofoil. | |
| 24.6.28 | Describe how TR varies with angle of attack. | |
| 24.6.30 | Define the TR components of lift and drag. | |
| 24.6.32 | Define the TR components of rotor thrust and rotor drag. | |
| **24.8** | **Lift** | |
| 24.8.2 | Explain the factors that affect lift in subsonic and transonic flow. | |
| 24.8.4 | State the lift formula. | |
| 24.8.6 | Explain the meaning of coefficient of lift (CL). | |
| 24.8.8 | Describe the variation of CL with angle of attack for a symmetrical and non | |

| Sub Topic | Syllabus Item |
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| | symmetrical aerofoil section. |
| 24.8.10 | Given a CL graph of symmetrical and non symmetrical aerofoil against angle of attack, show:<br>(a) the zero lift angle;<br>(b) the angle for maximum CL (CL max). |
| 24.8.12 | Explain the benefits of a high CL max. |
| 24.8.14 | Explain the effects of exceeding the critical (stalling) angle of attack. |
| 24.8.16 | Explain the effects of camber and surface roughness on CL. |
| 24.8.18 | Define aspect ratio. |
| 24.8.20 | Explain the effects of aspect ratio on CL. |
| 24.8.22 | Explain the main advantages of using the symmetrical blade section in light helicopters. |
| 24.8.24 | Explain the effects on the lift produced, as the rotor tip approaches transonic speeds. |
| **24.10** | **Drag** |
| 24.10.2 | State the drag formula. |
| 24.10.4 | Explain the meaning of coefficient of drag (CD). |
| 24.10.6 | Describe the types of drag which make-up total drag. |
| 24.10.8 | Explain parasite drag and describe its variation with airspeed. |
| 24.10.10 | Explain form drag and the main factors that affect it. |
| 24.10.12 | *Reserved* |
| 24.10.14 | Describe the effect of streamlining on form drag. |
| 24.10.16 | Explain skin friction drag and the main factors that affect it. |
| 24.10.18 | Define boundary layer. |
| 24.10.20 | Describe laminar and turbulent boundary layer flow. |
| 24.10.22 | Define, and explain the location of the:<br>(a) transition point;<br>(b) separation point. |
| 24.10.24 | Explain tip vortices. |
| 24.10.26 | Explain induced drag and the main factors that affect it. |
| 24.10.28 | Describe the method of reducing induced drag. |

| Sub Topic | Syllabus Item |
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| 24.10.30 | Explain the combination of the three types of drag into the total drag curve. |
| 24.10.32 | Explain the effects on drag, as the rotor tip approaches transonic speeds. |
| 24.10.34 | Given a graph of total drag against airspeed, show the speed for minimum drag. |
| **24.12** | **Lift/Drag Ratio** |
| 24.12.2 | Define lift/drag (L/D) ratio. |
| 24.12.4 | Explain the relationship between the lift/drag ratio and the CL/CD ratio. |
| 24.12.6 | Explain why flight at best lift/drag ratio speed is most efficient. |
| 24.12.8 | Given a graph of lift/drag ratio against angle of attack of a symmetrical aerofoil section, show:<br>(a) the 'most efficient' angle of attack;<br>(b) the zero lift angle of attack;<br>(c) the stalling angle of attack;<br>(d) the minimum drag angle of attack. |
| 24.12.10 | Explain the factors affecting the lift/drag ratio. |
| **24.14** | **Helicopter Rotor Discs** |
| | **Terminology** |
| 24.14.2 | With the aid of a diagram, identify and explain the meaning of:<br>(a) tip path;<br>(b) tip path plane;<br>(c) axis of rotation;<br>(d) plane of rotation;<br>(e) shaft axis;<br>(f) disc area;<br>(g) blade (pitch) angle;<br>(h) coning angle;<br>(i) feathering axis;<br>(j) feathering;<br>(k) disc loading;<br>(l) blade loading;<br>(m) solidity; |

| Sub Topic | Syllabus Item | |
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| | (n) | flapping; |
| | (o) | lead-lag (dragging); |
| | (p) | rotational airflow (Vr); |
| | (q) | induced flow; |
| | (r) | inflow angle; |
| | (s) | rotor thrust; |
| | (t) | total rotor thrust; |
| | (u) | rotor drag (torque). |
| | **Forces Acting on a Helicopter Rotor** | |
| 24.14.4 | With the aid of a diagram, identify and explain the forces acting on a rotor blade. | |
| 24.14.6 | Explain how total reaction can be resolved into lift/drag and rotor thrust/rotor drag. | |
| 24.14.8 | Explain the effect of a change of angle of attack and inflow angle on the rotor thrust/rotor drag ratio. | |
| 24.14.10 | With the aid of a diagram, identify and explain the force opposing weight. | |
| 24.14.12 | State and explain the four factors influencing rotor thrust. | |
| 24.14.14 | Explain the relationship between rotor thrust, centrifugal force and coning angle. | |
| 24.14.16 | State and explain the three factors affecting rotor RPM limits. | |
| 24.14.18 | Explain how changes in the following factors affect rotor drag: | |
| | (a) | disc loading; |
| | (b) | gross weight; |
| | (c) | altitude; |
| | (d) | configuration. |
| 24.14.20 | Explain ground effect. | |
| 24.14.22 | Explain how ground effect affects inflow angle; angle of attack; rotor drag and the power required to overcome rotor drag. | |
| 24.14.24 | Explain the effect of airflow over the disc on induced flow. | |
| 24.14.26 | Explain translational lift. | |
| 24.14.28 | Explain how translational lift affects inflow angle; angle of attack; rotor thrust and the power required to overcome rotor drag in level flight. | |
| 24.14.30 | Explain the principle of operation of delta-3 hinges and offset pitch horns in reducing blade flapping. | |

| Sub Topic | Syllabus Item |
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| **24.16** | **Anti-torque Tail Rotor** |
| 24.16.2 | Explain, with the aid of a diagram, the function of the anti-torque tail rotor. |
| 24.16.4 | Explain the effect of anti-torque on: |
| | (a) power required; |
| | (b) rotor rpm. |
| 24.16.6 | Explain the effect of the wind on tail rotor thrust. |
| 24.16.8 | Explain the meaning of: |
| | (a) translating tendency (tail rotor drift); |
| | (b) rolling tendency (tail rotor roll). |
| 24.16.10 | Explain design techniques that can compensate for translating and rolling tendencies. |
| 24.16.12 | Explain the influence of ground effect on the amount of tail rotor thrust required. |
| 24.16.14 | Explain the effect of a tail rotor failure in flight. |
| 24.16.16 | Describe pilot actions that may eliminate or reduce the effects of tail rotor failure in flight. |
| **24.18** | **Disc Control** |
| 24.18.2 | With the aid of a diagram, identify and explain the functions of: |
| | (a) collective pitch/control; |
| | (b) cyclic pitch/control; |
| | (c) swashplate (control orbit); |
| | (d) stationary star (non-rotating plate); |
| | (e) rotating star (rotating plate); |
| | (f) pitch link; |
| | (g) pitch horn. |
| 24.18.4 | Explain the use of a control orbit in applying cyclic and collective pitch. |
| 24.18.6 | Explain the effect of collective and cyclic control movement on swashplate movement, total rotor thrust and disc orientation. |
| 24.18.8 | Explain the effect of control input on blade lead/lag behaviour in fully articulated rotor systems. |
| 24.18.10 | Explain the following causes of movement about the lead/lag hinge: |
| | (a) conservation of angular momentum (Coriolis effect); |
| | (b) Hookes joint effect; |

| Sub Topic | Syllabus Item |
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| | (c) periodic drag changes; |
| | (d) random changes. |
| 24.18.12 | Explain phase lag and advance angle. |
| 24.18.14 | State the two main categories of vibration in helicopters. |
| 24.18.16 | Explain the causes and characteristics of vertical vibrations and lateral vibrations. |
| 24.18.18 | Describe the causes and characteristics of high frequency vibrations and engine vibrations. |
| 24.18.20 | Describe recommended pilot actions when confronted with vibrations. |
| **24.20** | **Hovering** |
| 24.20.2 | Define hover. |
| 24.20.4 | Describe the control inputs required during hovering flight. |
| 24.20.6 | Explain the meaning of in ground effect (IGE). |
| 24.20.8 | Explain the meaning of out of ground effect (OGE). |
| 24.20.10 | Explain the relationship between inflow angle and collective pitch. |
| 24.20.12 | Explain the following factors affecting ground effect: |
| | (a) skid height agl; |
| | (b) density altitude; |
| | (c) aircraft weight; |
| | (d) nature of the surface; |
| | (e) slope of the surface; |
| | (f) the wind. |
| 24.20.14 | Describe overpitching. |
| 24.20.16 | Describe: |
| | (a) the conditions likely to lead to over-pitching; |
| | (b) the symptoms of over-pitching; |
| | (c) the recovery technique for over-pitching. |
| 24.20.18 | Describe recirculation. |
| 24.20.20 | Describe: |
| | (a) the conditions likely to lead to recirculation; |
| | (b) the symptoms of recirculation; |

| Sub Topic | Syllabus Item |
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| | (c) the recovery technique for recirculation. |
| **24.22** | **Forward Flight** |
| 24.22.2 | Explain the arrangement of forces on the rotor and fuselage when: |
| | (a) transitioning into forward flight; |
| | (b) in equilibrium in forward flight. |
| 24.22.4 | Describe the changes to blade angle and tip path as the disc is tilted with cyclic. |
| 24.22.6 | Explain: |
| | (a) flapping to equality; |
| | (b) dissymmetry of lift; |
| | (c) means of overcoming dissymmetry of lift; |
| | (d) flap-back (blow-back); |
| | (e) flap-forward; |
| | (f) reverse flow. |
| 24.22.8 | State the flight profile in which translational lift is experienced. |
| 24.22.10 | State the typical speed range through which translational lift is noticeable. |
| 24.22.12 | Explain the meaning of inflow roll (transverse flow effect). |
| 24.22.14 | State the speed range in which inflow roll is most pronounced. |
| 24.22.16 | Describe how inflow roll is compensated for by the pilot. |
| 24.22.18 | With the aid of the power available/power required curves: |
| | (a) identify the TAS for minimum and maximum straight and level flight; |
| | (b) describe the factors that affect this TAS. |
| **24.24** | **Climbing and Descending** |
| 24.24.2 | Describe the forces acting on a rotor blade established in a vertical climb. |
| 24.24.4 | Define: |
| | (a) rate of climb; |
| | (b) angle of climb. |
| 24.24.6 | On the power available/power required curves, identify TAS for: |
| | (a) maximum rate of climb; |
| | (b) best angle of climb. |

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| 24.24.8 | With the aid of power available/power required curves, explain the effects on rate of climb, angle of climb, and required TAS as applicable, of:<br>(a) collective setting changes;<br>(b) altitude;<br>(c) aircraft weight;<br>(d) density altitude;<br>(e) angle of bank;<br>(f) external loads;<br>(g) the wind. |
| 24.24.10 | Describe the forces on the rotor disc in a vertical descent. |
| 24.24.12 | Define rate of descent and angle of descent. |
| 24.24.14 | With the aid of power available/power required curves, explain the effects on rate of descent, angle of descent, and required TAS as applicable, of:<br>(a) collective setting changes;<br>(b) altitude;<br>(c) aircraft weight;<br>(d) density altitude;<br>(e) angle of bank;<br>(f) external loads;<br>(g) the wind. |
| 24.24.16 | Define power check. |
| 24.24.18 | Describe:<br>(a) situations where a power check is necessary;<br>(b) the sequence of a power check. |
| **24.26** | **Turning** |
| 24.26.2 | Describe the forces acting on a helicopter in a level turn. |
| 24.26.4 | State the effect of angle of bank on rate of turn and power required. |
| 24.26.6 | Explain the factors involved in forward flight during a:<br>(a) steep turn;<br>(b) minimum radius/maximum rate turn. |

| Sub Topic | Syllabus Item |
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| 24.26.8 | Explain the effect of the following factors on the rate and radius of turn:<br>(a) altitude;<br>(b) gross weight;<br>(c) external loads;<br>(d) the wind. |
| 24.26.10 | State the effect of angle of bank on altitude, at a constant power and IAS. |
| 24.26.12 | Explain the effect of wind on indicated airspeed and translational lift during a turn. |
| 24.26.14 | Explain the effect of slipping and skidding on the rate and radius of turn. |
| **24.28** | **Transitioning to the Hover** |
| 24.28.2 | Explain the meaning and purpose of the flare. |
| 24.28.4 | Explain the effects of the flare on:<br>(a) rotor rpm;<br>(b) total rotor thrust;<br>(c) rotor drag. |
| 24.28.6 | Describe the causes of rotor rpm changes during the flare. |
| 24.28.8 | Describe a zero-speed landing. |
| 24.28.10 | Describe the power requirements during a zero-speed landing. |
| **24.30** | **Autorotation** |
| 24.30.2 | Define autorotation. |
| 24.30.4 | Describe the factors involved when transitioning into an autorotation from:<br>(a) the hover at altitude;<br>(b) forward flight. |
| 24.30.6 | Identify, on a diagram, the stalled, driven and driving regions (sections) of a rotor disc in autorotation. |
| 24.30.8 | Describe the forces acting on the stalled, driven and driving regions of a rotor in autorotation. |
| 24.30.10 | Describe the combined effect of all regions of a rotor in autorotation. |
| 24.30.12 | Explain the effect of airspeed on the angle of attack of a rotor blade during autorotation. |
| 24.30.14 | Describe the effect of forward flight on the distribution of autorotative forces. |
| 24.30.16 | Explain the effect of increased collective pitch on autorotation. |

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| 24.30.18 | Explain the effect of rotor RPM and airspeed on autorotational rate of descent. |
| 24.30.20 | Explain the effect of increased altitude and increased weight on rotor RPM in autorotation. |
| 24.30.22 | Identify on a graph, range and endurance speeds for autorotation. |
| 24.30.24 | Explain the effect of the following factors on the range and endurance in autorotation: |
| | (a) altitude; |
| | (b) gross weight; |
| | (c) parasite drag; |
| | (d) external loads; |
| | (e) the wind. |
| 24.30.26 | Explain the transition from autorotation to landing. |
| 24.30.28 | Describe the purpose of the Height/Velocity diagram (avoid curve). |
| 24.30.30 | Explain the hazards involved in operations within the avoid curve. |
| 24.30.32 | Identify, on a graph of the avoid curve, boundaries of safe operation. |
| | **Power, Range & Endurance** |
| **24.32** | **Power Required** |
| 24.32.2 | Explain the meaning of the following types of power required: |
| | (a) ancillary power; |
| | (b) profile power; |
| | (c) induced power; |
| | (d) parasite power. |
| 24.32.4 | Describe the factors that affect the amount of: |
| | (a) profile power required; |
| | (b) induced power required; |
| | (c) parasite power required. |
| 24.32.6 | On a graph, identify: |
| | (a) induced power required; |
| | (b) parasite power required; |
| | (c) profile power required; |
| | (d) total power required. |

| Sub Topic | Syllabus Item |
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| 24.32.8 | Explain the effect, on power required, of: |
| | (a) altitude; |
| | (b) weight; |
| | (c) slingloads and parasite drag items; |
| | (d) the flare; |
| | (e) acceleration; |
| | (f) ground effect; |
| | (g) rotor RPM; |
| | (h) increased temperature; |
| | (i) wind. |
| **24.34** | **Power Available** |
| 24.34.2 | On a graph, draw a power available curve for a typical light piston engine helicopter. |
| 24.34.6 | Describe the effect of the following on the power available curve: |
| | (a) changes in collective setting; |
| | (b) altitude; |
| | (c) density altitude; |
| | (d) leaning of the mixture. |
| 24.34.8 | Explain the factors affecting power excess. |
| 24.34.10 | Explain the effect of lowering the power available curve. |
| 24.34.12 | Explain the requirement for a power check. |
| **24.36** | **Flying for Range** |
| 24.36.2 | With respect to piston engine helicopters, explain the requirement for range flying. |
| 24.36.4 | On a power required graph, identify the speed for best range. |
| 24.36.6 | Explain the effect, on helicopter range, of: |
| | (a) airspeed; |
| | (b) wind; |
| | (c) altitude; |
| | (d) weight; |
| | (e) slingloads and parasite drag items; |

| Sub Topic | Syllabus Item |
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| | (f) engine RPM. |
| 24.36.8 | Describe the range configuration for piston and turbine helicopters. |
| **24.38** | **Flying for Endurance** |
| 24.38.2 | With respect to piston engine helicopters, explain the requirement for endurance flying. |
| 24.38.4 | On a power required graph, identify the speed for best endurance. |
| 24.38.6 | Explain the effect, on helicopter endurance, of: |
| | (a) airspeed; |
| | (b) wind; |
| | (c) altitude; |
| | (d) weight; |
| | (e) slingloads and parasite drag items. |
| 24.38.8 | Describe the endurance configuration for piston and turbine helicopters. |
| | **Hazardous Flight Conditions** |
| **24.40** | **Retreating Blade Stall** |
| 24.40.2 | Define retreating blade stall. |
| 24.40.4 | Explain the aerodynamic factors likely to lead to retreating blade stall. |
| 24.40.6 | Describe and explain the symptoms of retreating blade stall. |
| 24.40.8 | Explain the relationship between retreating blade stall and Vne. |
| 24.40.10 | Describe the recovery technique for retreating blade stall. |
| 24.40.12 | Explain the hazards of inappropriate control input during recovery. |
| **24.42** | **Vortex Ring State (Settling with Power)** |
| 24.42.2 | Define vortex ring state. |
| 24.42.4 | Describe the conditions that can lead to vortex ring state. |
| 24.42.6 | With respect to vortex ring state, describe: |
| | (a) the development; |
| | (b) the symptoms; and, |
| | (c) the methods of recovery. |
| 24.42.8 | State the effect of power, weight and density altitude on vortex ring state. |
| 24.42.10 | Explain tail rotor vortex ring state. |

| Sub Topic | Syllabus Item |
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| 24.42.12 | List the conditions that can lead to tail rotor vortex ring state. |
| 24.42.14 | State the indications that differentiate between vortex ring state and a rotor stall. |
| **24.44** | **Ground Resonance** |
| 24.44.2 | Describe ground resonance. |
| 24.44.4 | Describe the conditions likely to cause ground resonance. |
| 24.44.6 | Describe the symptoms of ground resonance. |
| 24.44.8 | Describe the recovery technique for ground resonance. |
| **24.46** | **Blade Sailing** |
| 24.46.2 | Describe blade sailing. |
| 24.46.4 | Describe the conditions likely to lead to blade sailing. |
| 24.46.6 | Describe the recovery technique for blade sailing. |
| **24.48** | **Dynamic Rollover** |
| 24.48.2 | Describe dynamic rollover. |
| 24.48.4 | Describe the conditions likely to lead to dynamic rollover. |
| 24.48.6 | Explain the factors influencing the critical angle at which dynamic rollover will occur. |
| 24.48.8 | Describe the recovery technique for dynamic rollover. |
| **24.50** | **Cyclic Limitations** |
| 24.50.2 | Explain the factors that limit the available cyclic in the air and on the ground. |
| **24.52** | **Mast Bumping** |
| 24.52.2 | Describe mast bumping. |
| 24.52.4 | Describe the conditions likely to lead to mast bumping. |
| 24.52.6 | Describe the forces involved during mast bumping. |
| 24.52.8 | Describe the means of avoiding mast bumping. |
| 24.52.10 | Describe the recovery technique for mast bumping. |
| **24.54** | **Exceeding Rotor RPM Limits** |
| 24.54.2 | Explain the reasons for high RPM limits. |
| 24.54.4 | Explain the reasons for low RPM limits |
| **24.56** | **Rotor Stalls** |
| 24.56.2 | Describe rotor stalling. |

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| 24.56.4 | Describe the conditions likely to lead to a rotor stall. |
| 24.56.6 | Describe the symptoms of a rotor stall. |
| 24.56.8 | Describe the recovery technique for a rotor stall. |
| 24.56.10 | State the indications that differentiate between a rotor stall and vortex ring state. |
| **24.58** | **Stability** |
| 24.58.2 | Define stability. |
| 24.58.4 | Describe what is meant by:<br>(a) static stability;<br>(b) dynamic stability;<br>(c) neutral stability. |
| 24.58.6 | Explain the relationship between:<br>(a) static stability and dynamic stability;<br>(b) static stability and dynamic instability. |
| 24.58.8 | Define convergent and divergent phugoid (oscillation). |
| 24.58.10 | Describe the meaning of:<br>(a) stick-held;<br>(b) stick-free. |
| 24.58.12 | Explain:<br>(a) longitudinal stability in the hover and in forward flight;<br>(b) lateral stability in forward flight;<br>(c) directional stability in the hover and in forward flight. |
| 24.58.14 | Explain how stick-held and stick-free affect longitudinal and lateral stability. |
| 24.58.16 | Explain the operation and effect of the following longitudinal stability aids:<br>(a) stabilisers;<br>(b) synchronised elevators;<br>(c) synthetic stabilisation. |
| 24.58.18 | Describe common methods whereby directional stability can be enhanced. |
| 24.58.20 | Define control power. |
| 24.58.22 | Explain the differences in control power between helicopters fitted with a: |

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| | (a) teetering rotor; |
| | (b) articulated rotor; |
| | (c) rigid rotor. |
| 24.58.24 | Explain how control power can be improved through: |
| | (a) offset flapping hinges; |
| | (b) horizontal stabilisers. |
| 24.58.26 | Describe the advantages of control power on: |
| | (a) CG limits; |
| | (b) maximum forward speed. |
| **24.60** | **Special Techniques** |
| 24.60.2 | Describe the factors involved during: |
| | (a) crosswind take-off and landing; |
| | (b) downwind take-off and landing; |
| | (c) running take-off and landing; |
| | (d) cushion creep take-off; |
| | (e) confined area (“towering”) take-off; |
| | (f) maximum performance take-off; |
| | (g) zero speed landing; |
| | (h) take-off and landing on sloping ground. |
| 24.60.4 | With respect to external (sling) load operations, describe: |
| | (a) consequences of, and precautions for, cable/strop snag during take-off; |
| | (b) effect on Vne; |
| | (c) actions to take in case of helicopter oscillation. |
| **24.62** | **Helicopter Performance** |
| 24.62.2 | Explain the effect of altitude on a helicopter’s performance. |
| 24.62.4 | Given the elevation and QNH of a location, calculate the pressure altitude. |
| 24.62.6 | Given a standard altimeter, determine the pressure altitude. |
| 24.62.8 | Given the pressure altitude and air temperature of a location, calculate the density altitude. |
| 24.62.10 | Given the elevation of a location, air temperature deviation from ISA, and QNH, |

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| | calculate the ambient temperature. |
| 24.62.12 | Explain the effect of a change in air temperature on the power required to hover IGE. |
| 24.62.14 | Explain why Vne varies with altitude. |
| 24.62.16 | Explain the effect of humidity on a helicopter's performance. |
| 24.62.18 | Describe the effect of a change in humidity on the density altitude of a location. |
| 24.62.20 | Explain the effect of the following on a helicopter's performance:<br>(a) aircraft gross weight;<br>(b) external stores;<br>(c) the wind. |
| 24.62.22 | Explain the effect of anti-torque application on rotor RPM. |
| 24.62.24 | Describe the effect on autorotation of ice accumulation on the rotor blades. |
| **24.64** | **Interpretation of Performance Planning Graphs** |
| 24.64.2 | Derive performance planning information from horsepower required and horsepower available curves, and from graphs published in piston engine and turbine engine helicopter Flight Manuals, with emphasis on:<br>(a) hover ceiling;<br>(b) take-off distance required over a 50ft obstacle;<br>(c) hover IGE and/or OGE, at various all-up weights;<br>(d) gross weight for hovering;<br>(e) turbine engine power;<br>(f) climb performance;<br>(g) range and endurance. |
| 24.64.4 | Given a typical height/velocity diagram:<br>(a) derive, for a given airspeed, the band of heights from which a forced landing is not possible following an engine failure;<br>(b) describe the effect of a change in air temperature on the range of speeds for safe level flight. |
| 24.64.6 | Explain the effects of the following on the size and shape of the avoid area of a height/velocity diagram:<br>(a) gross weight;<br>(b) altitude;<br>(c) density altitude; |

| Sub Topic | Syllabus Item |
|---|---|
| | (d) parasite drag; |
| | (e) carriage of a sling load. |
| 24.64.8 | Derive performance planning information from a graph showing the relationship between airspeed, altitude and Vne at various RPM settings. |

## Principles of Flight and Glider Operation

**Mechanics of flight:** Mass, inertia, momentum, force, forces in equilibrium, forces not in equilibrium, composition and resolution of forces, Newton's laws of motion, interrelation between mass, weight and gravity, speed, velocity, acceleration, motion in a curved path, centripetal and centrifugal force, moments, couples and the principles of moments.

**The atmosphere:** Air density and pressure, relation between density, pressure and temperature, pressure and temperature changes with height, the international standard atmosphere, meaning of density altitude and pressure altitude.

**Aerodynamics:** Airflow about an aerofoil, Bernoulli's theorem, angle of attack, angle of incidence, boundary layer, span, chord and aspect ratio, lift, form drag and induced drag, lift/drag ratio, glide ratio, forces acting on a glider while climbing, descending and turning, loading and acceleration during manoeuvres, turning and further effects of turning, aileron drag, autorotation, effects of flaps, slots and air brakes or spoilers, centre of gravity and its relation to stability and control, effect of wind and tail parachutes on glide ratio, effect of wind on a turn, effect of variation of air density on performance, effect of airframe icing on performance.

**Launching procedures:** Winch, auto- and aero-towing, techniques and precautions, ground handling, take-off performance requirements.

**Soaring:** Thermal soaring, principles, methods of determining the existence of thermals, cloud indicated and dry thermals, life cycle of thermals, cloud streets, ridge soaring and wave soaring, principles, influence of terrain features, effect of wind, hazards, and safety precautions.

**Landings:** Landing in strange fields, factors influencing the decision to land, choosing the field having regard to location, size, surface, slope and wind direction, approach and landing, cross-wind landing.

| Technical Knowledge Subjects 26 & 28 Structure | | | | | | | |
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| **Section 1 General** | | **Item Heading - Aeroplane (26)** | **Topic No.** | **Item Heading - Helicopter (28)** | **Topic No.** | **26** | **28** |
| | | | **26** | | **28** | | |
| **General Technical Knowledge** | 2 | Electricity and Magnetism | 2.2 | Electricity and Magnetism | 2.2 | □ | □ |
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| | 4 | Hydrodynamics | 4.2 | Hydrodynamics | 4.2 | □ | □ |
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| | 6 | Reserved | | Reserved | | | |
| | 8 | Reserved | | Reserved | | | |
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| **Powerplant and Systems** | 10 | Piston Engines - General | 10.2 | Piston Engines - General | 10.2 | □ | □ |
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| | 12 | Carburation | 12.2 | Carburation | 12.2 | □ | □ |
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| | 14 | Fuel Injection | 14.2 | Fuel Injection | 14.2 | □ | □ |
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| | 16 | Super and Turbo Charging | 16.2 | Super and Turbo Charging | 16.2 | □ | □ |
| | | | 16.4 | | 16.4 | □ | □ |
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| | 18 | Fuel | 18.2 | Fuel | 18.2 | □ | □ |
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| | 20 | Exhaust System | 20.2 | Exhaust System | 20.2 | □ | □ |
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| | 22 | Ignition System - Magneto | 22.2 | Ignition System - Magneto | 22.2 | □ | □ |
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| | 24 | Ignition System - Solid State | 24.2 | Ignition System - Solid State | 24.2 | □ | □ |
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| | 26 | Starter Motors | 26.2 | Starter Motors | 26.2 | □ | □ |
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| | 28 | Engine Performance | 28.2 | Engine Performance | 28.2 | □ | □ |
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| **Ancillary Systems** | 30 | Electrical System - DC | 30.2 | Electrical System - DC | 30.2 | □ | □ |
| | | | 30.4 | | 30.4 | □ | □ |
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| | 32 | Fuel Systems | 32.2 | Fuel Systems | 32.2 | □ | □ |
| | | | 32.4 | | 32.4 | □ | □ |
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| | 34 | Fuel Tanks | 34.2 | Fuel Tanks | 34.2 | □ | □ |
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| | 36 | Lubrication Systems - | 36.2 | Lubrication Systems - | 36.2 | □ | □ |

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| | 38 | Hydraulic Systems | 38.2 | Hydraulic Systems | 38.2 | □ | □ |
| | | | 38.4 | | 38.4 | □ | □ |
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| | 40 | Pneumatic Systems | 40.2 | Pneumatic Systems | 40.2 | □ | □ |
| | | | 40.4 | | 40.4 | □ | □ |
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| | 42 | Fire Warning Systems | 42.2 | Fire Warning Systems | 42.2 | □ | □ |
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| | 44 | Fire Protection Systems | 44.2 | Fire Protection Systems | 44.2 | □ | □ |
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| | 46 | Ice and Rain Protection Systems | 46.2 | Ice and Rain Protection Systems | 46.2 | □ | □ |
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| | 48 | Reserved | | Reserved | | | |
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| **Instruments** | 50 | Engine Instruments | 50.2 | Engine Instruments | 50.2 | □ | □ |
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| | 52 | Pressure Instruments | 52.2 | Pressure Instruments | 52.2 | □ | □ |
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| | 54 | Magnetic Instruments | 54.2 | Magnetic Instruments | 54.2 | □ | □ |
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| | 56 | Gyroscopic Instruments | 56.2 | Gyroscopic Instruments | 56.2 | □ | □ |
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| | 58 | GNSS Instruments | 58.2 | GNSS Instruments | 58.2 | □ | □ |
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| | 60 | TCAS | 60.2 | TCAS | 60.2 | □ | □ |
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| | 62 | GPWS Systems | 62.2 | GPWS Systems | 62.2 | □ | □ |
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| | 64 | EFIS Instrument Displays | 64.2 | EFIS Instrument Displays | 64.2 | □ | □ |
| | | | 64.4 | | 64.4 | □ | □ |
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| | | **Aeroplane - 26** | | **Helicopter - 28** | | | |
| **Section 2 Aeroplane/Helicopter** | | **Item Heading** | **Topic No.** | **Item Heading** | | **26** | **28** |
| **Structure and Systems** | 66 | Cooling Systems | 66.2 | Cooling Systems | 66.2 | □ | □ |
| | | | 66.4 | | 66.4 | □ | □ |
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| | 68 | Landing Gear - | 68.2 | Landing Gear - | 68.2 | □ | □ |

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| | | Fixed | | Fixed | | | |
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| | 70 | Landing Gear - Retractable | 70.2 | Landing Gear - Retractable | 70.2 | □ | □ |
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| | 72 | Wheel Brake Systems | 72.2 | | | □ | |
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| | 74 | Airframe Structure | 74.2 | Airframe Structure | 74.2 | □ | □ |
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| | 76 | Propellers | 76.2 | Reserved | | □ | |
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| | 78 | Reserved | | Transmission Systems | 78.2 | | □ |
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| | 80 | Reserved | | Main Rotor Systems | 80.2 | | □ |
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| | 82 | Reserved | | Tail Rotor Systems | 82.2 | | □ |
| | | | | | 82.4 | | □ |
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| | 84 | Control Systems | 84.2 | Control Systems | 84.2 | □ | □ |
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| | 86 | Flight Director - Autopilot Systems | 86.2 | Reserved | | □ | |
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| | 88 | Oxygen Systems | 88.2 | Reserved | | □ | |
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| **Weight and Balance** | 90 | Definitions, Terminology and Abbreviations | 90.2 | Definitions, Terminology and Abbreviations | 90.2 | □ | □ |
| | | | | | | | |
| | 92 | Weight and Balance Principles | 92.2 | Reserved | | □ | |
| | | | 92.4 | | | □ | |
| | | | 92.6 | | | □ | |
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| | | | 92.10 | | | □ | |
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| | 94 | Weight | 94.2 | Weight | 94.2 | □ | □ |
| | | | 94.4 | | 94.4 | □ | □ |
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| | 96 | Centre of Gravity | 96.2 | Centre of Gravity | 96.2 | □ | □ |
| | | | 96.4 | | 96.4 | □ | □ |
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## Subject No. 26 General Aircraft Technical Knowledge (Aeroplane)

***Note:*** *This syllabus is primarily based on a piston-engine light twin aeroplane.*

Each subject has been given a subject number and each topic within that subject a topic number. These reference numbers will be used on knowledge deficiency reports and will provide valuable feedback to the examination candidate. These reference numbers are common across the subject levels and therefore may not be consecutive.

This syllabus pre-supposes a knowledge and understanding already attained at PPL level.

Mnemonics used are those in common use at the time of writing.

The use of a specific mnemonic indicates this syllabus requires knowledge of the concept or system commonly or historically associated with that mnemonic.

Section 1 is common to both Subject 26 (Aeroplane) and Subject 28 (Helicopter)

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| | **Section 1 General Technical Knowledge** |
| **26.2** | **Electricity and Magnetism** |
| 26.2.2 | Explain the basic characteristics of an electrical circuit. |
| 26.2.4 | State Ohm's law. |
| 26.2.6 | Describe the terms:<br>(a) electromotive force (volts);<br>(b) current (amperes);<br>(c) resistance (ohms). |
| 26.2.8 | Describe the structure of a:<br>(a) two-wire circuit;<br>(b) grounded 'earth return' electrical circuit. |
| 26.2.10 | Distinguish between direct and alternating current. |
| 26.2.12 | Explain the terms:<br>(a) frequency (Hertz);<br>(b) rectification. |
| 26.2.14 | Explain the properties of magnetism, including:<br>(a) polarity;<br>(b) attraction;<br>(c) repulsion. |
| 26.2.16 | Distinguish between:<br>(a) temporary and permanent magnets;<br>(b) the properties of 'soft iron' and 'hard iron' magnets. |
| 26.2.18 | Describe the terms: |

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| | (a) magnetic field;<br>(b) magnetic flux;<br>(c) permeability. |
| 26.2.20 | Explain electromagnetism. |
| 26.2.22 | Describe the lines of magnetic force around a;<br>(a) straight conductor;<br>(b) current carrying coil. |
| 26.2.24 | Describe the principle of operation of an electromagnetic switch (or relay). |
| 26.2.26 | Describe typical examples of the use of electromagnetic switches in aircraft electrical circuits. |
| 26.2.28 | Explain the principle of electromagnetic induction. |
| 26.2.30 | Describe the principle of operation of a simple alternator. |
| 26.2.32 | Describe:<br>(a) the features of a practical alternator;<br>(b) how the AC output is normally rectified to provide DC. |
| 26.2.34 | Describe the principle of operation of a simple generator. |
| 26.2.36 | Describe:<br>(a) the features of a practical generator;<br>(b) how the output is passed through a commutator to provide DC. |
| 26.2.38 | Explain:<br>(a) the need for voltage regulation for both alternators and generators;<br>(b) why a generator also requires a current regulator and a reverse current relay. |
| 26.2.40 | Explain the principle of operation of a battery. |
| 26.2.42 | With respect to batteries, distinguish between:<br>(a) primary and secondary cells;<br>(b) wet cells and dry cells;<br>(c) lead-acid and nickel-cadium (and similar) types. |
| 26.2.44 | Explain the meaning of:<br>(a) battery capacity;<br>(b) thermal runaway. |
| 26.2.46 | Explain the basic features and operation of a:<br>(a) lead-acid battery;<br>(b) nickel-cadmium (NiCad) battery. |

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| 26.2.48 | Explain the advantages of NiCad batteries. |
| **26.4** | **Hydrodynamics** |
| 26.4.2 | State Pascal's principle. |
| 26.4.4 | Describe mechanical advantage, and how it can be gained hydraulically. |
| 26.4.6 | Explain the principle of operation of aircraft hydraulic services. |
| **26.6** | **Reserved** |
| **26.8** | **Reserved** |
| | **Power Plant and Systems** |
| **26.10** | **Piston Engines - general** |
| 26.10.2 | Explain the fundamental difference between piston and gas turbine (jet) engines. |
| 26.10.4 | Distinguish between the basic types of piston aircraft engine. |
| 26.10.6 | Explain the fundamental operating principle of a piston four-stroke cycle engine. |
| 26.10.8 | Explain the purpose of the main components of a four-stroke cycle piston engine including:<br>(a) cylinders;<br>(b) cylinder heads;<br>(c) pistons;<br>(d) connecting rods;<br>(e) crankshaft;<br>(f) valves;<br>(g) valve operating mechanism;<br>(h) camshaft;<br>(i) spark plugs;<br>(j) injectors. |
| 26.10.10 | With respect to a four-stroke piston engine, explain the meaning of the following terms:<br>(a) cycle;<br>(b) stroke;<br>(c) top dead centre (TDC);<br>(d) bottom dead centre (BDC);<br>(e) bore;<br>(f) clearance volume;<br>(g) swept volume;<br>(h) compression ratio;<br>(i) firing interval; |

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| | (j) firing order;<br>(k) manifolds;<br>(l) manifold pressure;<br>(m) crank angle. |
| 26.10.12 | With respect to a four-stroke piston engine, explain the meaning of the following terms:<br>(a) valve lag;<br>(b) valve lead;<br>(c) valve overlap. |
| 26.10.14 | Explain the advantages of valve overlap. |
| 26.10.16 | Explain the meaning of the term ignition timing, and the need for spark advance. |
| 26.10.18 | Distinguish between detonation and pre-ignition. |
| 26.10.20 | Explain the main causes of detonation (pre-ignition) including the reasons for avoiding them. |
| 26.10.22 | Explain diesel (compression ignition) knock (detonation). |
| 26.10.24 | Describe the use of a Ground Power Unit (GPU). |
| **26.12** | **Carburation** |
| 26.12.2 | Explain the basic principle of operation of a simple float-type carburettor. |
| 26.12.4 | Explain the following in relation to fuel-air mixture ratios:<br>(a) rich and lean;<br>(b) normal workable mixture ratio limits;<br>(c) the chemically correct or stoichiometric ratio;<br>(d) the approximate ratios for maximum power output and best economy. |
| 26.12.6 | Describe a typical carburettor mixture setting curve and the operating area where detonation will occur. |
| 26.12.8 | Explain the need for the following in an aero-engine carburetor;<br>(a) a venturi;<br>(b) atomization and diffusion;<br>(c) an accelerating system;<br>(d) an idling system;<br>(e) a power enrichment (economizer) system;<br>(f) a mixture control;<br>(g) a cut-off system. |
| 26.12.10 | Explain the disadvantages of a float type carburettor in an aero-engine. |
| 26.12.12 | Explain the correct use of the mixture control. |

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| 26.12.14 | Explain the consequences of operating with over-rich and over-lean mixture settings. |
| 26.12.16 | With respect to carburettor ice, explain the process and atmospheric conditions for the formation of:<br>(a) refrigeration (or fuel) ice;<br>(b) throttle ice;<br>(c) impact ice. |
| 26.12.18 | Explain the:<br>(a) normal symptoms of carburettor ice formation;<br>(b) the correct use of the carburettor heat control. |
| 26.12.20 | Describe how carburettor icing can prevent the normal operation of an aero-engine. |
| 26.12.22 | Describe the effect of excessive carburettor heat in high output engines. |
| 26.12.24 | With respect to carburettor air intakes, explain the correct use of:<br>(a) ram air;<br>(b) filtered air;<br>(c) carburettor heat. |
| 26.12.26 | Describe the effects of the partial blockage of the engine air intake filter. |
| 26.12.28 | Explain the reasons for a reduction in power when carburettor heat is operated. |
| 26.12.30 | Describe the typical source of heat for the carburettor hot air. |
| **26.14** | **Fuel Injection** |
| 26.14.2 | Explain the principal differences between a fuel injection system and carburettor systems. |
| 26.14.4 | Explain the purpose of the following components in a basic fuel injection system:<br>(a) delivery pump system;<br>(b) distribution system;<br>(c) injectors. |
| 26.14.6 | Explain the principal differences between continuous flow fuel injection, and direct fuel injection systems. |
| 26.14.8 | With regard to using fuel injection systems in aero-engines, explain the:<br>(a) advantages;<br>(b) disadvantages. |
| 26.14.10 | Explain the normal symptoms of intake ice formation, and the correct use of alternate air sources. |
| **26.16** | **Super and Turbo Charging** |

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| 26.16.2 | With regard to exhaust driven turbo charging and mechanically driven supercharging, explain the:<br>(a) advantages;<br>(b) disadvantages. |
| 26.16.4 | Explain the basic principle of operation of an exhaust driven turbocharger. |
| **26.18** | **Fuel** |
| 26.18.2 | Explain the differences between aviation gasoline (AVGAS) and motor gasoline (MOGAS). |
| 26.18.4 | Explain fuel octane ratings and performance numbers. |
| 26.18.6 | Explain the likely result of using a higher grade, or a lower grade, of fuel than that recommended for a given aircraft. |
| 26.18.8 | Explain the caution against using automobile fuel (MOGAS) in an aircraft engine, unless specifically authorised. |
| 26.18.10 | Describe the distinguishing features of aviation turbine fuel (AVTUR/Jet A1). |
| 26.18.12 | State the difference between the decals used on AVTUR and AVGAS fuelling equipment. |
| 26.18.14 | Explain the precautions which can be taken to avoid fuel contamination with water and other impurities. |
| 26.18.16 | Explain the special precautions which must be taken when fuelling from drum stock. |
| 26.18.18 | Explain the reasons for the avoidance of non-approved plastic containers. |
| **26.20** | **Exhaust Systems** |
| 26.20.2 | Describe the function of the exhaust manifold. |
| 26.20.4 | Explain the importance of proper sealing of the exhaust manifold. |
| 26.20.6 | Describe the possible sources, indications and associated danger of carbon monoxide gas. |
| **26.22** | **Ignition Systems – Magneto** |
| 26.22.2 | Explain the reasons for fitting independent dual ignition systems to engines. |
| 26.22.4 | List the essential components of an ignition system. |
| 26.22.6 | Describe the operation of the following:<br>(a) an aircraft magneto;<br>(b) the distributor;<br>(c) ignition harness (high tension leads); |

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| | (d) spark plugs;<br>(e) impulse couplings. |
| 26.22.8 | Explain the purpose of fitting an impulse coupling to a magneto. |
| 26.22.10 | Explain the reason ignition is timed to occur before top dead centre (TDC). |
| 26.22.12 | Describe the operation of the ignition switch(es) in the cockpit. |
| 26.22.14 | Outline the correct procedures to be followed during magneto checks. |
| 26.22.16 | Describe the indications of various problems manifested during a magneto check. |
| 26.22.18 | Explain the causes of spark plug fouling and the methods of clearing such fouling. |
| **26.24** | **Ignition Systems – Solid State** |
| 26.24.2 | Describe the components of a typical solid state ignition system. |
| 26.24.4 | Describe the operation of a typical solid state ignition system. |
| 26.24.6 | Explain the purpose for conducting typical solid state ignition integrity checks. |
| 26.24.8 | Explain the procedure for conducting typical solid state ignition integrity checks. |
| 26.24.10 | With reference to a solid state ignition system:<br>(a) explain the significance of maintaining the ignition power supply;<br>(b) describe a typical power supply backup system. |
| **26.26** | **Starter Motors** |
| 26.26.2 | Describe the functioning of the starter motor. |
| 26.26.4 | Describe the operational limitations of the starter motor. |
| 26.26.6 | Explain the correct operation of a typical starter switch. |
| **26.28** | **Engine Performance** |
| 26.28.2 | Explain the meaning of the terms;<br>(a) force;<br>(b) work;<br>(c) power;<br>(d) energy;<br>(e) torque. |
| 26.28.4 | Explain the relationship between horsepower and kilowatts. |
| 26.28.6 | Explain the meaning of:<br>(a) brake power;<br>(b) rated power; |

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| | (c) rated altitude (critical altitude);<br>(d) full throttle height. |
| 26.28.8 | Explain the meaning of:<br>(a) thermal efficiency;<br>(b) mechanical efficiency;<br>(c) volumetric efficiency. |
| 26.28.10 | Explain the relationship between typical brake power and power available curves. |
| 26.28.12 | Explain the general conditions for the most efficient engine operation. |
| 26.28.14 | Describe the effect of changing altitude on manifold pressure and power output of normally aspirated engines. |
| | **Ancillary Systems** |
| **26.30** | **Electrical Systems - DC** |
| 26.30.2 | Describe the systems which typically require DC power in an aircraft. |
| 26.30.4 | Explain the function(s) of the following in a typical electrical system:<br>(a) the battery;<br>(b) a ground power source;<br>(c) the alternator or generator;<br>(d) bus bars;<br>(e) over voltage protection. |
| 26.30.6 | Given appropriate data, determine the duration of battery operation following a generator failure. |
| 26.30.8 | Describe the relative advantages and disadvantages of:<br>(a) a generator;<br>(b) an alternator. |
| 26.30.10 | Explain the functions and interpretation of:<br>(a) left-zero ammeters;<br>(b) centre-zero ammeters. |
| 26.30.12 | Explain the functions and correct operation of a:<br>(a) single battery master switch;<br>(b) split battery/alternator switch. |
| 26.30.14 | Explain the operation of:<br>(a) fuses;<br>(b) circuit breakers;<br>(c) overload switches. |
| 26.30.16 | Explain operational principles for the handling of the electrical DC system, |

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| | including:<br>(a) avoiding overheating electrical services if operated during pre-flight;<br>(b) not starting or stopping the engine with unnecessary electrical equipment switched on;<br>(c) avoiding prolonged use of the starter motor;<br>(d) checking satisfactory operation of the alternator/generator after start, and periodically during flight;<br>(e) ensuring the battery master is switched off before vacating the aircraft after flight;<br>(f) use of a ground power unit. |
| 26.30.18 | Explain the identification of:<br>(a) an excessive charge rate;<br>(b) alternator/generator failure;<br>(c) a total electric failure. |
| 26.30.20 | Explain the risks associated with:<br>(a) resetting blown fuse/popped circuit breakers;<br>(b) using fuses as a switch. |
| 26.30.22 | Explain the issues related specifically to 'technically enhanced aircraft' (TEA) during the handling of electrical malfunctions. |
| **26.32** | **Fuel Systems** |
| 26.32.2 | Distinguish between gravity-fed and pump-fed fuel systems. |
| 26.32.4 | For a typical fuel system, explain the function, and where appropriate, the correct handling of the following:<br>(a) fuel strainers and filters;<br>(b) engine-driven fuel pump;<br>(c) boost (auxiliary) pump(s);<br>(d) engine primers and priming systems. |
| **26.34** | **Fuel Tanks** |
| 26.34.2 | For a fuel system, explain the function, and where appropriate, the correct handling of the following:<br>(a) tank filler caps and drains;<br>(b) expansion spaces;<br>(c) tank vents;<br>(d) baffles;<br>(e) sumps and drains;<br>(f) fuel quantity detectors;<br>(g) fuel strainers and filters;<br>(h) tank selector valves;<br>(i) cross feed valves; |

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| | (j) fuel flow meters. |
| 26.34.4 | Describe:<br>(a) the general rules for refuelling;<br>(b) the correct use of fuel tank dipsticks;<br>(c) the correct use of magna-sticks. |
| 26.34.6 | Describe the correct procedures to be used for carrying out fuel quality checks. |
| 26.34.8 | Describe the indications of water in a fuel sample. |
| 26.34.10 | Describe the symptoms of a blocked fuel tank vent in a gravity feed fuel system. |
| 26.34.12 | Describe the importance of correct management of fuel selection. |
| 26.34.14 | Detail the actions recommended in the case of loss of power through faulty fuel selection. |
| 26.34.16 | Describe the typical methods of cross-feeding fuel. |
| **26.36** | **Lubrication Systems - Engine** |
| 26.36.2 | Explain the main functions of an engine oil system. |
| 26.36.4 | Describe the effect of temperature on the viscosity and lubrication qualities of oil. |
| 26.36.6 | Compare the features of the ashless dispersant (AD) oils used in piston aero-engines with straight mineral oil and detergent oils. |
| 26.36.8 | With respect to oil grades, differentiate between the commercial aviation numbers and SAE ratings. |
| 26.36.10 | Differentiate between a wet sump and a dry sump oil system. |
| 26.36.12 | Describe the function of:<br>(a) the engine-driven oil pump and pressure relief valve;<br>(b) oil lines, passages and galleries;<br>(c) oil sumps, and scavenge pumps;<br>(d) oil cooler;<br>(e) oil tank and filter. |
| 26.36.14 | Explain the need for periodic oil changes. |
| 26.36.16 | Describe the likely results of operating an engine with:<br>(a) incorrect oil type;<br>(b) incorrect oil quantity. |
| 26.36.18 | Describe the likely causes of:<br>(a) low oil pressure;<br>(b) high oil pressure; |

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| | (c) high oil temperature. |
| 26.36.20 | Explain the relationship between a fluctuating or low oil pressure reading accompanied by a rise in oil temperature. |
| 26.36.22 | Describe the actions the pilot should take in the low pressure/high temperature situation. |
| **26.38** | **Hydraulic Systems** |
| 26.38.2 | Describe:<br>(a) mechanical advantage;<br>(b) how mechanical advantage can be gained hydraulically;<br>(c) the principle of operation of typical aircraft hydraulic services. |
| 26.38.4 | Explain the advantages of using hydraulics to operate aircraft services. |
| 26.38.6 | Differentiate between the three types of hydraulic oil. |
| 26.38.8 | Describe the function of common hydraulic system components including:<br>(a) reservoirs;<br>(b) pumps;<br>(c) pressure regulators;<br>(d) accumulators;<br>(e) check valves and release valves;<br>(f) selector valves;<br>(g) actuators;<br>(h) filters. |
| 26.38.10 | Describe the operation of the following hydraulic systems:<br>(a) open centre system;<br>(b) pressurised system. |
| 26.38.12 | Describe the operation of a typical aircraft hydraulic system. |
| **26.40** | **Pneumatic Systems** |
| 26.40.2 | Explain the relative:<br>(a) advantages of pneumatic systems over hydraulic systems;<br>(b) disadvantages of pneumatic systems over hydraulic systems. |
| 26.40.4 | Describe the operation of a typical pneumatic system. |
| **26.42** | **Fire Warning Systems** |
| 26.42.2 | Describe the operation of a typical fire detection system. |
| **26.44** | **Fire Protection Systems** |
| 26.44.2 | Explain any precautions to be taken when using the common fire extinguishing |

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| | agents available. |
| 26.44.4 | Describe typical fire extinguishing systems. |
| 26.44.6 | Explain the associated limitations of typical fire extinguishing systems. |
| **26.46** | **Ice and Rain Protection Systems** |
| 26.46.2 | Distinguish between anti-icing systems and de-icing systems. |
| 26.46.4 | Explain the operation and the proper handling of the following ice protection systems:<br>(a) mechanical;<br>(b) fluid;<br>(c) thermal. |
| 26.46.6 | Describe typical systems for:<br>(a) ice detection;<br>(b) windscreen heating;<br>(c) rain clearance. |
| 26.46.8 | Describe the performance reductions associated with:<br>(a) ice accumulation;<br>(b) operation of anti-ice and de-icing equipment. |
| 26.46.10 | Explain the function and operation of:<br>(a) static discharge wicks;<br>(b) bonding strips. |
| **26.48** | **Reserved** |
| | **Instruments** |
| **26.50** | **Engine Instruments** |
| 26.50.2 | Describe the function and principle of operation of the following instruments:<br>(a) tachometers (centrifugal, drag cup, electrical and electronic types);<br>(b) manifold pressure and boost gauges;<br>(c) oil pressure gauges (direct reading, remote indicating and ratiometer types);<br>(d) fuel pressure gauges;<br>(e) vacuum gauges;<br>(f) cylinder head and exhaust gas temperature gauges (thermocouples);<br>(g) oil temperature gauges;<br>(h) outside air temperature gauges;<br>(i) fuel quantity gauges;<br>(j) fuel flow gauges. |

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| 26.50.4 | Explain the principle of operation of a simple AC synchro system. |
| **26.52** | **Pressure Instruments** |
| 26.52.2 | Define:<br>(a) static air pressure;<br>(b) dynamic air pressure;<br>(c) total (pitot) pressure. |
| 26.52.4 | Explain the pressure requirements of the three basic pressure instruments. |
| 26.52.6 | Describe a typical pitot-static system. |
| 26.52.8 | Explain the difference between a single pitot (pressure) head and separate pitot tube and static vent system. |
| 26.52.10 | Explain the function of pitot heat. |
| 26.52.12 | Explain the following errors affecting an ASI:<br>(a) density error (IAS/TAS relationship);<br>(b) position (pressure) error;<br>(c) compressibility error. |
| 26.52.14 | Describe the pre-flight and in-flight serviceability checks for an ASI. |
| 26.52.16 | Explain the principle of operation of an altimeter. |
| 26.52.18 | Explain the meanings of the subscale settings QNH and QFE. |
| 26.52.20 | Explain the effect of pressure setting error on altimeter indication. |
| 26.52.22 | Explain the effect of air mass temperature, at constant QNH, on altimeter indication. |
| 26.52.24 | Explain the following errors affecting an altimeter:<br>(a) instrument error;<br>(b) position error;<br>(c) lag. |
| 26.52.26 | Describe the serviceability checks and the accepted indication tolerances of an altimeter. |
| 26.52.28 | Explain the principle of operation of a vertical speed indicator (VSI). |
| 26.52.30 | Explain the following errors affecting a VSI:<br>(a) position error;<br>(b) lag. |
| 26.52.32 | Explain the serviceability checks for a VSI. |
| 26.52.34 | With regard to blockages and leaks in the pitot-static system of the various |

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| | pressure instruments, explain the:<br>(a) instrument symptoms;<br>(b) indication errors;<br>(c) possible remedies available. |
| 26.52.36 | Explain the function and operation of the alternate static system. |
| **26.54** | **Magnetic Instruments** |
| 26.54.2 | Describe the features of the earth's magnetic field (flux). |
| 26.54.4 | Explain magnetic variation. |
| 26.54.6 | Describe the angle of dip and components H and Z of the earth's magnetic flux. |
| 26.54.8 | Describe the basic features of a typical aircraft direct-reading magnetic compass. |
| 26.54.10 | Explain the reason(s) for:<br>(a) pendulous suspension of the magnet system;<br>(b) immersing the magnet system in fluid. |
| 26.54.12 | With reference to a direct-reading compass, describe:<br>(a) acceleration errors;<br>(b) turning errors;<br>(c) the practical aspects of these errors. |
| 26.54.14 | Explain magnetic deviation and how it is compensated for in a direct-reading compass. |
| 26.54.16 | Given a typical deviation card, apply corrections for residual deviation. |
| 26.54.18 | Explain the serviceability checks for a direct-reading compass. |
| 26.54.20 | Explain what a compass swing is and the occasions on which it is required. |
| 26.54.22 | Outline the service limits and tolerances for a direct-reading compass. |
| **26.56** | **Gyroscopic Instruments** |
| 26.56.2 | Describe a typical aircraft vacuum (suction system). |
| 26.56.4 | Distinguish between suction pump, venturi, and positive pressure systems. |
| 26.56.6 | Describe the inherent properties of a spinning gyroscope rotor. |
| 26.56.8 | Explain what is meant by the term gimbal. |
| 26.56.10 | List the types of gyroscope. |
| 26.56.12 | Explain the principle of operation of a turn indicator. |
| 26.56.14 | Distinguish between a turn indicator (TI) and a turn co-ordinator (TC). |

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| 26.56.16 | Describe the errors which a turn indicator is subject to. |
| 26.56.18 | Explain the principle of operation of the balance ball. |
| 26.56.20 | Interpret various TI and TC indications. |
| 26.56.22 | Explain the serviceability checks for the TI/TC. |
| 26.56.24 | Explain the principle of operation of a direction indicator/heading indicator (DI/HI). |
| 26.56.26 | Explain the following errors which the DI/HI is subject to;<br>(a) gimbal error;<br>(b) real drift (or real wander);<br>(c) apparent drift (or apparent wander);<br>(d) low rotor speed. |
| 26.56.28 | Describe the characteristics of a toppled directional gyro (DI/HI). |
| 26.56.30 | Explain the DI/HI typical:<br>(a) operating limitations;<br>(b) serviceability checks. |
| 26.56.32 | Explain the advantages of an electrically-driven DI/HI versus an air-driven instrument. |
| 26.56.34 | Explain the principle of operation of an artificial horizon/attitude indicator (AH/AI). |
| 26.56.36 | Describe the effect on an air-driven AH/AI, including the errors in indication arising from a:<br>(a) straight-line acceleration;<br>(b) turn. |
| 26.56.38 | Explain the general operating limitations of an:<br>(a) air-driven AH/AI;<br>(b) electrically-driven AH/AI. |
| 26.56.40 | Distinguish between the indications of the TC and AH/AI under various conditions. |
| **26.58** | **GNSS Systems** |
| 26.58.2 | Describe the principle of a Global Navigation Satellite System (GNSS). |
| 26.58.4 | Explain the limitations of the Global Navigation Satellite System (GNSS). |
| 26.58.6 | Explain the term RAIM prediction and the significance of these predictions. |
| 26.58.8 | Explain the term RNP and the significance of the RNP value. |

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| **26.60** | **TCAS Systems** |
| 26.60.2 | Describe the function and operation of a typical TCAS system. |
| **26.62** | **GPWS Systems** |
| 26.62.2 | Describe the function and operation of a typical GPWS system. |
| **26.64** | **"EFIS" Instrument Displays** |
| 26.64.2 | Describe the components and operation of a typical EFIS cockpit display system. |
| 26.64.4 | Describe the function of the:<br>(a) air data computer;<br>(b) signal generator;<br>(c) input data sources to a basic glass flight display system. |
| 26.64.6 | Describe the components and operation of an Attitude Heading Reference System (AHRS). |
| 26.64.8 | Describe the management of EFIS system failures. |
| | **Section 2 Aeroplane Technical Knowledge** |
| | **Structure and Systems** |
| **26.66** | **Cooling Systems - Engines** |
| 26.66.2 | Explain the reasons why excessively high engine temperatures and rapid cooling must be avoided. |
| 26.66.4 | Describe the ways in which heat from the combustion process is dispersed from a typical aero-engine. |
| 26.66.6 | In a typical aircraft engine, explain the function of:<br>(a) cowling ducts and baffles;<br>(b) cooling fins;<br>(c) pilot-operated cowl flaps;<br>(d) oil cooler;<br>(e) radiator;<br>(f) intercooler. |
| 26.66.8 | Explain the general engine handling techniques for maintaining engine temperatures within the proper range, for aircraft:<br>(a) without CHT (cylinder head temperature) gauge or cowl flaps;<br>(b) fitted with CHT gauge and cowl flaps. |
| **26.68** | **Landing Gear - Fixed** |
| 26.68.2 | Explain the requirements which the undercarriage/landing system must be able to meet. |

| Sub Topic | Syllabus Item |
|---|---|
| 26.68.4 | Describe the features of a typical undercarriage construction. |
| 26.68.6 | Explain the operation of an oleo-pneumatic shock strut. |
| 26.68.8 | Describe the pilot checks of oleo-pneumatic undercarriage legs. |
| 26.68.10 | Describe the construction of aircraft wheel assemblies and tyres. |
| 26.68.12 | Explain the requirements for tyre care and checks. |
| **26.70** | **Landing Gear - Retractable** |
| 26.70.2 | Describe the essential features of a retractable undercarriage system. |
| 26.70.4 | Explain the speed limitations for landing gear operation. |
| 26.70.6 | Describe typical:<br>(a) emergency gear operation systems;<br>(b) associated emergency gear operation procedures.. |
| 26.70.8 | Describe typical gear warning and indicating systems. |
| 26.70.10 | Describe the function and operation of ground retraction protection systems. |
| **26.72** | **Aircraft Wheel Brake System** |
| 26.72.2 | Describe the principle of operation of the common types of wheel brake units. |
| 26.72.4 | Outline the operation of:<br>(a) an independent brake system;<br>(b) a boosted brake system;<br>(c) a power brake system. |
| 26.72.6 | Explain the operation of anti-skid brake systems. |
| **26.74** | **Airframe Structure** |
| 26.74.2 | Explain different types of loading which an airframe must be designed to accept. |
| 26.74.4 | Explain the effects of the application of a load to an airframe structure (stress and strain). |
| 26.74.6 | Differentiate between bending, tensile, compression, torsional and shear loads. |
| 26.74.8 | Briefly describe the various construction styles of a fuselage. |
| 26.74.10 | Briefly describe the common types of wing construction. |
| 26.74.12 | Briefly describe the construction of:<br>(a) the tailplane;<br>(b) the vertical fin;<br>(c) control surfaces. |

| Sub Topic | Syllabus Item |
|---|---|
| **26.76** | **Propellers** |
| 26.76.2 | Explain the disadvantages of the fixed-pitch propeller. |
| 26.76.4 | For a constant speed propeller, differentiate between the functions of the propeller (pitch) control and the throttle control, when the propeller is:<br>(a) in the constant-speed range;<br>(b) below the constant-speed rpm range. |
| 26.76.6 | Explain how the constant-speed unit (CSU) acts to change the pitch of the blades and maintain rpm with changes:<br>(a) to power;<br>(b) in airspeed. |
| 26.76.8 | Explain the method of operation of typical pitch changing mechanisms. |
| 26.76.10 | Explain the operation of a typical CSU governor. |
| 26.76.12 | Explain the power management requirements as the propeller blades are travelling from the normal thrust to the reverse thrust angle. |
| 26.76.14 | Describe the normal handling of the propeller pitch and power controls for a two lever control system:<br>(a) when the aircraft is on the ground;<br>(b) for 'exercising' the CSU;<br>(c) prior to take-off and landing;<br>(d) when increasing or decreasing power in the air. |
| 26.76.16 | Describe the normal handling of the power control for a single lever control system;<br>(a) when the aircraft is on the ground;<br>(b) for 'exercising' the CSU;<br>(c) prior to take-off and landing;<br>(d) when increasing or decreasing power in the air. |
| 26.76.18 | Describe the types of failure which can affect the CSU. |
| 26.76.20 | Explain the:<br>(a) conditions which can lead to a 'runaway propeller';<br>(b) required remedial action to manage a 'runaway propeller'. |
| 26.76.22 | Describe the function and operation of a:<br>(a) manual feather propeller;<br>(b) auto-feather propeller;<br>(c) auto-coarsen propeller. |
| **26.78** | **Reserved** |
| **26.80** | **Reserved** |

| Sub Topic | Syllabus Item |
|---|---|
| **26.82** | **Reserved** |
| **26.84** | **Control Systems** |
| 26.84.2 | Briefly describe the method of operation of the primary control surfaces found in a light twin aeroplane. |
| **26.86** | **Flight Director – Autopilot Systems** |
| 26.86.2 | Describe the function of a basic FD-AFCS system. |
| 26.86.4 | Describe the operation of a basic FD-AFCS system. |
| 26.86.6 | Describe the typical:<br>(a) vertical operational modes;<br>(b) lateral operational modes. |
| 26.86.8 | With regard to the operation of a FD-AFCS system, explain the:<br>(a) limitations;<br>(b) cautions. |
| **26.88** | **Oxygen Systems** |
| 26.88.2 | Describe the:<br>(a) function of a cockpit fitted or portable oxygen system;<br>(b) principle of operation of a cockpit fitted or portable oxygen system. |
| | **Weight and Balance** |
| **26.90** | **Definitions, Terminology and Abbreviations** |
| 26.90.2 | Explain the meaning of the following terms:<br>(a) arm (moment arm);<br>(b) datum;<br>(c) moment (including units used);<br>(d) centre of gravity (C of G);<br>(e) longitudinal C of G range and limits;<br>(f) station;<br>(g) index units;<br>(h) basic empty weight (empty aircraft weight);<br>(i) empty weight centre of gravity position;<br>(j) basic operating weight (aircraft prepared for service weight);<br>(k) payload (commercial load);<br>(l) zero fuel weight (ZFW);<br>(m) ramp weight;<br>(n) gross weight (AUW);<br>(o) take-off weight;<br>(p) maximum certificated take-off weight (MCTOW); |

| Sub Topic | Syllabus Item |
|---|---|
| | (q) landing weight;<br>(r) maximum certificated landing weight (MCLW);<br>(s) centre of gravity envelope;<br>(t) specific gravity;<br>(u) the specific gravity and the weight of fuel of AVGAS or Jet A-1. |
| **26.92** | **Weight and Balance Principles** |
| 26.92.2 | Explain the principles of aeroplane balance. |
| 26.92.4 | Explain the function of the tailplane in providing the final longitudinal balancing force. |
| 26.92.6 | Explain the significance of lateral fuel imbalance and the limitations typically applied. |
| 26.92.8 | Describe the effect on longitudinal stability and resultant handling issues with the aeroplane loaded with the centre of gravity:<br>(a) forward;<br>(b) outside the forward limit;<br>(c) aft;<br>(d) outside the aft limit. |
| 26.92.10 | Explain the expected effect of fuel burn on the centre of gravity position. |
| **26.94** | **Weight** |
| 26.94.2 | Given the appropriate conversion data, convert between:<br>(a) US gallons and litres;<br>(b) pounds and kilograms. |
| 26.94.4 | Given the fuel's specific gravity, calculate the weight of a given volume of fuel. |
| 26.94.6 | Given the appropriate loading data:<br>(a) calculate the take-off weight;<br>(b) calculate the landing weight;<br>(c) calculate the landing weight for a limited take-off weight flight;<br>(d) for a specific maximum take-off weight, calculate the payload available;<br>(e) for a specific maximum zero fuel weight, calculate the payload available;<br>(f) calculate the allowable load in various compartments. |
| **26.96** | **Centre of Gravity** |
| 26.96.2 | Given appropriate loading data and graphs and using a typical weight and balance work sheet, calculate the longitudinal centre of gravity position:<br>(a) at take-off;<br>(b) for landing. |

| Sub Topic | Syllabus Item |
|---|---|
| 26.96.4 | Plot the longitudinal and lateral centre of gravity positions on a graph showing the centre of gravity limits. |
| 26.96.6 | Solve the following loading problems:<br>(a) find a revised longitudinal centre of gravity position after loading or offloading weight;<br>(b) loading or offloading weight to place the longitudinal centre of gravity at a given station;<br>(c) loading or offloading weight at a given station without exceeding the longitudinal centre of gravity limits;<br>(d) moving weight from one station to another and calculating the revised longitudinal centre of gravity position. |

## Subject No. 28 General Aircraft Technical Knowledge (Helicopter)

***Note:*** *This syllabus is primarily based on a typical light piston-engine or single turbine powered helicopter. For the purposes of this syllabus, any references to aircraft should be understood to be limited to helicopters only.*

Each subject has been given a subject number and each topic within that subject a topic number. These reference numbers will be used on knowledge deficiency reports and will provide valuable feedback to the examination candidate. These reference numbers are common across the subject levels and therefore may not be consecutive.

This syllabus pre-supposes a knowledge and understanding already attained at PPL level.

Mnemonics used are those in common use at the time of writing.

The use of a specific mnemonic indicates this syllabus requires knowledge of the concept or system commonly or historically associated with that mnemonic.

Section 1 is common to both Subject 26 (Aeroplane) and Subject 28 (Helicopter)

| Sub Topic | Syllabus Item |
|---|---|
| | **Section 1 General Aircraft Technical Knowledge** |
| **28.2** | **Electricity and Magnetism** |
| 28.2.2 | Explain the basic characteristics of an electrical circuit. |
| 28.2.4 | State Ohm's law. |
| 28.2.6 | Describe the terms:<br>(a) electromotive force (volts);<br>(b) current (amperes);<br>(c) resistance (ohms). |
| 28.2.8 | Describe the structure of a:<br>(a) two-wire circuit;<br>(b) grounded 'earth return' electrical circuit. |
| 28.2.10 | Distinguish between direct and alternating current. |
| 28.2.12 | Explain the terms:<br>(a) frequency (Hertz);<br>(b) rectification. |
| 28.2.14 | Explain the properties of magnetism, including:<br>(a) polarity;<br>(b) attraction;<br>(c) repulsion. |
| 28.2.16 | Distinguish between:<br>(a) temporary and permanent magnets;<br>(b) the properties of 'soft iron' and 'hard iron' magnets. |
| 28.2.18 | Describe the terms: |

| Sub Topic | Syllabus Item |
|---|---|
| | (a) magnetic field;<br>(b) magnetic flux;<br>(c) permeability. |
| 28.2.20 | Explain electromagnetism. |
| 28.2.22 | Describe the lines of magnetic force around a;<br>(a) straight conductor;<br>(b) current carrying coil. |
| 28.2.24 | Describe the principle of operation of an electromagnetic switch (or relay). |
| 28.2.26 | Describe typical examples of the use of electromagnetic switches in aircraft electrical circuits. |
| 28.2.28 | Explain the principle of electromagnetic induction. |
| 28.2.30 | Describe the principle of operation of a simple alternator. |
| 28.2.32 | Describe:<br>(a) the features of a practical alternator;<br>(b) how the AC output is normally rectified to provide DC. |
| 28.2.34 | Describe the principle of operation of a simple generator. |
| 28.2.36 | Describe:<br>(a) the features of a practical generator;<br>(b) how the output is passed through a commutator to provide DC. |
| 28.2.38 | Explain:<br>(a) the need for voltage regulation for both alternators and generators;<br>(b) why a generator also requires a current regulator and a reverse current relay. |
| 28.2.40 | Explain the principle of operation of a battery. |
| 28.2.42 | With respect to batteries, distinguish between:<br>(a) primary and secondary cells;<br>(b) wet cells and dry cells;<br>(c) lead-acid and nickel-cadium (and similar) types. |
| 28.2.44 | Explain the meaning of:<br>(a) battery capacity;<br>(b) thermal runaway. |
| 28.2.46 | Explain the basic features and operation of a:<br>(a) lead-acid battery;<br>(b) nickel-cadmium (NiCad) battery. |

| Sub Topic | Syllabus Item |
|---|---|
| 28.2.48 | Explain the advantages of NiCad batteries. |
| **28.4** | **Hydrodynamics** |
| 28.4.2 | State Pascal's principle. |
| 28.4.4 | Describe mechanical advantage, and how it can be gained hydraulically. |
| 28.4.6 | Explain the principle of operation of aircraft hydraulic services. |
| **28.6** | **Reserved** |
| **28.8** | **Reserved** |
| | **Power Plant and Systems** |
| **28.10** | **Piston Engines - general** |
| 28.10.2 | Explain the fundamental difference between piston and gas turbine (jet) engines. |
| 28.10.4 | Distinguish between the basic types of piston aircraft engine. |
| 28.10.6 | Explain the fundamental operating principle of a piston four-stroke cycle engine. |
| 28.10.8 | Explain the purpose of the main components of a four-stroke cycle piston engine including:<br>(a) cylinders;<br>(b) cylinder heads;<br>(c) pistons;<br>(d) connecting rods;<br>(e) crankshaft;<br>(f) valves;<br>(g) valve operating mechanism;<br>(h) camshaft;<br>(i) spark plugs;<br>(j) injectors. |
| 28.10.10 | With respect to a four-stroke piston engine, explain the meaning of the following terms:<br>(a) cycle;<br>(b) stroke;<br>(c) top dead centre (TDC);<br>(d) bottom dead centre (BDC);<br>(e) bore;<br>(f) clearance volume;<br>(g) swept volume;<br>(h) compression ratio;<br>(i) firing interval; |

| Sub Topic | Syllabus Item |
|---|---|
| | (j) firing order;<br>(k) manifolds;<br>(l) manifold pressure;<br>(m) crank angle. |
| 28.10.12 | With respect to a four-stroke piston engine, explain the meaning of the following terms:<br>(a) valve lag;<br>(b) valve lead;<br>(c) valve overlap. |
| 28.10.14 | Explain the advantages of valve overlap. |
| 28.10.16 | Explain the meaning of the term ignition timing, and the need for spark advance. |
| 28.10.18 | Distinguish between detonation and pre-ignition. |
| 28.10.20 | Explain the main causes of detonation (pre-ignition) including the reasons for avoiding them. |
| 28.10.22 | Explain diesel (compression ignition) knock (detonation). |
| 28.10.24 | Describe the use of a Ground Power Unit (GPU). |
| **28.12** | **Carburation** |
| 28.12.2 | Explain the basic principle of operation of a simple float-type carburettor. |
| 28.12.4 | Explain the following in relation to fuel-air mixture ratios:<br>(a) rich and lean;<br>(b) normal workable mixture ratio limits;<br>(c) the chemically correct or stoichiometric ratio;<br>(d) the approximate ratios for maximum power output and best economy. |
| 28.12.6 | Describe a typical carburettor mixture setting curve and the operating area where detonation will occur. |
| 28.12.8 | Explain the need for the following in an aero-engine carburetor;<br>(a) a venturi;<br>(b) atomization and diffusion;<br>(c) an accelerating system;<br>(d) an idling system;<br>(e) a power enrichment (economizer) system;<br>(f) a mixture control;<br>(g) a cut-off system. |
| 28.12.10 | Explain the disadvantages of a float type carburettor in an aero-engine. |
| 28.12.12 | Explain the correct use of the mixture control. |

| Sub Topic | Syllabus Item |
|---|---|
| 28.12.14 | Explain the consequences of operating with over-rich and over-lean mixture settings. |
| 28.12.16 | With respect to carburettor ice, explain the process and atmospheric conditions for the formation of:<br>(a) refrigeration (or fuel) ice;<br>(b) throttle ice;<br>(c) impact ice. |
| 28.12.18 | Explain the:<br>(a) normal symptoms of carburettor ice formation;<br>(b) the correct use of the carburettor heat control. |
| 28.12.20 | Describe how carburettor icing can prevent the normal operation of an aero-engine. |
| 28.12.22 | Describe the effect of excessive carburettor heat in high output engines. |
| 28.12.24 | With respect to carburettor air intakes, explain the correct use of:<br>(a) ram air;<br>(b) filtered air;<br>(c) carburettor heat. |
| 28.12.26 | Describe the effects of the partial blockage of the engine air intake filter. |
| 28.12.28 | Explain the reasons for a reduction in power when carburettor heat is operated. |
| 28.12.30 | Describe the typical source of heat for the carburettor hot air. |
| **28.14** | **Fuel Injection** |
| 28.14.2 | Explain the principal differences between a fuel injection system and carburettor systems. |
| 28.14.4 | Explain the purpose of the following components in a basic fuel injection system:<br>(a) delivery pump system;<br>(b) distribution system;<br>(c) injectors. |
| 28.14.6 | Explain the principal differences between continuous flow fuel injection, and direct fuel injection systems. |
| 28.14.8 | With regard to using fuel injection systems in aero-engines, explain the:<br>(a) advantages;<br>(b) disadvantages. |
| 28.14.10 | Explain the normal symptoms of intake ice formation, and the correct use of alternate air sources. |

| Sub Topic | Syllabus Item |
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| **28.16** | **Super and Turbo Charging** |
| 28.16.2 | With regard to exhaust driven turbo charging and mechanically driven supercharging, explain the:<br>(a) advantages;<br>(b) disadvantages. |
| 28.16.4 | Explain the basic principle of operation of an exhaust driven turbocharger. |
| **28.18** | **Fuel** |
| 28.18.2 | Explain the differences between aviation gasoline (AVGAS) and motor gasoline (MOGAS). |
| 28.18.4 | Explain fuel octane ratings and performance numbers. |
| 28.18.6 | Explain the likely result of using a higher grade, or a lower grade, of fuel than that recommended for a given aircraft. |
| 28.18.8 | Explain the caution against using automobile fuel (MOGAS) in an aircraft engine, unless specifically authorised. |
| 28.18.10 | Describe the distinguishing features of aviation turbine fuel (AVTUR/Jet A1). |
| 28.18.12 | State the difference between the decals used on AVTUR and AVGAS fuelling equipment. |
| 28.18.14 | Explain the precautions which can be taken to avoid fuel contamination with water and other impurities. |
| 28.18.16 | Explain the special precautions which must be taken when fuelling from drum stock. |
| 28.18.18 | Explain the reasons for the avoidance of non-approved plastic containers. |
| **28.20** | **Exhaust Systems** |
| 28.20.2 | Describe the function of the exhaust manifold. |
| 28.20.4 | Explain the importance of proper sealing of the exhaust manifold. |
| 28.20.6 | Describe the possible sources, indications and associated danger of carbon monoxide gas. |
| **28.22** | **Ignition Systems – Magneto** |
| 28.22.2 | Explain the reasons for fitting independent dual ignition systems to engines. |
| 28.22.4 | List the essential components of an ignition system. |
| 28.22.6 | Describe the operation of the following:<br>(a) an aircraft magneto;<br>(b) the distributor; |

| Sub Topic | Syllabus Item |
|---|---|
| | (c) ignition harness (high tension leads);<br>(d) spark plugs;<br>(e) impulse couplings. |
| 28.22.8 | Explain the purpose of fitting an impulse coupling to a magneto. |
| 28.22.10 | Explain the reason ignition is timed to occur before top dead centre (TDC). |
| 28.22.12 | Describe the operation of the ignition switch(es) in the cockpit. |
| 28.22.14 | Outline the correct procedures to be followed during magneto checks. |
| 28.22.16 | Describe the indications of various problems manifested during a magneto check. |
| 28.22.18 | Explain the causes of spark plug fouling and the methods of clearing such fouling. |
| **28.24** | **Ignition Systems – Solid State** |
| 28.24.2 | Describe the components of a typical solid state ignition system. |
| 28.24.4 | Describe the operation of a typical solid state ignition system. |
| 28.24.6 | Explain the purpose for conducting typical solid state ignition integrity checks. |
| 28.24.8 | Explain the procedure for conducting typical solid state ignition integrity checks. |
| 28.24.10 | With reference to a solid state ignition system:<br>(a) explain the significance of maintaining the ignition power supply;<br>(b) describe a typical power supply backup system. |
| **28.26** | **Starter Motors** |
| 28.26.2 | Describe the functioning of the starter motor. |
| 28.26.4 | Describe the operational limitations of the starter motor. |
| 28.26.6 | Explain the correct operation of a typical starter switch. |
| **28.28** | **Engine Performance** |
| 28.28.2 | Explain the meaning of the terms;<br>(a) force;<br>(b) work;<br>(c) power;<br>(d) energy;<br>(e) torque. |
| 28.28.4 | Explain the relationship between horsepower and kilowatts. |
| 28.28.6 | Explain the meaning of:<br>(a) brake power; |

| Sub Topic | Syllabus Item |
|---|---|
| | (b) rated power;<br>(c) rated altitude (critical altitude);<br>(d) full throttle height. |
| 28.28.8 | Explain the meaning of:<br>(a) thermal efficiency;<br>(b) mechanical efficiency;<br>(c) volumetric efficiency. |
| 28.28.10 | Explain the relationship between typical brake power and power available curves. |
| 28.28.12 | Explain the general conditions for the most efficient engine operation. |
| 28.28.14 | Describe the effect of changing altitude on manifold pressure and power output of normally aspirated engines. |
| | **Ancillary Systems** |
| **28.30** | **Electrical Systems - DC** |
| 28.30.2 | Describe the systems which typically require DC power in an aircraft. |
| 28.30.4 | Explain the function(s) of the following in a typical electrical system:<br>(a) the battery;<br>(b) a ground power source;<br>(c) the alternator or generator;<br>(d) bus bars;<br>(e) over voltage protection. |
| 28.30.6 | Given appropriate data, determine the duration of battery operation following a generator failure. |
| 28.30.8 | Describe the relative advantages and disadvantages of:<br>(a) a generator;<br>(b) an alternator. |
| 28.30.10 | Explain the functions and interpretation of:<br>(a) left-zero ammeters;<br>(b) centre-zero ammeters. |
| 28.30.12 | Explain the functions and correct operation of a:<br>(a) single battery master switch;<br>(b) split battery/alternator switch. |
| 28.30.14 | Explain the operation of:<br>(a) fuses;<br>(b) circuit breakers;<br>(c) overload switches. |

| Sub Topic | Syllabus Item |
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| 28.30.16 | Explain operational principles for the handling of the electrical DC system, including:<br>(a) avoiding overheating electrical services if operated during pre-flight;<br>(b) not starting or stopping the engine with unnecessary electrical equipment switched on;<br>(c) avoiding prolonged use of the starter motor;<br>(d) checking satisfactory operation of the alternator/generator after start, and periodically during flight;<br>(e) ensuring the battery master is switched off before vacating the aircraft after flight;<br>(f) use of a ground power unit. |
| 28.30.18 | Explain the identification of:<br>(a) an excessive charge rate;<br>(b) alternator/generator failure;<br>(c) a total electric failure. |
| 28.30.20 | Explain the risks associated with:<br>(a) resetting blown fuse/popped circuit breakers;<br>(b) using fuses as a switch. |
| 28.30.22 | Explain the issues related specifically to 'technically enhanced aircraft' (TEA) during the handling of electrical malfunctions. |
| **28.32** | **Fuel Systems** |
| 28.32.2 | Distinguish between gravity-fed and pump-fed fuel systems. |
| 28.32.4 | For a typical fuel system, explain the function, and where appropriate, the correct handling of the following:<br>(a) fuel strainers and filters;<br>(b) engine-driven fuel pump;<br>(c) boost (auxiliary) pump(s);<br>(d) engine primers and priming systems. |
| **28.34** | **Fuel Tanks** |
| 28.34.2 | For a fuel system, explain the function, and where appropriate, the correct handling of the following:<br>(a) tank filler caps and drains;<br>(b) expansion spaces;<br>(c) tank vents;<br>(d) baffles;<br>(e) sumps and drains;<br>(f) fuel quantity detectors;<br>(g) fuel strainers and filters;<br>(h) tank selector valves; |

| Sub Topic | Syllabus Item |
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| | (i) cross feed valves;<br>(j) fuel flow meters. |
| 28.34.4 | Describe:<br>(a) the general rules for refuelling;<br>(b) the correct use of fuel tank dipsticks;<br>(c) the correct use of magna-sticks. |
| 28.34.6 | Describe the correct procedures to be used for carrying out fuel quality checks. |
| 28.34.8 | Describe the indications of water in a fuel sample. |
| 28.34.10 | Describe the symptoms of a blocked fuel tank vent in a gravity feed fuel system. |
| 28.34.12 | Describe the importance of correct management of fuel selection. |
| 28.34.14 | Detail the actions recommended in the case of loss of power through faulty fuel selection. |
| 28.34.16 | Describe the typical methods of cross-feeding fuel. |
| **28.36** | **Lubrication Systems - Engine** |
| 28.36.2 | Explain the main functions of an engine oil system. |
| 28.36.4 | Describe the effect of temperature on the viscosity and lubrication qualities of oil. |
| 28.36.6 | Compare the features of the ashless dispersant (AD) oils used in piston aero-engines with straight mineral oil and detergent oils. |
| 28.36.8 | With respect to oil grades, differentiate between the commercial aviation numbers and SAE ratings. |
| 28.36.10 | Differentiate between a wet sump and a dry sump oil system. |
| 28.36.12 | Describe the function of:<br>(a) the engine-driven oil pump and pressure relief valve;<br>(b) oil lines, passages and galleries;<br>(c) oil sumps, and scavenge pumps;<br>(d) oil cooler;<br>(e) oil tank and filter. |
| 28.36.14 | Explain the need for periodic oil changes. |
| 28.36.16 | Describe the likely results of operating an engine with:<br>(a) incorrect oil type;<br>(b) incorrect oil quantity. |
| 28.36.18 | Describe the likely causes of:<br>(a) low oil pressure; |

| Sub Topic | Syllabus Item |
|---|---|
| | (b) high oil pressure;<br>(c) high oil temperature. |
| 28.36.20 | Explain the relationship between a fluctuating or low oil pressure reading accompanied by a rise in oil temperature. |
| 28.36.22 | Describe the actions the pilot should take in the low pressure/high temperature situation. |
| **28.38** | **Hydraulic Systems** |
| 28.38.2 | Describe:<br>(a) mechanical advantage;<br>(b) how mechanical advantage can be gained hydraulically;<br>(c) the principle of operation of typical aircraft hydraulic services. |
| 28.38.4 | Explain the advantages of using hydraulics to operate aircraft services. |
| 28.38.6 | Differentiate between the three types of hydraulic oil. |
| 28.38.8 | Describe the function of common hydraulic system components including:<br>(a) reservoirs;<br>(b) pumps;<br>(c) pressure regulators;<br>(d) accumulators;<br>(e) check valves and release valves;<br>(f) selector valves;<br>(g) actuators;<br>(h) filters. |
| 28.38.10 | Describe the operation of the following hydraulic systems:<br>(a) open centre system;<br>(b) pressurised system. |
| 28.38.12 | Describe the operation of a typical aircraft hydraulic system. |
| **28.40** | **Pneumatic Systems** |
| 28.40.2 | Explain the relative:<br>(a) advantages of pneumatic systems over hydraulic systems;<br>(b) disadvantages of pneumatic systems over hydraulic systems. |
| 28.40.4 | Describe the operation of a typical pneumatic system. |
| **28.42** | **Fire Warning Systems** |
| 28.42.2 | Describe the operation of a typical fire detection system. |

| Sub Topic | Syllabus Item |
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| **28.44** | **Fire Protection Systems** |
| 28.44.2 | Explain any precautions to be taken when using the common fire extinguishing agents available. |
| 28.44.4 | Describe typical fire extinguishing systems. |
| 28.44.6 | Explain the associated limitations of typical fire extinguishing systems. |
| **28.46** | **Ice and Rain Protection Systems** |
| 28.46.2 | Distinguish between anti-icing systems and de-icing systems. |
| 28.46.4 | Explain the operation and the proper handling of the following ice protection systems:<br>(a) mechanical;<br>(b) fluid;<br>(c) thermal. |
| 28.46.6 | Describe typical systems for:<br>(a) ice detection;<br>(b) windscreen heating;<br>(c) rain clearance. |
| 28.46.8 | Describe the performance reductions associated with:<br>(a) ice accumulation;<br>(b) operation of anti-ice and de-icing equipment. |
| 28.46.10 | Explain the function and operation of:<br>(a) static discharge wicks;<br>(b) bonding strips. |
| **28.48** | **Reserved** |
| | **Instruments** |
| **28.50** | **Engine Instruments** |
| 28.50.2 | Describe the function and principle of operation of the following instruments:<br>(a) tachometers (centrifugal, drag cup, electrical and electronic types);<br>(b) manifold pressure and boost gauges;<br>(c) oil pressure gauges (direct reading, remote indicating and ratiometer types);<br>(d) fuel pressure gauges;<br>(e) vacuum gauges;<br>(f) cylinder head and exhaust gas temperature gauges (thermocouples);<br>(g) oil temperature gauges;<br>(h) outside air temperature gauges;<br>(i) fuel quantity gauges; |

| Sub Topic | Syllabus Item |
|---|---|
| | (j) fuel flow gauges. |
| 28.50.4 | Explain the principle of operation of a simple AC synchro system. |
| **28.52** | **Pressure Instruments** |
| 28.52.2 | Define:<br>(a) static air pressure;<br>(b) dynamic air pressure;<br>(c) total (pitot) pressure. |
| 28.52.4 | Explain the pressure requirements of the three basic pressure instruments. |
| 28.52.6 | Describe a typical pitot-static system. |
| 28.52.8 | Explain the difference between a single pitot (pressure) head and separate pitot tube and static vent system. |
| 28.52.10 | Explain the function of pitot heat. |
| 28.52.12 | Explain the following errors affecting an ASI:<br>(a) density error (IAS/TAS relationship);<br>(b) position (pressure) error;<br>(c) compressibility error. |
| 28.52.14 | Describe the pre-flight and in-flight serviceability checks for an ASI. |
| 28.52.16 | Explain the principle of operation of an altimeter. |
| 28.52.18 | Explain the meanings of the subscale settings QNH and QFE. |
| 28.52.20 | Explain the effect of pressure setting error on altimeter indication. |
| 28.52.22 | Explain the effect of air mass temperature, at constant QNH, on altimeter indication. |
| 28.52.24 | Explain the following errors affecting an altimeter:<br>(a) instrument error;<br>(b) position error;<br>(c) lag. |
| 28.52.26 | Describe the serviceability checks and the accepted indication tolerances of an altimeter. |
| 28.52.28 | Explain the principle of operation of a vertical speed indicator (VSI). |
| 28.52.30 | Explain the following errors affecting a VSI:<br>(a) position error;<br>(b) lag. |
| 28.52.32 | Explain the serviceability checks for a VSI. |

| Sub Topic | Syllabus Item |
|---|---|
| 28.52.34 | With regard to blockages and leaks in the pitot-static system of the various pressure instruments, explain the:<br>(d) instrument symptoms;<br>(e) indication errors;<br>(f) possible remedies available. |
| 28.52.36 | Explain the function and operation of the alternate static system. |
| **28.54** | **Magnetic Instruments** |
| 28.54.2 | Describe the features of the earth's magnetic field (flux). |
| 28.54.4 | Explain magnetic variation. |
| 28.54.6 | Describe the angle of dip and components H and Z of the earth's magnetic flux. |
| 28.54.8 | Describe the basic features of a typical aircraft direct-reading magnetic compass. |
| 28.54.10 | Explain the reason(s) for:<br>(a) pendulous suspension of the magnet system;<br>(b) immersing the magnet system in fluid. |
| 28.54.12 | With reference to a direct-reading compass, describe:<br>(a) acceleration errors;<br>(b) turning errors;<br>(c) the practical aspects of these errors. |
| 28.54.14 | Explain magnetic deviation and how it is compensated for in a direct-reading compass. |
| 28.54.16 | Given a typical deviation card, apply corrections for residual deviation. |
| 28.54.18 | Explain the serviceability checks for a direct-reading compass. |
| 28.54.20 | Explain what a compass swing is and the occasions on which it is required. |
| 28.54.22 | Outline the service limits and tolerances for a direct-reading compass. |
| **28.56** | **Gyroscopic Instruments** |
| 28.56.2 | Describe a typical aircraft vacuum (suction system). |
| 28.56.4 | Distinguish between suction pump, venturi, and positive pressure systems. |
| 28.56.6 | Describe the inherent properties of a spinning gyroscope rotor. |
| 28.56.8 | Explain what is meant by the term gimbal. |
| 28.56.10 | List the types of gyroscope. |
| 28.56.12 | Explain the principle of operation of a turn indicator. |

| Sub Topic | Syllabus Item |
|---|---|
| 28.56.14 | Distinguish between a turn indicator (TI) and a turn co-ordinator (TC). |
| 28.56.16 | Describe the errors which a turn indicator is subject to. |
| 28.56.18 | Explain the principle of operation of the balance ball. |
| 28.56.20 | Interpret various TI and TC indications. |
| 28.56.22 | Explain the serviceability checks for the TI/TC. |
| 28.56.24 | Explain the principle of operation of a direction indicator/heading indicator (DI/HI). |
| 28.56.26 | Explain the following errors which the DI/HI is subject to;<br>(a) gimbal error;<br>(b) real drift (or real wander);<br>(c) apparent drift (or apparent wander);<br>(d) low rotor speed. |
| 28.56.28 | Describe the characteristics of a toppled directional gyro (DI/HI). |
| 28.56.30 | Explain the DI/HI typical:<br>(a) operating limitations;<br>(b) serviceability checks. |
| 28.56.32 | Explain the advantages of an electrically-driven DI/HI versus an air-driven instrument. |
| 28.56.34 | Explain the principle of operation of an artificial horizon/attitude indicator (AH/AI). |
| 28.56.36 | Describe the effect on an air-driven AH/AI, including the errors in indication arising from a:<br>(a) straight-line acceleration;<br>(b) turn. |
| 28.56.38 | Explain the general operating limitations of an:<br>(a) air-driven AH/AI;<br>(b) electrically-driven AH/AI. |
| 28.56.40 | Distinguish between the indications of the TC and AH/AI under various conditions. |
| **28.58** | **GNSS Systems** |
| 28.58.2 | Describe the principle of a Global Navigation Satellite System (GNSS). |
| 28.58.4 | Explain the limitations of the Global Navigation Satellite System (GNSS). |
| 28.58.6 | Explain the term RAIM prediction and the significance of these predictions. |

| Sub Topic | Syllabus Item |
|---|---|
| 28.58.8 | Explain the term RNP and the significance of the RNP value. |
| **28.60** | **TCAS Systems** |
| 28.60.2 | Describe the function and operation of a typical TCAS system. |
| **28.62** | **GPWS Systems** |
| 28.62.2 | Describe the function and operation of a typical GPWS system. |
| **28.64** | **"EFIS" Instrument Displays** |
| 28.64.2 | Describe the components and operation of a typical EFIS cockpit display system. |
| 28.64.4 | Describe the function of the:<br>(a) air data computer;<br>(b) signal generator;<br>(c) input data sources to a basic glass flight display system. |
| 28.64.6 | Describe the components and operation of an Attitude Heading Reference System (AHRS). |
| 28.64.8 | Describe the management of EFIS system failures. |
| | **Section 2 Helicopter Technical Knowledge** |
| | **Helicopter Structure and Systems** |
| **28.66** | **Cooling Systems - Engines** |
| 28.66.2 | Explain the reasons why excessively high engine temperatures must be avoided. |
| 28.66.4 | Explain the most common means of engine cooling in helicopters fitted with piston engines. |
| 28.66.6 | For an air-cooled engine, explain the function of:<br>(a) cowling ducts and baffles;<br>(b) cooling fins. |
| 28.66.8 | Explain the method of reducing CHT in a piston engine helicopter. |
| **28.68** | **Landing Gear - Fixed** |
| 28.68.2 | Explain the requirements which the undercarriage/landing skid system must be able to meet. |
| 28.68.4 | Describe the features of a simple light helicopter undercarriage/landing skid construction. |
| 28.68.6 | Explain the procedure for tie down (or picketing) of a light helicopter. |

| Sub Topic | Syllabus Item |
|---|---|
| **28.70** | **Landing Gear - Retractable** |
| 28.70.2 | Describe the main components of retractable landing gear. |
| 28.70.4 | Describe the principle of operation of a typical retractable landing gear. |
| 28.70.6 | Describe the protection device to avoid gear retraction on ground. |
| **28.72** | **Reserved** |
| **28.74** | **Airframe Structure** |
| 28.74.2 | Explain the effects of the application of a load to an airframe structure (stress and strain). |
| 28.74.4 | Differentiate between bending, tensile, compression, torsional and shear loads. |
| **28.76** | **Reserved** |
| **28.78** | **Transmission Systems** |
| 28.78.2 | Explain the purpose of a freewheeling unit. |
| 28.78.4 | Explain the purpose of a swash plate assembly. |
| 28.78.6 | Explain the purpose of a centrifugal clutch in a helicopter transmission system. |
| 28.78.8 | Explain the purpose of a rotor brake. |
| 28.78.10 | Explain the purpose of the main rotor gear box. |
| 28.78.12 | Describe the:<br>(a) purpose of the swash plate (control unit);<br>(b) principle of operation of the swash plate. |
| 28.78.14 | Explain the most common method of cooling main transmissions. |
| 28.78.16 | Explain the:<br>(a) procedures for the laboratory analysis of transmission oil samples;<br>(b) reasons for the laboratory analysis of transmission oil samples. |
| 28.78.18 | Describe the:<br>(a) causes of high frequency vibrations;<br>(b) symptoms of high frequency vibrations. |
| 28.78.20 | Describe the:<br>(a) purpose of the transmission/engine chip detector warning system;<br>(b) principle of operation of the transmission/engine chip detector warning system. |
| 28.78.22 | Explain the function of a dual purpose tachometer in a helicopter. |

| Sub Topic | Syllabus Item |
|---|---|
| **28.80** | **Main Rotor Systems** |
| 28.80.2 | Describe the construction of modern helicopter rotor blades. |
| 28.80.4 | Describe the design features of:<br>(a) rigid rotor systems;<br>(b) semi-rigid rotor systems;<br>(c) fully articulated rotor systems. |
| 28.80.6 | Explain the causes of dragging in a fully articulated rotor system. |
| 28.80.8 | Explain the function of the blade damper in fully articulated rotor systems. |
| 28.80.10 | Explain the reason a semi-rigid (two-bladed) rotor system is frequently under-slung. |
| 28.80.12 | Explain the design feature (advance angle) which compensates for phase lag. |
| 28.80.14 | Explain the reason for rigging the rotor mast away from the helicopter vertical axis. |
| 28.80.16 | Describe the methods of chordwise and spanwise balancing. |
| 28.80.18 | Explain the reason for sweepback design near main rotor blade tips. |
| 28.80.20 | Explain the reason for washout in the design of main rotor blades. |
| 28.80.22 | Explain the advantages of employing a delta-three hinge in a fully articulated rotor system. |
| 28.80.24 | Explain the purpose of employing an offset pitch horn in a rotor system. |
| 28.80.26 | Explain the normal methods of trimming controls in a helicopter. |
| 28.80.28 | Describe the various methods of rotor stabilisation. |
| 28.80.30 | Describe the susceptibility of the various rotor systems to ground resonance. |
| 28.80.32 | Describe the susceptibility of the various rotor systems to mast bumping. |
| 28.80.34 | Describe the various types of vibration which may occur in a helicopter, their causes and possible remedies. |
| 28.80.36 | Describe the design feature employed to reduce vibration in semi-rigid rotor systems. |
| **28.82** | **Tail Rotor Systems** |
| 28.82.2 | Describe the construction of modern tail rotors and their hubs. |
| 28.82.4 | Explain the purpose of a strike tab on the tail rotor blades. |
| 28.82.6 | Describe the: |

| Sub Topic | Syllabus Item |
|---|---|
| | (a) advantages associated with conventional exposed tail rotors.<br>(b) disadvantages associated with conventional exposed tail rotors. |
| 28.82.8 | Explain the:<br>(a) advantages associated with shrouded (Fenestron) tail rotors.<br>(b) disadvantages associated with shrouded tail rotors. |
| 28.82.10 | Explain the reason asymmetric aerofoils tend to be employed on tail rotors and not on main rotors. |
| 28.82.12 | Describe alternate methods of anti-torque control. |
| 28.82.14 | Describe the design features which can be employed to reduce tail rotor roll. |
| **28.84** | **Control Systems** |
| 28.84.2 | Describe the:<br>(a) purpose of the collective control;<br>(b) principle of the operation of the collective control. |
| 28.84.4 | Describe the purpose of a throttle cam-linkage (correlating unit). |
| 28.84.6 | Describe the purpose of the twist grip throttle. |
| 28.84.8 | Describe the:<br>(a) purpose of the cyclic control;<br>(b) principle of operation of the cyclic control. |
| 28.84.10 | Describe the:<br>(a) purpose of the tail rotor pedal controls;<br>(b) principle of operation of the tail rotor pedal controls. |
| 28.84.12 | Explain the requirement for a dual purpose tachometer in a helicopter. |
| 28.84.14 | Describe the indications on the engine/rotor tachometer during an autorotation:<br>(a) with the engine running;<br>(b) without the engine running. |
| **28.86** | **Reserved** |
| **28.88** | **Reserved** |
| | **Weight and Balance** |
| **28.90** | **Definitions, Terminology and Abbreviations** |
| 28.90.2 | Explain the meaning of the following terms:<br>(a) arm (moment arm);<br>(b) datum;<br>(c) moment (including units used); |

| Sub Topic | Syllabus Item |
|---|---|
| | (d) centre of gravity (C of G);<br>(e) longitudinal C of G range and limits;<br>(f) lateral centre of gravity range and limits;<br>(g) station;<br>(h) index units;<br>(i) basic empty weight (empty aircraft weight);<br>(j) empty weight centre of gravity position;<br>(k) basic operating weight (aircraft prepared for service weight);<br>(l) payload (commercial load);<br>(m) zero fuel weight (ZFW);<br>(n) ramp weight;<br>(o) gross weight (AUW);<br>(p) take-off weight;<br>(q) maximum certificated take-off weight (MCTOW);<br>(r) landing weight;<br>(s) maximum certificated landing weight (MCLW);<br>(t) centre of gravity envelope;<br>(u) the specific gravity and the weight of fuel of AVGAS or Jet A-1. |
| **28.92** | **Reserved** |
| **28.94** | **Weight** |
| 28.94.2 | Given the appropriate conversion data:<br>(a) calculate the weight of a given volume of fuel;<br>(b) convert between US gallons and litres;<br>(c) convert between pounds and kilograms. |
| 28.94.4 | Explain the effect of operating a helicopter outside of its weight limits. |
| 28.94.6 | From appropriate loading data/graphs for a typical light helicopter:<br>(a) calculate the take-off weight;<br>(b) calculate the landing weight;<br>(c) calculate the landing weight for a limited take-off weight flight;<br>(d) given a maximum take-off weight, calculate the payload available;<br>(e) given a maximum zero fuel weight, calculate the payload available;<br>(f) calculate the allowable load in various compartments. |
| **28.96** | **Centre of Gravity** |
| 28.96.2 | Explain the principles of helicopter balance. |
| 28.96.4 | Explain the effect of operating a helicopter outside of the centre of gravity limits. |
| 28.96.6 | Given loading data/graphs for a typical light helicopter:<br>(a) calculate the longitudinal centre of gravity position; |

| Sub Topic | Syllabus Item |
|---|---|
| | (b) calculate the lateral centre of gravity position;<br>(c) plot the longitudinal and lateral centre of gravity positions on a graph showing the centre of gravity limits. |
| 28.96.8 | Explain the likely effect of a displaced lateral centre of gravity on the position of the cyclic control. |
| 28.96.10 | Explain the effect of external loads on the centre of gravity position. |
| 28.96.12 | Solve the following loading problems:<br>(a) find a revised centre of gravity position after loading or offloading weight;<br>(b) loading or offloading weight to place the longitudinal centre of gravity at a given station;<br>(c) loading or offloading weight at a given station without exceeding the centre of gravity limits;<br>(d) moving weight from one station to another and finding the new centre of gravity position. |
| 28.96.14 | Explain the likely effect of fuel burn on the centre of gravity position. |

## General Aircraft Technical Knowledge – Glider

**Airframes:** Types of wing and fuselage construction, control surfaces, ailerons, elevators, rudder, flaps, spoilers, air brakes, dragchutes, trimming devices, procedures for assembly and disassembly of wings and fuselage including the installation of wings, tail surfaces and flying control systems specifically designed for quick removal and installation by pilots, mass and aerodynamic balancing of controls, pre-flight inspection procedures, ballast, airframe limitations, interpretation of a typical flight envelope diagram.

**Weight and balance:** Centre of gravity, limits, effects of loading on position.

**Instruments:** Principles, use, errors and operating limitations of altimeter, airspeed indicator, variometer, total energy variometer, turn co-ordinator, turn and slip indicator, magnetic compass, artificial horizon and barograph.

**Ancillary equipment:** Operation and use of oxygen breathing equipment, use and limitations of cable and wire tow ropes, parachutes, characteristics of VHF radio communications.

**Pilot maintenance:** Abilities and restrictions in accordance with Part 43.

## Balloon Technical Knowledge and Aerostatics

**Terminology:** True, pressure and density altitude, air temperature, buoyant lift, burner and pilot light, car lines, crew chief, crown, crown line, dump valve, envelope and deflation systems, false lift, handling line, hands off, heavy, international standard atmosphere, light, load ring, burner frame, mouth, QNH, QNE, QFE, rigging lines and flying wires, rip line, rip panel, skirt, tie-off thread, weighing off.

**Conversion of units:** Between pounds & kilograms, pounds-inches & kilogram-metres, Fahrenheit & Celsius, litres, imperial gallons & pints, true, pressure & density altitude.

**Envelope:** Construction, types of design, materials used, strength, and ancillaries. Temperature limitations and effects of heat on envelope life. Heat indicator systems.

**Burner and fuel system:** Description of burner unit, layout of fuel system, properties of fuel used.

**Basket:** Construction and contents, methods of attachment.

**Rigging and mooring:** Including the installation of baskets and burners specifically designed for quick removal or installation by a pilot; and the interchange of baskets and burners, when designated as interchangeable in the type certificate.

**Flying procedures:** Site selection, launch and landing, weather limitations to operations, pre-flight, laying-out and inspection, the ripping panel, inflation methods and precautions, take-off techniques employed, control in flight, landing techniques, emergency procedures.

**Weight calculations:** Loading chart use, winter and summer operating conditions, use of Langford's formula.

**General maintenance:** Fabric patches, load bearing tapes, wire ropes, burner, fuel system, and piping, pressure gauge, regulator, on-off valve, self-sealing couplings, steel and aluminium fuel cylinders.

**Instruments:** Construction, operating principles, and limitations of altimeters, thermometers and variometers.

**General limitations:** Weather, fuel, permitted damage before the operation is unsafe, safety equipment including fire precautions and personal survival, instruments, loading and rates of climb, attachments to the envelope and basket, hazards.

**Pilot maintenance:** Abilities and restrictions in accordance with Part 43.

## Human Factors Matrix

| | | Topic No. | PPL | CPL | ATPL |
|---|---|---|---|---|---|
| | | | 10 | 34 | 46 |
| **Human Factors - General** | Airmanship and Responsibility | 2 | √ | √ | √ |
| | Human Factors Models and Programmes | 4 | √ | √ | √ |
| | | | | | |
| **Physiology and the Effects of Flight** | The Atmosphere | 6 | √ | √ | √ |
| | Circulation and Respiratory Systems | 8 | √ | √ | √ |
| | Hypoxia | 10 | √ | √ | √ |
| | Hyperventilation | 12 | √ | √ | √ |
| | Entrapped Gases | 14 | √ | √ | √ |
| | Decompression Sickness | 16 | √ | √ | √ |
| | Vision and Visual Perception | 18 | √ | √ | √ |
| | Hearing and Balance | 20 | √ | √ | √ |
| | Spatial Orientation | 22 | √ | √ | |
| | Gravitational Forces | 24 | √ | √ | |
| | Motion Sickness | 26 | √ | √ | |
| | Flight Anxiety | 28 | √ | √ | |
| **Flying and Health** | | | | | |
| | Fitness to Fly | 30 | √ | √ | √ |
| | Alcohol and Drugs | 32 | √ | √ | √ |
| | Blood Donation | 34 | √ | √ | |
| | Environmental Hazards | 36 | √ | √ | √ |
| | Stress Management | 38 | √ | √ | √ |
| | Sleep and Fatigue | 40 | √ | √ | √ |
| | Ageing | 42 | √ | √ | √ |
| | | | | | |

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|---|---|---|---|---|---|
| **Aviation Psychology** | Information Processing | 44 | √ | √ | √ |
| | Situational Awareness | 46 | √ | √ | √ |
| | Judgement and Decision Making | 48 | √ | √ | √ |
| | Social Psychology and Flight Deck Management | 50 | √ | √ | √ |
| | Threat and Error Management | 52 | √ | √ | √ |
| | Culture | 54 | √ | √ | √ |
| | | | | | |
| **Ergonomics** | Flight Deck Design | 56 | | √ | √ |
| | Design of Controls | 58 | | √ | √ |
| | Instrumentation, Displays and Alerts | 60 | √ | √ | √ |
| | Documents and Procedures | 62 | √ | √ | √ |
| | | | | | |
| **First Aid and Survival** | First Aid | 64 | √ | √ | |
| | Survival | 66 | √ | √ | |

## Subject No. 34 Human Factors

***Note:*** *This syllabus is based on flight operations requiring a CPL.*

This syllabus presupposes knowledge already attained at PPL level.

Each subject has been given a subject number and each topic within that subject a topic number. These reference numbers will be used on knowledge deficiency reports and will provide valuable feedback to the examination candidate.

| Sub Topic | Syllabus Item |
|---|---|
| | **Human Factors - General** |
| **34.2** | **Airmanship, Professionalism and Responsibility** |
| 34.2.2 | Define professionalism in aviation. |
| 34.2.4 | Distinguish between piloting for personal reasons and for hire or reward. |
| 34.2.6 | List the people to whom a pilot is responsible in carrying out his or her duties. |
| 34.2.8 | Describe key features of good and safe airmanship. |
| **34.4** | **Human Factors Models and Programmes** |
| 34.4.2 | Define human factors as used in a professional aviation context. |
| 34.4.4 | Describe the fundamentals of the SHELL Model in relation to the interaction of humans with other humans, hardware, information sources, and the environment. |
| 34.4.6 | Explain the role of human factors programmes in promoting aviation safety in flight operations requiring a commercial pilot licence. |
| 34.4.8 | Describe the importance of an effective human factors programme in operations requiring a commercial pilot licence. |
| | **Physiology and the Effects of Flight** |
| **34.6** | **The Atmosphere** |
| 34.6.2 | State the percentage of the two main gases in the atmosphere. |
| 34.6.4 | Describe the variation of pressure as altitude increases. |
| 34.6.6 | Explain how the partial pressure of oxygen changes as altitude increases. |
| **34.8** | **Circulation and Respiratory Systems** |
| 34.8.2 | Describe the basic anatomy of the respiratory system. |
| 34.8.4 | Describe the physiology of the respiratory system. |
| 34.8.6 | Describe the basic anatomy of the circulatory system. |
| 34.8.8 | Describe the physiology of the circulatory system. |
| 34.8.10 | Describe the role of the lungs in oxygen and carbon dioxide transfer. |
| **34.10** | **Hypoxia** |
| 34.10.2 | State the partial pressure of oxygen both inside and outside the lungs at sea level. |

| Sub Topic | Syllabus Item |
|---|---|
| 34.10.4 | Explain the mechanical effect of the partial pressure of oxygen on oxygen transfer in the lungs. |
| 34.10.6 | Explain the causes of hypoxia. |
| 34.10.8 | Describe the primary physiological and behavioural consequences of hypoxia for flight crew and passengers. |
| 34.10.10 | Describe the common symptoms of hypoxia. |
| 34.10.12 | Explain the reasons hypoxia symptoms are difficult to detect. |
| 34.10.14 | Explain the relationship between hypoxic onset and both vision and cognitive performance. |
| 34.10.16 | Describe how hypoxia can be prevented. |
| 34.10.18 | List the main factors influencing variation in hypoxia onset (tolerance) between individuals. |
| 34.10.20 | State the factors that affect the likelihood of suffering from hypoxia. |
| 34.10.22 | Describe how hypoxia can be treated. |
| 34.10.24 | Define the concept of ‘time of useful consciousness’. |
| 34.10.26 | State the approximate time of useful consciousness at:<br>(a) 18,000ft;<br>(b) 25,000ft;<br>(c) 35,000ft. |
| 34.10.28 | Explain oxygen paradox. |
| **34.12** | **Hyperventilation** |
| 34.12.2 | Explain the causes of hyperventilation. |
| 34.12.4 | Describe the symptoms of hyperventilation. |
| 34.12.6 | Describe how hyperventilation can be treated. |
| 34.12.8 | Describe the differences between hyperventilation and hypoxia. |
| **34.14** | **Entrapped Gasses** |
| 34.14.2 | Explain the causes of barotrauma. |
| 34.14.4 | Describe the symptoms of barotrauma. |
| 34.14.6 | Describe the effects of barotrauma on the various parts of the body. |
| 34.14.8 | Describe how barotrauma can be prevented. |
| 34.14.10 | Describe how barotrauma can be treated. |
| **34.16** | **Decompression Sickness** |
| 34.16.2 | Explain the causes of decompression sickness. |
| 34.16.4 | Describe the symptoms of decompression sickness. |
| 34.16.6 | Explain how decompression sickness can be prevented. |

| Sub Topic | Syllabus Item |
|---|---|
| 34.16.8 | Describe how decompression sickness can be treated. |
| 34.16.10 | Explain the effects of an explosive decompression on the body. |
| 34.16.12 | Explain the actions that must be taken to deal with an explosive decompression. |
| 34.16.14 | Explain the dangers of flying after diving. |
| 34.16.16 | State the approximate required times between diving at various depths and flying. |
| **34.18** | **Vision and Visual Perception** |
| 34.18.2 | Distinguish between rod and cone cell functions and distribution in the retina. |
| 34.18.4 | Describe the limitations of the eye in terms of:<br>(a) the ability to discern objects at night<br>(b) the ability to discern objects in daylight, including wires and other aircraft<br>(c) poor lighting<br>(d) glare<br>(e) lack of contrast<br>(f) the blind spot<br>(g) colour perception. |
| 34.18.6 | Explain the process of dark adaptation. |
| 34.18.8 | State the normal time for full night vision adaptation. |
| 34.18.10 | Identify precautionary actions to protect night vision adaptation. |
| 34.18.12 | Describe methods of cockpit/flight deck lighting and problems associated with each. |
| 34.18.14 | Describe the requirements for using corrective lenses. |
| 34.18.16 | Describe the factors associated with the selection of suitable sunglasses for flying. |
| 34.18.18 | Describe the visual system resting state focus and its effects on object detection. |
| 34.18.20 | Explain effective visual search techniques. |
| 34.18.22 | Explain the see and avoid method of avoiding mid-air collisions. |
| 34.18.24 | Explain the following visual illusions:<br>(a) autokinesis<br>(b) stroboscopic illumination illusion/flicker vertigo<br>(c) the break-off phenomenon<br>(d) sector whiteout |

| Sub Topic | Syllabus Item |
|---|---|
| | (e) the black hole phenomenon. |
| 34.18.26 | Describe the methods of avoiding and/or coping with: |
| | (a) autokinesis |
| | (b) stroboscopic illumination illusion/flicker vertigo |
| | (c) the break-off phenomenon |
| | (d) sector whiteout |
| | (e) the black hole phenomenon. |
| 34.18.28 | Describe conditions which can lead to the creation of a false horizon. |
| 34.18.30 | Explain the effect of a false horizon on visual perception. |
| 34.18.32 | Explain relative motion. |
| 34.18.34 | Explain the effect of fog, haze, and/or dust on visual perception. |
| 34.18.36 | Describe the optical characteristics of the windshield. |
| 34.18.38 | Explain the effect of rain on the windshield. |
| 34.18.40 | Explain the effect of sloping terrain on visual perception. |
| 34.18.42 | Explain the effect of the following factors on visual perception during the following approach situations: |
| | (a) steep/shallow approach angles |
| | (b) length, width and texture of the runway |
| | (c) the intensity of the approach lights. |
| **34.20** | **Hearing and Balance** |
| 34.20.2 | Describe the basic anatomy of the ear. |
| 34.20.4 | Describe the physiology of the ear. |
| 34.20.6 | Describe the effect of prolonged noise exposure on hearing. |
| 34.20.8 | Describe methods of protecting hearing. |
| 34.20.10 | Specify the various levels of noise in decibels at which various grades of hearing protection are required. |
| 34.20.12 | Specify noise levels at which hearing damage may occur. |
| 34.20.14 | Describe what is meant by the action threshold for hearing protection. |
| 34.20.16 | Explain the effects of age induced hearing loss (presbycusis). |
| 34.20.18 | Explain the effects of pressure changes on the middle ear and eustachian tubes. |
| 34.20.20 | Explain the effects of colds; hay fever; and/or allergies on the sinuses and eustachian tubes. |
| **34.22** | **Spatial Orientation** |
| 34.22.2 | Define spatial orientation. |

| Sub Topic | Syllabus Item |
|---|---|
| 34.22.4 | Define disorientation. |
| 34.22.6 | Outline the basic anatomy of the motion, orientation and gravitational sensory organs, including:<br>(a) the semi-circular canals<br>(b) vestibular sac/tubes. |
| 34.22.8 | Outline the physiology of the motion, orientation and gravitational sensory organs, including:<br>(a) the semi-circular canals<br>(b) vestibular sac/tubes. |
| 34.22.10 | Explain the interconnection between the visual and kinaesthetic senses in maintaining accurate spatial orientation. |
| 34.22.12 | Explain the body's limitations in maintaining spatial orientation when vision is adversely affected. |
| 34.22.14 | Explain the effects of the following spatial illusions:<br>(a) the leans and sub-threshold stimulation<br>(b) somatogravic illusion<br>(c) somatogyral illusion<br>(d) cross coupled turning (Coriolis effect)<br>(e) pressure vertigo. |
| 34.22.16 | Describe the factors which affect an individual's susceptibility to disorientation. |
| 34.22.18 | Explain how disorientation can be prevented. |
| **34.24** | **Gravitational Forces** |
| 34.24.2 | Explain the effects of positive and negative accelerations on:<br>(a) the circulatory system<br>(b) vision<br>(c) consciousness. |
| 34.24.4 | Explain the causes and symptoms of:<br>(a) black-out<br>(b) red-out<br>(c) G-LOC (gravity induced loss of consciousness). |
| **34.26** | **Motion Sickness** |
| 34.26.2 | Explain the causes of motion sickness. |
| 34.26.4 | Describe how motion sickness can be prevented. |
| 34.26.6 | Describe how motion sickness can be treated. |

| Sub Topic | Syllabus Item |
|---|---|
| **34.28** | **Flight Anxiety** |
| 34.28.2 | Explain the causes of flight anxiety. |
| 34.28.4 | Recognise the signs of flight anxiety in passengers. |
| 34.28.6 | Describe how flight anxiety can be prevented. |
| 34.28.8 | Describe how flight anxiety can be treated. |
| | **Flying and Health** |
| **34.30** | **Fitness to Fly** |
| 34.30.2 | Describe the term fitness to fly. |
| 34.30.4 | Explain the responsibilities of pilots towards medical fitness for flight. |
| 34.30.6 | Identify symptoms and circumstances that would lead you to consult your aviation medical examiner prior to further flight. |
| 34.30.8 | Describe the IMSAFE method of assessing fitness for flight. |
| 34.30.10 | Describe the problems associated with pregnancy and flying. |
| 34.30.12 | State when a pregnant pilot must stop flying. |
| 34.30.14 | With regard to the following factors, describe their effects on pilot performance and methods by which they may be minimised/managed:<br>(a) arterial disease<br>(b) blood pressure<br>(c) diet<br>(d) exercise<br>(e) obesity<br>(f) smoking<br>(g) respiratory tract infection/allergies (including colds, sinus, hay fever, influenza, asthma)<br>(h) food poisoning and gastroenteritis<br>(i) neurological factors (including fits/epilepsy, brain injury, fainting, headaches, migraines)<br>(j) emotional factors (including depression and anxiety)<br>(k) physical injuries<br>(l) dehydration<br>(m)hypoglycaemia. |
| 34.30.16 | Describe the symptoms of gastrointestinal problems. |
| 34.30.18 | Identify the primary causes of food poisoning. |
| **34.32** | **Alcohol and Drugs** |
| 34.32.2 | Explain the effects of alcohol on pilot performance. |

| Sub Topic | Syllabus Item |
|---|---|
| 34.32.4 | Explain the restriction associated with the consumption of alcohol and flying. |
| 34.32.6 | Describe how individuals differ in the effect of alcohol consumption. |
| 34.32.8 | Explain the effects of drugs on pilot performance. |
| 34.32.10 | Describe considerations associated with the taking of over the counter medication and flying. |
| 34.32.12 | Explain why illegal/recreational drugs are unacceptable for pilots. |
| **34.34** | **Blood Donation** |
| 34.34.2 | Describe the effect on the body of donating blood. |
| 34.34.4 | State the recommended time period between donating blood and flying. |
| **34.36** | **Environmental Hazards** |
| 34.36.2 | Describe the symptoms, effects and immediate treatments for the following hazards present in the aviation environment:<br>(a) carbon monoxide<br>(b) fuel<br>(c) chemical sprays<br>(d) lubricating oils<br>(e) hydraulic fluids<br>(f) compressed gases<br>(g) liquid oxygen<br>(h) de-icing fluids<br>(i) fire extinguishing agents<br>(j) fire accelerant substances. |
| 34.36.4 | State the source of carbon monoxide poisoning in general aviation aircraft. |
| 34.36.6 | Describe reliable methods for the detection of carbon monoxide. |
| 34.36.8 | Describe methods of eliminating carbon monoxide from the cockpit. |
| 34.36.10 | Identify the negative effects of vibration and resonance. |
| 34.36.12 | Outline ways that vibration can be controlled. |
| **34.38** | **Stress Management** |
| 34.38.2 | Describe a simple model of stress. |
| 34.38.4 | Explain the relationship between stress and arousal. |
| 34.38.6 | Identify and give examples of physical, environmental, task-related, organisational and psychological stressors. |
| 34.38.8 | Describe how the following environmental stressors affect pilot performance: |

| Sub Topic | Syllabus Item |
|---|---|
| | (a) heat |
| | (b) cold |
| | (c) noise |
| | (d) vibration |
| | (e) humidity. |
| 34.38.10 | Explain methods of identifying stress. |
| 34.38.12 | Explain the difference between acute and chronic stress. |
| 34.38.14 | Describe the physiological effects of stress. |
| 34.38.16 | Describe the psychological effects of stress. |
| 34.38.18 | Describe the effects of stress on attention, motivation and performance. |
| 34.38.20 | Describe the factors that improve personal stress tolerance. |
| 34.38.22 | Describe the relationship between stress and fatigue. |
| 34.38.24 | Explain methods of managing stress. |
| **34.40** | **Sleep and Fatigue (Alertness management)** |
| 34.40.2 | Describe the stages of sleep. |
| 34.40.4 | Describe the mechanism of sleep regulation. |
| 34.40.6 | Describe problems associated with sleep at abnormal times of the day. |
| 34.40.8 | Explain what is meant by sleep debt. |
| 34.40.10 | Explain how individuals differ in their requirement for sleep. |
| 34.40.12 | Explain the effects of the following alertness management techniques: |
| | (a) napping |
| | (b) caffeine consumption |
| | (c) taking sedatives |
| | (d) taking stimulants other than caffeine. |
| 34.40.14 | Describe sleep disorders and their effects on pilot performance. |
| 34.40.16 | Explain the causes of fatigue and its effect on pilot performance. |
| 34.40.18 | Describe the symptoms of fatigue. |
| 34.40.20 | Explain the difference between acute and chronic fatigue. |
| 34.40.22 | Describe methods of managing fatigue. |
| 34.40.24 | Define the following terms: |
| | (a) biological clock |
| | (b) circadian rhythm |
| | (c) circadian dysrhythmia |
| | (d) desynchronisation |

| Sub Topic | Syllabus Item |
|---|---|
| | (e) zeitgeber. |
| 34.40.26 | Describe the central human physiological processes underlying circadian rhythm processes. |
| 34.40.28 | Explain how circadian rhythms affect pilot performance. |
| 34.40.30 | Explain the effects of circadian dysrhythmia and methods of managing these. |
| 34.40.32 | Describe the impact of shiftwork on a pilot's performance. |
| 34.40.34 | Describe how the biological effects of shiftwork can be minimised. |
| 34.40.36 | Identify the principles of good rostering practice. |
| **34.42** | **Ageing** |
| 34.42.2 | Describe methods by which age-related changes in memory and speed of information processing can be moderated by older pilots. |
| 34.42.4 | Describe what changes would indicate early dementia or age related cognitive impairment in another pilot. |
| | **Aviation Psychology** |
| **34.44** | **Information Processing** |
| 34.44.2 | Identify the human sensors pilots depend on for information acquisition. |
| 34.44.4 | Describe the brain's role in registering sensations, processing sensory information, storing information and controlling actions. |
| 34.44.6 | Describe a basic model of information processing, including the concepts of:<br>(a) attention<br>(b) divided attention<br>(c) selective attention<br>(d) attention getting stimulus<br>(e) sensory threshold<br>(f) sensitivity<br>(g) adaptation<br>(h) habitation. |
| 34.44.8 | Describe the following types of memory:<br>(a) peripheral/sensory memory<br>(b) short term/working memory<br>(c) long term memory<br>(d) motor/skills memory<br>(e) semantic memory |

| Sub Topic | Syllabus Item |
|---|---|
| | (f) episodic memory. |
| 34.44.10 | Describe the limitations of memory. |
| 34.44.12 | Explain the following methods of retaining and retrieving information from memory:<br>(a) chunking<br>(b) mnemonics<br>(c) associations (verbal and visual)<br>(d) checklists<br>(e) aide memoirs. |
| 34.44.14 | Explain the concept of mental workload. |
| 34.44.16 | Explain the concept of overload. |
| 34.44.18 | Describe methods of managing potential overload. |
| 34.44.20 | Describe and compare skill, rule and knowledge based behaviours. |
| 34.44.22 | Describe the process of acquiring a skill. |
| 34.44.24 | Describe failures of skill, rule and knowledge based behaviours. |
| 34.44.26 | Explain confirmation bias. |
| 34.44.28 | Describe the effect of the following on perception:<br>(a) expectation<br>(b) experience. |
| 34.44.30 | Describe the formation of mental models. |
| 34.44.32 | Describe the special perceptual problems associated with:<br>(a) snow operations<br>(b) water operations<br>(c) agricultural and low flying operations. |
| **34.46** | **Situational Awareness** |
| 34.46.2 | Describe strategies to maintain and enhance situational awareness. |
| 34.46.4 | Explain the relationship between crew resource management (CRM) and the building of situational awareness amongst flight-crew. |
| **34.48** | **Judgement and Decision Making** |
| 34.48.2 | Distinguish between skills, knowledge and attitudes. |
| 34.48.4 | Describe methods of countering the hazardous attitudes. |
| 34.48.6 | Describe the error/poor judgement chain. |
| 34.48.8 | Explain clues or red flags that can assist in identifying the error/poor judgement chain. |
| 34.48.10 | Identify risk assessment techniques. |

| Sub Topic | Syllabus Item |
|---|---|
| 34.48.12 | Identify risk levels that compromise safety. |
| 34.48.14 | Outline the general concepts behind decision making. |
| 34.48.16 | Describe methods of enhancing decision making skills. |
| 34.48.18 | Explain the application of decision-making models used in aviation including:<br>(a) DECIDE<br>(b) SADIE<br>(c) FDODAR. |
| 34.48.20 | Identify specific factors that influence the decision making process. |
| 34.48.22 | Explain the setting of personal limitations and decision points. |
| 34.48.24 | Outline the dangers of get-home-itis. |
| 34.48.26 | Identify situations where time pressure compromises safety or increases risk levels. |
| **34.50** | **Social Psychology and Flight Deck Management** |
| 34.50.2 | Identify the broad characteristics of personality and distinguish individual differences. |
| 34.50.4 | Define cognitive dissonance. |
| 34.50.6 | Explain the concept of crew resource management (CRM). |
| 34.50.8 | Describe methods of maximising crew resource management. |
| 34.50.10 | Define teamwork and team membership. |
| 34.50.12 | Identify the factors that affect team performance. |
| 34.50.14 | Describe how effective teams or team working can reduce errors. |
| 34.50.16 | Describe group decision making. |
| 34.50.18 | Explain the advantages and disadvantages of group decision making. |
| 34.50.20 | Explain the concepts of:<br>(a) risk shift<br>(b) conformity<br>(c) compliance. |
| 34.50.22 | Describe the following personality traits and explain their effect on group decision making:<br>(a) introversion<br>(b) extraversion<br>(c) anxiety. |
| 34.50.24 | Explain and differentiate between goal/task directed and relationship directed styles of behaviour. |

| Sub Topic | Syllabus Item |
|---|---|
| 34.50.26 | Describe autocratic and democratic leadership styles. |
| 34.50.28 | Describe ideal leadership characteristics. |
| 34.50.30 | Explain problems that can arise from:<br>(a) status/seniority differences<br>(b) lack of assertiveness<br>(c) cultural differences. |
| 34.50.32 | Explain the concept of authority gradient. |
| 34.50.34 | Explain the advantages and disadvantages of varying cockpit authority gradients. |
| 34.50.36 | Explain problems that can arise from an authority gradient that is too steep or too shallow. |
| 34.50.38 | Describe the cultural aspects of authority gradients. |
| 34.50.40 | Describe a basic model of communications. |
| 34.50.42 | Explain the influence of the following on the effectiveness of cockpit communications:<br>(a) the skills of enquiry, advocacy and assertion<br>(b) listening<br>(c) conflict resolution<br>(d) critique/feedback. |
| 34.50.44 | Describe the barriers to effective communication. |
| 34.50.46 | Identify techniques to reduce communication barriers. |
| 34.50.48 | Explain the following strategies used to reduce communication errors in aviation:<br>(a) read-backs<br>(b) standard phraseology<br>(c) standard calls<br>(d) cross-checks<br>(e) document verification checks<br>(f) display and control setting checks<br>(g) sterile cockpit policies. |
| 34.50.50 | Describe means of managing effective communications between flight crew and:<br>(a) cabin crew<br>(b) passengers<br>(c) air traffic control services |

| Sub Topic | Syllabus Item |
|---|---|
| | (d) maintenance personnel |
| | (e) company personnel. |
| **34.52** | **Threat and Error Management** |
| 34.52.2 | Explain the role of human error in aviation accidents. |
| 34.52.4 | Explain the degree to which human error can be eliminated. |
| 34.52.6 | Describe the main types of threats which could potentially affect a safe flight. |
| 34.52.8 | Describe threat management, including means of: |
| | (a) recognising threats |
| | (b) avoiding |
| | (c) mitigating the effects of threats. |
| 34.52.10 | Describe and identify examples of overt/active threats. |
| 34.52.12 | Describe and identify examples of latent threats. |
| 34.52.14 | Identify methods and means for detecting error in the aviation system. |
| 34.52.16 | Describe error avoidance techniques. |
| 34.52.18 | Explain how incipient errors can be trapped after they have been committed. |
| 34.52.20 | Explain how the consequences of errors that are not trapped can be mitigated. |
| 34.52.22 | Explain how CRM countermeasures assist the management of threat and error. |
| 34.52.24 | Explain the basic elements and features of the Reason Model. |
| 34.52.26 | Describe and identify examples of a latent failure/error. |
| 34.52.28 | Describe and identify examples of an active failure/error. |
| 34.52.30 | Identify and describe slips, lapses, mistakes and violations. |
| **34.54** | **Culture** |
| 34.54.2 | Identify the elements in a safety culture. |
| 34.54.4 | Describe reporting mechanisms to rectify safety problems. |
| 34.54.6 | Define the core concept of an organisational culture. |
| 34.54.8 | Outline the ways in which organisational culture affects performance. |
| 34.54.10 | Explain the principles of SMS in air operations. |
| 34.54.12 | Describe what is meant by harassment, its effects on employees and how it should be dealt with should it arise in the workplace. |
| 34.54.14 | Describe what is meant by stereotypes and stereotypical behaviour within organisations and give examples of where such behaviour may have a negative impact on safety. |

| Sub Topic | Syllabus Item |
|---|---|
| 34.54.16 | List the key reasons for a safety reporting system within an aviation organisation. |
| 34.54.18 | Explain the rationale for mandatory reporting of incidents as required by Part 12. |
| 34.54.20 | Explain the relevance of internal hazard reporting. |
| 34.54.22 | Describe the key elements of the Just Culture approach to the management of errors, reporting, and the use of disciplinary sanctions under this approach. |
| 34.54.24 | Distinguish between normal error, at risk behaviour and high culpability behaviour. |
| 34.54.26 | Distinguish between negligent and reckless behaviour. |
| 34.54.28 | Identify the attributes of at risk behaviour. |
| 34.54.30 | Describe the concepts of risk creep and risk tolerance and their application within an aviation organisation. |
| 34.54.32 | Describe the role of punitive sanction. |
| | **Ergonomics** |
| **34.56** | **Flight Deck Design** |
| 34.56.2 | Describe the basic principles of control, display and workspace design. |
| 34.56.4 | Explain the importance of the following in flight deck design:<br>(a) reach<br>(b) comfort<br>(c) posture<br>(d) lighting levels. |
| 34.56.6 | Define biomechanics |
| 34.56.8 | Define anthropometry. |
| 34.56.10 | Distinguish between biometrics, biomechanics and anthropometry. |
| 34.56.12 | Describe applications of biomechanics in the design of flight decks. |
| 34.56.14 | Explain the relevance of anthropometry in the design of flight decks. |
| 34.56.16 | Describe the effects of a poorly designed cockpit on pilot performance. |
| 34.56.18 | Explain the importance of eye datum or eye design position. |
| 34.56.20 | Describe the problems associated with windshield design and visibility. |
| 34.56.22 | List the advantages and disadvantages of working in an automated cockpit. |
| 34.56.24 | Describe the effects of advanced cockpit automation, including:<br>(a) failure to monitor<br>(b) boredom and complacency<br>(c) loss of proficiency |

| Sub Topic | Syllabus Item |
|---|---|
| | (d) job satisfaction |
| | (e) crew coordination |
| | (f) problems associated with equipment failure. |
| 34.56.26 | Explain the concept of mode awareness in setting up and operating automated systems. |
| 34.56.28 | Describe elements of coping behaviour associated with automatic cockpits. |
| **34.58** | **Design of Controls** |
| 34.58.2 | Explain the importance of the following in control design: |
| | (a) size |
| | (b) shape/recognition by touch |
| | (c) location |
| | (d) layout and the uniformity of spatial arrangement |
| | (e) direction of movement |
| | (f) visibility. |
| **34.60** | **Instrumentation, Displays and Alerts** |
| 34.60.2 | Explain the importance of the following in the design of instrumentation, displays and alerts: |
| | (a) size |
| | (b) position |
| | (c) layout |
| | (d) visibility |
| | (e) legibility |
| | (f) scale |
| | (g) use of colour |
| | (h) illumination. |
| 34.60.4 | Describe common errors in display interpretation. |
| 34.60.6 | Describe potential errors in the interpretation of three pointer altimeters. |
| 34.60.8 | Describe potential errors in the interpretation of the artificial horizon. |
| 34.60.10 | Describe the basic requirements of alerts. |
| 34.60.12 | Describe problems associated with the presentation and misinterpretation of alerts. |
| 34.60.14 | Describe how colour coding conventions are used in aviation instruments, displays and navigation charts. |
| **34.62** | **Documents and Procedures** |
| 34.62.2 | Explain the rationale behind consistent and thorough checklist and SOP use |

| Sub Topic | Syllabus Item |
|---|---|
| | as opposed to reliance on memory. |
| 34.62.4 | Distinguish between normal and emergency checklists. |
| 34.62.6 | Describe the elements of an effective checklist. |
| 34.62.8 | Identify the phases of flight that a checklist plays an important role. |
| 34.62.10 | Describe the reasons for checklist complacency. |
| 34.62.12 | Describe the possible ramifications of checklist complacency. |
| 34.62.14 | Explain the importance of colour, font and type size for written checklists. |
| 34.62.16 | Describe problems associated with the design and use of checklists and manuals. |
| 34.62.18 | Describe problems associated with the design and use of maps and charts. |
| | **First Aid and Survival** |
| **34.64** | **First Aid** |
| 34.64.2 | Describe the basic principles of first aid. |
| 34.64.4 | Describe the basic principles of Cardiopulmonary Resuscitation. |
| **34.66** | **Survival** |
| 34.66.2 | State the components of a pre-flight passenger briefing by a pilot with respect to aircraft safety features and equipment. |
| 34.66.4 | Explain the basic steps in post-crash survivor management. |
| 34.66.6 | Explain the basic principles of survival. |
| 34.66.8 | List the priorities of survival in order of importance. |
| 34.66.10 | Explain typical survival items that could be carried on a cross-country flight over bush clad and mountainous terrain. |
| 34.66.12 | Explain the process of hypothermia. |

# APPENDIX IV - Commercial Pilot Licence Flight Test Syllabus

***Acceptable performance parameters, for the guidance of flight examiners, are published in the CAA "Flight Test Standards Guide Commercial Pilot Licence Issue and Biennial Flight Review (BFR) – Aeroplane".***

## Flight Test Syllabus — Aeroplane

### General requirements

The test is to include an oral general knowledge test followed by a pilot competency test. Failure to pass in any item of the test may result in the applicant and the instructor being advised of the failure aspects and the further training believed necessary before a further flight test may be undertaken.

The candidate is to demonstrate a professional attitude to aviation by arriving punctually for the flight test, suitably attired and fit for flying.

The candidate is to present, for the examiner's inspection, their summarised and certified pilot log book, written exam credits, knowledge deficiency reports improvement content listed against rule references and certified, current AIPNZ Volume 4 and appropriate Visual Navigation Chart.

### Aircraft, equipment and facilities required for the flight test

The aircraft is to be fitted with:

- fully functioning dual flight controls, and
- those instruments essential to the manoeuvres planned to be demonstrated during the flight visible to both pilots without excessive parallax error, and
- at least three-point lap-and-sash harness, and
- intercommunication equipment of an approved type.

The candidate is to provide adequate and private facilities for briefing prior to and after the flight test.

### General knowledge test

The candidate will be able to:

**Licence privileges:**

Demonstrate a sound knowledge of CPL(A) privileges, currency and medical requirements.

**Aircraft documents:**

Demonstrate a sound knowledge of the certificate of airworthiness, aircraft technical log, *Aircraft Flight Manual* and associated pilot's operating handbook.

**Weather and AIP supplements:**

Obtain and interpret, fully and accurately, the meteorological forecast for the period of the flight test or a hypothetical cross-country flight (as required by the examiner) including a TAF and METAR (with associated SPARs, SPECIs and SIGMETs as applicable). Obtain and demonstrate knowledge of the applicable NOTAMs.

Make a sound go/no go decision based on all available pre-flight planning data.

**Aircraft performance and operating requirements:**

Demonstrate a sound knowledge of the effect of seasonal conditions on aircraft performance and the application of the performance group rating system.

Accurately calculate the take-off and landing distances relating to air transport operations considering density altitude, wind, terrain and other relevant conditions (within a time appropriate to a professional approach).

**Fuel:**

Accurately calculate fuel requirements including reserves for an air transport operation under CAR Part 135.

Establish fuel on board and accurately calculate endurance.

**Aircraft loading:**

Demonstrate a sound knowledge of the aircraft's weight limitations, including fuel, oil, baggage, load distribution and security.

Accurately calculate the centre of gravity position for take-off and landing (using a professional approach and within a reasonable time).

**Pre-flight:**

Demonstrate a sound knowledge of aircraft type specific systems, features, protrusions, intakes and aerials.

Demonstrate the pre-flight, internal and external serviceability inspection, in accordance with the aircraft's pilot operating handbook.

**Passenger briefing:**

Supervise the passenger(s) on the movement area and in the aircraft.

Brief the passenger(s) on the location and operation of all emergency equipment including doors and hatches, seat belts and shoulder harness, ELT and portable electronic devices.

Brief the passenger(s) on the rules regarding smoking in aircraft and the actions in event of an emergency landing (and/or ditching if appropriate).

## Piloting technique test for aeroplanes

The candidate will be able to:

**Engine start, warm-up and shutdown:**

Ensure that the aircraft is positioned to taxi and that the area is clear before starting.

Demonstrate, setting the brakes, the correct use of primer and/or auxiliary fuel pump(s) (as applicable), starting the engine, checking engine instruments and only taxiing when temperatures and pressures have stabilised in accordance with the *Aircraft Flight Manual*.

Verbalise or demonstrate the actions required in the event of an engine fire during or after start (at examiner discretion).

**Air traffic service procedure:**

Obtain ATIS information when appropriate and available.

Read back appropriate instructions, information and clearances.

Request and comply with ATS clearances and instructions when appropriate and request/suggest alternatives when considered necessary, in an appropriately assertive communication style, using the correct aeronautical phraseology.

**Taxiing and brake check:**

Perform a brake and instrument serviceability check in accordance with recommended procedures.

Control the aircraft's speed without excessive use of brakes, avoid hazards, and position the aircraft's controls for the prevailing wind in accordance with the *Aircraft Flight Manual*.

**Engine checks, run-up and operation:**

Carry out the pre-flight engine run up and checks in accordance with the *Aircraft Flight Manual* or check list.

Demonstrate, in flight, smooth operation of the throttle and use of the mixture, carburettor heat control and auxiliary fuel pump (if applicable) in accordance with the *Aircraft Flight Manual* or checklist. Select appropriate fuel tanks and monitor fuel consumption accurately.

**Pre take-off checks:**

Carry out the pre take-off checks in accordance with the *Aircraft Flight Manual* or checklist.

Verbalise (for the examiner's benefit) the departure procedure to be followed (if applicable) and the actions to be taken in the event of an engine failure during and after take-off.

**Normal take-off:**

Complete the line up checks in accordance with recommended procedures.

Ensure the take-off path is clear and advance the throttle(s) to maximum allowable power, checking engine instruments and airspeed increasing.

Use correct elevator inputs for nose wheel or tail wheel type aeroplanes, rotate at the appropriate Vr and maintain an accurately straight take-off and climb out path.

Establish and maintain the recommended climb speed accurately, trimming to maintain the nose attitude accurately and completing after take-off checks as applicable.

**Crosswind take-off:** (at examiner discretion)

Explain the aircraft's maximum demonstrated crosswind limitation.

Accurately determine or estimate the crosswind component.

Demonstrate, if conditions permit, a crosswind take-off, positioning the flight controls to compensate for crosswind in accordance with the *Aircraft Flight Manual*, reducing windward aileron with effective speed increase to a positive clean lift-off, and maintaining an accurately straight take-off and climb out path.

Establish and maintain the recommended climb speed accurately, trimming to maintain the nose attitude accurately and completing after take-off checks as applicable.

**Short field take-off:**

Demonstrate a maximum performance take-off from a (simulated) field of minimal length, utilising full runway length and configuring the aircraft appropriately.

While holding against the brakes ensure minimum static RPM is achieved and that engine pressures and temperatures are normal.

Accurately rotate at the recommended Vr and initially achieve the best angle of climb speed.

When clear of (simulated) obstacles raise flap (if applicable) in accordance with the *Aircraft Flight Manual* and recommended procedures to achieve and accurately maintain the best rate of climb speed (Vy). Accurately maintain a straight take-off and climb out path throughout.

Modify the Vr and Vx when the conditions warrant (in accordance with recommended procedures) and accurately trim to maintain the nose attitude, completing after take-off checks as applicable.

**Engine failure techniques:**

React immediately and appropriately to a simulated abandoned take-off and/or EFATO (at examiner discretion).

During the aborted take-off close the throttle fully, maintain direction, apply brakes as required and verbalise the subsequent actions.

During a simulated EFATO lower the aircraft's nose immediately, close the throttle, select a suitable (or most suitable) landing area within range, use flap as required to achieve the landing and carry out FMI trouble checks (including MAYDAY) if time permits.

Alternatively or subsequently (as time permits) verbalise the FMI securing checks, delaying 'master off' if electric flap is involved.

React correctly (power first) and promptly to the examiner's "go around" command.

**Climbing:**

Accurately maintain the nominated climb speed, accurately trim to maintain the climb attitude, maintain engine temperatures and pressures within their normal ranges and systematically comply with recommended procedures for clearing the flight path ahead.

**Straight and level flight:**

Achieve and maintain accurate level flight at the nominated altitude.

Accurately maintain the nominated (DI) heading and accurately trim for level flight.

**Slow flight**

Maintain level flight while reducing airspeed to a minimum of 1.2 Vs and manoeuvre in various configurations at that speed including changing direction from an established turn to a turn in the opposite direction using up to 20º angle of bank and re-establishing normal cruise.

**Medium turns:**

Clear the area in accordance with recommended procedures and demonstrate an accurately coordinated level medium turn through 180º left and right, using and maintaining an accurate bank angle of 30º.

**Climbing turns:**

Clear the area in accordance with recommended procedures and demonstrate an accurately coordinated climbing turn through 180º left and right, using and maintaining a bank angle appropriate to flight performance requirements.

**Steep turns:**

Clear the area in accordance with recommended procedures and demonstrate an accurately coordinated level steep turn through 360º left and right, using an accurate bank angle of 45º.

During the entry, increase power appropriately, and on exit, return to straight and level flight coincident with accurately achieving the reference point, accurately maintaining the nominated altitude throughout.

**Maximum rate turns:**

Demonstrate an awareness of the aircraft's Va speed (for the weight) in relation to the aircraft's speed at commencement of the manoeuvre (entry speed at examiner discretion) and adopt the most suitable entry technique.

Clear the area in accordance with recommended procedures and demonstrate an accurately coordinated maximum rate turn through 360º left and right, accurately maintaining the nominated altitude.

On exit, return to straight and level flight coincident with accurately achieving the reference point.

**Stalling in basic configuration:**

Demonstrate basic stall entry from level flight with recovery at onset or recovery at the stall (at examiner discretion).

Carry out HASELL and HELL checks as appropriate, ensuring adequate height to recover.

During entry accurately maintain level flight, preventing yaw, and during the recovery, minimise the height loss through the application of full power (preventing yaw) and return to straight and level flight.

**Stalling in power-on configurations:**

Demonstrate stall entry with power on (with or without flap at examiner discretion) from level flight with recovery at onset or at the stall (at examiner discretion).

Carry out HASELL and HELL as appropriate, ensuring adequate height to recover.

During entry accurately maintain level flight, preventing yaw, and during the recovery, minimise the height loss through the application of full power (preventing yaw) and return to straight and level flight.

**Wing drop stall:**

Demonstrate a wing drop stall.

Carry out HASELL and HELL checks as appropriate, ensuring adequate height to recover.

During entry maintain level flight and during the recovery, initially maintain ailerons neutral, prevent further yaw with rudder and minimise the height loss through the application of full power, then, return to straight and level flight.

**Stalling in a steep turn:**

Demonstrate stall entry with power on (reduced power setting at examiner discretion) from a steep level turn with recovery at onset or at the stall (at examiner discretion).

Carry out HASELL and HELL checks as appropriate, ensuring adequate height to recover.

During entry accurately maintain balanced level flight.

During the recovery, initially maintain ailerons neutral, prevent further yaw with rudder, minimise the height loss through the application of full power (preventing yaw) and return to straight and level flight or continue in the turn (at examiner discretion) using a reduced angle of bank.

**Forced landing without power:**

*The examiner will simulate the engine failure (without warning) from altitude (examiner's discretion).*

Demonstrate a sound knowledge of the factors affecting the choice of a suitable forced landing area and demonstrate a high level of situational awareness by quickly choosing the best available landing area and simultaneously carry out the initial actions.

Subsequently, plan the descent/approach pattern and execute the plan accurately maintaining the nominated glide speed.

During the subsequent actions, attempt to determine the cause of the engine failure through trouble checks and assuming no response from a partial power check, simulate a Mayday call, brief the passengers and simulate the shut-down checks.

Initiate the missed approach, not below minimum safe altitude (or higher as directed by the flight examiner).

**Forced landing with power:**

From approximately 500 feet AGL, when confronted with simulated conditions (at examiner discretion) that would make a forced landing with power advisable, react promptly and decisively. The examiner will specify the simulated cloud base, visibility and remaining daylight (as applicable).

In accordance with recommended procedures, configure the aircraft appropriately and nominate a suitable landing area with due regard to wind, terrain, obstructions and other relevant factors. If this demonstration is carried out in a designated low flying area, initiate the missed approach at the minimum safe height (or higher as directed by the flight examiner).

**Descent:**

Enter and maintain the (examiner) nominated descent, accurately maintain the nominated speed, accurately trim to maintain the descent attitude, warm or clear the engine as appropriate and systematically clear the flight path ahead in accordance with recommended procedures.

**Descending turns:**

Clear the area in accordance with recommended procedures and demonstrate an accurately coordinated descending turn through 180º left and right, using and maintaining an accurate bank angle of 30º and a constant airspeed.

**Steep gliding turns:**

Clear the area in accordance with recommended procedures.

From a medium gliding turn, demonstrate an accurately coordinated steep gliding turn through at least 180º left and right, increasing the airspeed through 30º angle of bank and subsequently maintaining an accurate bank angle of 45º and a nominated constant airspeed appropriate to the bank angle.

**Flap usage or sideslipping:**

Use correct flap extension and retraction procedures, carried out within the appropriate speed range.

When applicable to aircraft type, demonstrate a straight sideslip and sideslipping whilst turning (with an appropriate speed increase to the recommended glide speed).

**Low flying in simulated poor visibility:**

Carry out the appropriate checks prior to entering the low flying area (if applicable).

Use flap and power to configure the aircraft appropriately for simulated poor visibility conditions in accordance with recommended procedures and accurately maintain the nominated airspeed and altitude.

Carry out constant radius, weather avoidance, coastal or restricted terrain reversal turns (at the examiner's discretion) in accordance with the recommended procedure using no more than 45º angle of bank (when required).

Maintain an appropriate lookout throughout.

**Joining the circuit:**

Demonstrate joining the circuit using an appropriate procedure (as nominated by the flight examiner).

Carry out rejoining and circuit checks, obtain ATIS information and ATS clearances (as and when applicable).

Demonstrate a high level of situational awareness, maintaining lookout and a listening watch throughout.

**Normal approach and landing:**

Carry out appropriate circuit checks and demonstrate a normal approach and landing using full flap (provided the conditions are appropriate).

Maintain the nominated approach speed accurately, land on the centre line (if applicable) and maintain a straight landing roll using brakes as required.

**Flapless approach and landing:**

Demonstrate a flapless approach and landing, accurately maintaining an appropriate nominated approach speed, land on the centre line (if applicable) and maintain a straight landing roll using brakes appropriately.

**Crosswind approach and landing: (**at examiner discretion)

Demonstrate a crosswind landing (if conditions permit), accurately correcting for drift throughout the circuit and approach.

Give due consideration to aircraft limitations, and make a sound decision to continue or abort the approach.

Establish an appropriate configuration and approach/threshold speed, and maintain the nominated speed(s) accurately.

Prior to touchdown, accurately align the aircraft with the runway (centre line if applicable) and position controls correctly throughout the landing roll.

**Glide approach and landing: (**at examiner discretion)

Demonstrate completion of a forced landing without power from the ideal 1000 foot area from the downwind position abeam the threshold of the runway in use.

On achieving the ideal commencement position fully close the throttle and assume the initial actions, subsequent actions, trouble checks and shut-down checks have all been completed.

Initially demonstrate the ability to achieve the 1/3 aim point from approximately 500 feet AGL and then employ the recommended procedures to modify the touch down point such that a normal touch down is achieved between the threshold and the 1/3 aim point.

**Short field approach and landing:**

Demonstrate an approach and landing into a (simulated) field of minimal length, in accordance with the *Aircraft Flight Manual* or performance charts.

Nominate an approach and threshold speed appropriate to the conditions and progressively reduce the approach speed to accurately achieve the nominated threshold speed, or on final, accurately stabilise the threshold speed at approximately 300 feet AGL (maximum).

Consider the effect of the modified threshold speed (if applicable) on the landing distance and make a sound decision to continue or divert. Initiate a go-round at the decision height or point, if a landing cannot be assured; otherwise regulate the descent with power to accurately achieve the pre-selected touch-down point.

After touchdown, use brakes as required and maintain the runway centre line (if applicable) throughout the landing roll.

**Approach and go-round from below 50 feet:**

*The examiner will call for a go-round during at least one approach from below 50 feet.*

Initiate the go-round, leading with full power (if applicable), confirming carburettor air cold and raising the flap progressively in accordance with the recommended procedure whilst accurately tracking the runway centre line.

**Radiotelephony tuning and procedures:**

Demonstrate an adequate listening watch and communicate clearly and assertively using standard aviation phraseology.

**Lookout:**

Demonstrate an adequate lookout (both on the ground and in the air).

Maintain an adequate level of situational awareness by ensuring compliance with the minimum VMC requirements for VFR flight and building a mental picture of the relative position of traffic, which may potentially affect the flight.

**Flight orientation:**

Demonstrate an in-depth knowledge of the local area by navigating to and from the designated training area, via compulsory VFR reporting points (if applicable) and without infringing controlled airspace or becoming disorientated.

**Pilot judgement:**

Demonstrate appropriate pilot judgement skills in relation to aircraft performance, operation and procedures.

**Balance:**

Ensure all in-flight manoeuvres are coordinated.

**Post flight:**

Taxi clear of the active runway and complete after landing checks as appropriate.

Park the aircraft into wind (if applicable) with due attention to other aircraft or objects.

Carry out the engine shut down in accordance with the *Aircraft Flight Manual* or checklist, secure the aircraft, supervise the passenger(s) on the movement area and complete all post flight documentation.

### Instrument flight – full panel

The candidate will be able to:

**Straight and level:**

By sole reference to all flight instruments, demonstrate achieving and maintaining level flight, maintain the nominated (DI) heading and accurately trim for level flight.

**Medium turns:**

By sole reference to all flight instruments, demonstrate a coordinated level medium turn through 180º left and right, using and maintaining an accurate bank angle of 30º.

**Climbing and descending:**

By sole reference to all flight instruments, demonstrate entering and maintaining climbing and descending flight, maintaining a constant airspeed and heading.

**Stall onset in level flight:**

By sole reference to all flight instruments, demonstrate stall entry with power on from level flight with recovery at onset.

Carry out (with the assistance of the examiner) HASELL and HELL checks as appropriate, ensuring adequate height to recover.

During entry accurately maintain level flight, preventing yaw, and during the recovery, minimise the height loss through the application of full power (preventing yaw) and return to straight and level flight.

**Stall onset in a climbing turn:**

By sole reference to all flight instruments, demonstrate stall entry with power on (reduced power setting at examiner discretion) from a climbing turn with recovery at onset.

Carry out (with the assistance of the examiner) HASELL and HELL checks as appropriate, ensuring adequate height to recover.

During entry maintain balanced flight.

During the recovery, initially maintain ailerons neutral, prevent further yaw with rudder, minimise the height loss through the application of full power (preventing yaw) and continue in the turn using a reduced angle of bank or return to straight and level **(**at examiner discretion).

**Recovery from spiral dive:**

By sole reference to all flight instruments, recognise and demonstrate recovery from a power on (reduced power setting at examiner discretion) spiral dive.

During the recovery, close the throttle, roll wings level and smoothly ease out of the ensuing dive to regain straight and level flight.

### Instrument flight – limited panel

The candidate will be able to:

**Straight and level:**

By sole reference to basic flight instruments, demonstrate achieving and maintaining level flight, maintain the nominated compass heading and accurately trim for level flight.

**Compass turns:**

By sole reference to basic flight instruments, demonstrate level, Rate 1 turns, onto a nominated compass heading.

**Climbing and descending:**

By sole reference to basic flight instruments, demonstrate entering and maintaining climbing and descending flight, maintaining a constant airspeed and compass heading.

**Climbing and descending turns:**

By sole reference to basic flight instruments, demonstrate climbing and descending turns onto a nominated compass heading.

**Unusual attitude recovery:**

By sole reference to basic flight instruments, recognise and demonstrate recovery from power on (reduced power setting at examiner discretion) nose high, nose low and spiral dive attitudes.

During the recovery, correctly identify the aircraft's attitude, apply the correct recovery technique to initially return to straight and level flight and then return to the nominated altitude and compass heading.

## Flight test syllabus — helicopter

***Acceptable performance parameters, for the guidance of flight examiners, are published in the CAA "Flight Test Standards Guide Commercial Pilot Licence Issue and Biennial Flight Review (BFR) – Helicopter".***

The test is to include an oral general knowledge test followed by a pilot competency test. The candidate is to provide a copy of the current meteorological forecast for the period of the flight. Failure to pass in any item of the test may result in the applicant and the instructor being advised of the failure aspects and of the further training believed necessary before a further flight test may be undertaken.

### General knowledge test

**Aircraft documents:**

Certificate of airworthiness, helicopter flight manual, release to service and radio licence.

**Helicopter performance and operating requirements:**

As in current legislation.

**Fuel:**

Requirements and management.

**Loading:**

Including fuel, oil and baggage.

**Emergency equipment:**

Location and use.

**Weather, NOTAM and AIP supplements:**

Obtained and correctly interpreted.

**Piloting technique test**

**Pre-flight inspection:**

As in check list.

**Start-up, warm-up, clutch engagement:**

As in flight manual.

**Run-up, functional checks:**

As in flight manual.

**Lift-off to hover:**

Maintain correct attitude and heading, constant height, good RPM control and co-ordination, hover check - power, centre of gravity position indicated by cyclic, control response.

**Hover taxiing:**

Steady walking pace, good height and RPM control, skids aligned with direction of movement.

**Hover patterns and turns:**

Smooth control of the helicopter in spot turns and sideways and backwards flight.

**Normal circuit:**

Good lift-off, hover, correct attitude during transition to normal climb ± 10 knots, turn at nominated height, downwind at nominated height ± 50 feet, downwind checks, judgement of base turn, safe approach speed, reasonable approach angle to nominated touchdown spot, good RPM and directional control throughout, terminate at a hover then land vertically.

**Limited-power operations:**

Demonstrate running take-off, run-on landing, cushion creep take-off, zero speed landing, towering take-off.

**Quick stops:**

At nominated height, perform quick stops terminating into wind, safe position of tail rotor and avoid dangerous sink.

**Magnetic compass headings:**

Clear the area in accordance with recommended procedures and (with the DI covered or desynchronised) demonstrate turns onto compass headings (as nominated by the examiner) in level, climbing or descending flight (at examiner discretion).

**Steep turns:**

Through 360º left and right, look-out, bank angle of 45º, correct power use during entry and roll-out, correct co-ordination and balance to within one quarter of a ball deflection, ± 50 feet.

**Straight-in autorotation:**

From approximately 800 foot height perform a straight-in autorotation with power recovery to a 3 foot hover, initial collective fully down, positive needle split at approximately 300 RPM, good speed and RPM control in descent, safe cyclic action, co-ordination of throttle, collective and anti-torque pedal.

**180º autorotation:**

From approximately 800 foot height perform a 180º autorotation with power recovery to the hover, control as for straight-in case.

**Autorotation:**

IAS and RPM variation, from approximately 800 foot height perform an approach with varying IAS and RPM to hover over a nominated spot.

**Low flying:**

At a nominated height and not below a nominated speed, maintain good RPM control whilst turning and following basic contours with use of the collective.

**Mountainous-terrain awareness:**

On a knoll (or spot on a ridge) perform a reconnaissance, determine the wind direction and report it, then carry out a circuit with power check and safe approach to a hover or landing as applicable. In no-natural-horizon conditions, demonstrate flying in a valley terminating in an approach to a hover, or landing as applicable, at a position nominated by the examiner. This item may be omitted

from the test if a Category B or A flight instructor has certified the candidate's competence in the candidate's log book.

**Slope landings and take-offs:**

Demonstrate slope landings across and up slope, maximum operating engine RPM, gentle ground contact, correct handling of collective and cyclic throughout.

**Confined areas:**

As appropriate perform a high reconnaissance of selected confined areas, consider size, shape, wind, best approaches, obstructions, termination hover height or landing spot (or both), surface, slope and overshoots, plan circuit, make power assessment, circuit and approach to hover or landing, and departure. Test to include advanced confined area operations involving maximum power or steep towering take-off techniques and hover manoeuvres to position where appropriate, which might include turns about the mast or cargo hook, nose and tail rotor.

**Carriage of external rack loads:**

To be covered by an oral discussion and briefing.

**Carriage of sling loads:**

With the helicopter at or near its MCTOW, and using a sling at least four metres long, position the helicopter on the ground, attach the sling to the hook and demonstrate a lift-off with maximum operating engine RPM, circuit and approach to the hover over a nominated spot with manual release, maximum operating engine RPM on finals to the hover. This item may be omitted from the test if a Category B or A flight instructor has certified the candidate's competence in the candidate's log book.

**Run-down procedures:**

As in flight manual.

**Emergencies:**

Hydraulic controls failure if applicable, tail rotor emergencies, discussions on forced landings, fire in the air, ditching, and any other emergency relevant to the helicopter being used for the test.

**Airmanship:**

The whole flight will be considered and an assessment made of pilot judgement, decision making, and adequacy of lookout.

**Air traffic control:**

Comply with air traffic services practices and procedures and carry out the required communications with a degree of competency appropriate to the privileges of a CPL(H). Provided that, where the applicant is the holder of at least a CPL(A), the flight examiner may substitute an oral examination on air traffic services practices and procedures when the helicopter is not equipped with two-way radio or air traffic services are not available.

Intercommunication equipment of an approved type is to be provided for use during the flight test.

## Flight Test Syllabus — Glider

The test includes an oral general knowledge and pilot competency test. Failure to pass in any item of the test will result in the applicant's instructor being advised of the failure aspects and the training believed necessary before another flight test may be undertaken.

### General knowledge test

Certificate of airworthiness, flight manual, release to service, daily inspection book, radio certificate.

Take-off and performance requirements:

Aircraft loading, weight and balance limitations.

Aircraft inspection, pilot maintenance, and pre-flight check.

Location, use and operation of emergency equipment.

Pre-flight tow equipment check.

Glider under tow - emergency signals to and from tug aircraft.

Rope and cable break procedures.

Care and use of oxygen equipment and problems associated with high altitude flying particularly with regard to passengers of unknown health status.

### Piloting technique test

Pre-flight operations, including the installation of wings, tail surfaces and flying control systems specifically designed for quick removal and installation by pilots.

Take-off and climb.

Action after release.

Turns onto compass headings.

Maintaining compass headings.

Medium turns.

Stall onset and recovery.

Fully developed stall and recovery.

Stall-spin situation.

Steep turns.

Sideslipping.

Take-off and landing into wind and crosswind.

Simulated paddock landing with altimeter covered.

Air traffic control: Comply with ATS practices and procedures, and carry out communications with a degree of competency appropriate to the privileges of a CPL (G).

## Flight Test Syllabus — Balloon

***Acceptable performance parameters, for the guidance of flight examiners, are published in the CAA "Flight Test Standards Guide Commercial Pilot Licence Issue and Biennial Flight Review (BFR) – Balloon".***

### General requirements

The test is to include an oral general knowledge test followed by a pilot competency test. Failure to pass in any item of the test may result in the applicant being advised of the further training believed necessary before another flight test may be undertaken.

The candidate is to demonstrate a professional attitude to aviation by arriving punctually for the flight test, suitably attired and fit for flying.

The candidate is to present, for the examiner's inspection, their summarised and certified pilot log book, written exam credits and knowledge deficiency reports with evidence of improvement certified (if applicable), current AIPNZ Volume 4 and appropriate Visual Navigation Chart.

The candidate is to provide adequate and private facilities for briefing prior to and after the flight test.

### General knowledge test

The candidate will be able to:

**Licence privileges:**

Demonstrate a sound knowledge of CPL (B) privileges, currency and medical requirements.

**Aircraft documents:**

Demonstrate a sound knowledge of the certificate of airworthiness, aircraft technical log, forms 2173 and 2129, *Aircraft Flight Manual* and associated pilot's operating handbook and limitations specific to type.

**Weather and AIP supplements:**

Obtain and interpret, fully and accurately, the meteorological forecast for the period of the flight test or a hypothetical cross-country flight (as required by the examiner) including a TAF and METAR (with associated SPECIs and SIGMETs as applicable). Use and interpret pibal information. Obtain and demonstrate knowledge of the applicable NOTAMs.

Make a sound go/no go decision based on all available pre-flight planning data.

**Systems operation:**

Demonstrate a professional understanding of the fuel system, burners, pilot lights and associated gauges. Establish the fuel quantity on board and calculate endurance. Have adequate knowledge of the use of deflation systems.

**Launch site selection:**

Select a suitable launch site considering size, surface conditions, accessibility, surrounding obstructions, surface wind, winds aloft and suitable landing areas. Arrange to launch at a suitable time considering atmospheric conditions and make a sound go/no-go decision based on all launch site considerations.

**Crew briefing and preparation:**

Brief crew members on safety procedures and the responsibilities of each crew member and establish a common means of communication. Describe the proposed direction of flight and the estimated time aloft.

Supervise and coordinate all activities, ensuring that all necessary equipment is on board.

**Layout and assembly:**

Position the envelope and basket considering wind, surface conditions and obstacles.

Assemble the fuel system and check for security, leaks and correct fuel pressure.

Tie off the basket before cold air is introduced to the envelope and attach the basket to the envelope and all cables and lines in accordance with the pilot operating handbook through the use of a checklist.

**Pre-flight inspection:**

Demonstrate the pre-flight inspection including checking of fuel and burner system, venting/deflation system, basket/envelope suspension and handling lines, instruments and gauges in accordance with the checklist.

Demonstrate an in depth knowledge of all significant balloon features and the detection of possible defects.

**Inflation:**

Accomplish the tie-off procedure, position the inflator fan for initial cold inflation and inflate the balloon to a vertical position whilst maintaining control.

Control and supervise the passenger(s) throughout the inflation process.

Position and secure the vent/deflation lines.

**Passenger briefing:**

Supervise and brief the passenger(s) on boarding, in-flight and landing procedures and behaviour.

Brief the passenger(s) on the rules regarding smoking and the actions in event of an emergency landing (and/or water landing if appropriate).

**Basket/Gondola management:**

Secure all loose items and organise material and equipment in a logical, efficient manner.

**Pre-launch check:**

Complete the final instrument serviceability checks and ensure that vent/deflation lines are positioned and secured properly.

Complete the pre-launch checklist and confirm that the balloon is in a safe operating condition.

Review wind conditions, temperature and obstructions and accomplish final coordination with the ground crew, including signals and emergency procedures.

Bring the balloon to equilibrium whilst dividing attention in and around the basket/gondola, ensuring there is no conflict with traffic prior to launch.

**Radio communications:**

Obtain ATIS information (when appropriate/available).

Read back appropriate instructions, information and clearances.

Use correct aeronautical phraseology at all times with appropriate assertiveness.

Correctly set QNH (when available) and cross checks the altimeter(s).

Demonstrate knowledge of appropriate transponder codes.

**Normal launch:**

Direct the ground crew to clear the area, recognise equilibrium and use the tie-off-quick release line correctly.

Recognise the current conditions and the presence of false lift (if applicable) and control lift-off and the initial ascent.

**Launch over obstacle:**

Demonstrate situational awareness by determining the height of, and distance to, obstacles relative to the wind conditions. Recognise the presence of false lift and act decisively to clear obstacles.

**Ascents:**

Demonstrate entry to an ascent (from level flight), ascending at a specified rate and entering level flight (from the ascent) at a specified altitude.

**Level flight:**

Demonstrate level flight at a nominated altitude by recognising vertical movement and maintaining equilibrium through smooth use of burner controls, using instruments to confirm altitude.

**Descents:**

Demonstrate entry to a descent (from level flight), descending at a specified rate and entering level flight (from the descent) at a specified altitude.

**Approach to landing:**

Complete the pre-landing checks in accordance with the checklist, stowing loose articles and securing equipment as appropriate and considering the wind conditions, landing area, obstructions and surface, select the most suitable touchdown point.

Brief the passenger(s).

Demonstrate a normal approach to landing, establishing an appropriate approach profile and rate(s) of descent.

Make a timely decision to abort the approach if necessary.

Demonstrate knowledge of the use of drop lines.

**Steep approach to landing:**

Complete the pre-landing checks in accordance with the checklist, stowing loose articles and securing equipment as appropriate.

Brief the passenger(s).

Demonstrate an approach to land over an obstacle and through timing, judgement and control, throughout the approach and landing use vents and burner controls to appropriately land the balloon and control ground travel.

Make a timely decision to abort the approach if necessary.

**Normal landing:**

Demonstrate a normal landing using the vent/deflation system and burner controls appropriately to land within the selected area.

Stabilise the balloon on landing and ensure sufficient negative buoyancy has been achieved prior to allowing occupants to exit.

**High wind landing:**

Demonstrate (at Examiner discretion) a landing where the surface wind is greater than 10 knots (or as specified by the manufacturer in the Pilot Operating Handbook as a high wind condition).

Brief the passenger(s).

Identify hazards associated with a high wind landing: select an appropriate landing site and use the vent/deflation system and burner controls appropriately to control ground travel.

**Rapid ascent and descent:**

Demonstrate in depth knowledge of situations requiring the use of a rapid ascent and descent and the reasons for monitoring temperature control.

Demonstrate a professional level of knowledge of potential problems with envelope distortion and the hazards of exceeding the manufacturer’s limitations.

Demonstrate knowledge of the time and altitude required to recover from a rapid descent.

**Contour flying:**

Demonstrate contour flying by maintaining the nominated height above terrain and obstacles, compensating for wind gusts, wind shear, thermal activity and orographic conditions whilst avoiding over burning and over venting and dividing attention between balloon control, ground track and lookout.

**Obstacle avoidance:**

Understand the importance of timely recognition of obstacles, particularly power lines.

Explain (or demonstrate at Examiner discretion) the techniques for avoiding obstacles and the procedure to be used if collision is imminent.

**Tethering:**

Demonstrate the recommended tethering procedure.

Demonstrate a professional level of knowledge of the number, strength and location of lines, the size of the area required considering wind conditions and obstructions, and the effects of false lift and wind gusts on tethering.

Brief the ground crew on tethering procedures and crowd control.

**Threat and error management:**

Demonstrate threat and error management techniques through situational awareness, decision making and human factors considerations.

**Navigation:**

Demonstrate navigation techniques including identifying lateral and vertical airspace restrictions, verifying the aircraft's position at all times and analysing the difference between the planned flight and the actual flight.

Determine the duration of the flight considering the availability of suitable landing areas, fuel consumption, wind and obstacles.

**Lookout:**

Demonstrate an adequate lookout (both on the ground and in the air).

Maintain situational awareness by ensuring compliance with the minimum VMC requirements for VFR flight and building a mental picture of the relative position of traffic, which may potentially affect the flight.

**Systems and equipment malfunctions:**

Demonstrate (if applicable) or explain (at examiner discretion) pilot actions in the event of, pilot light flameout or failure, blast valve failure, fuel exhaustion, fuel leak, fire and/or any other malfunction relevant to the balloon type.

**Emergency equipment and survival gear:**

Demonstrate professional knowledge of survival equipment appropriate to various climates and types of terrain within the Pacific region.

Demonstrate the location, purpose and method of operation or use of all emergency equipment and survival gear on board.

**Flight over water:**

Demonstrate in depth knowledge of the effects of wind and current on a water landing, the preparations required for over flight and/or contact with water including briefing the passengers, the procedure to be followed after water contact and the Civil Aviation Rules (CAR's) relating to required equipment for flight over water.

**Thermal flight:**

Demonstrates an in depth knowledge of the conditions that can cause thermal activity, the effects on balloon flight and the recommended procedures to follow on encountering thermal activity.

**Recovery:**

Demonstrates professional knowledge of the elements of recovery, the landing site approval process, ground crew supervision (including vehicle and crowd control) and the importance of minimizing property damage.

**Deflation and pack up:**

Demonstrate envelope deflation (considering wind and obstacles), fuel system security, the use of an appropriate checklist and post flight inspection procedures for the disassembly, packing and

storage of the envelope, basket components and fuel system as applicable and passenger supervision and control throughout.

**Refuelling:**

Demonstrate an in depth knowledge of the properties of various fuels, fuel cylinders and related parts, safety considerations, the risk of explosion and burns, moisture contamination and the method of filling cylinders.

# Appendix V – Aeroplane Basic Mountain Flying Training Syllabus

***Acceptable performance parameters, for the guidance of flight instructors, are published in the CAA's "Mountain Flying Training Standards Guide."***

## General requirements

- A ground theory course; and
- A minimum of 5 hours dual flying training to include at least:
    - 2 hours low flying; and
    - 2 hours basic mountain flying training.

***Note:*** *This basic mountain flying requirement is in addition to the terrain and weather awareness requirements met at PPL(A) level.*

## Training programme requirements

Training organisations are required to develop basic mountain flying ground and flight training in accordance with this syllabus and the *Mountain Flying Training Standards Guide*.

This course of training is to expand on both PPL terrain awareness and CPL low flying training and introduce trainees to the principles of basic mountain flying to further develop the experience level and understanding of operating near terrain and the associated weather, especially wind.

Training organisations shall ensure that instructors giving basic mountain flying training in accordance with this syllabus have the following minimum experience:

- • Category C out of direct supervision.
- • 500 hours total time in aeroplanes.
- • 40 hours pilot in command instructing in aeroplanes in terrain awareness training (or, have evidence of prior mountain flying experience assessed from the pilot logbook, by the flight examiner, as clearly in excess of this requirement); and
- • 150 hours of PPL/CPL instruction in aeroplanes; and
- • Have completed a course of mountain flying ground and flight training; and
- • Have demonstrated competence to an appropriately qualified flight examiner and on successful completion have had their logbook endorsed.

## Recommendations

Basic mountain flying training does not require high mountains to establish the principles.

Opportunities for scenario based decision making should be maximised.

As with terrain awareness, training should focus (whenever the opportunity presents itself) on recognising the significance of weather, especially wind relative to the terrain and its impact on flight conditions and flight path.

As a means of increasing student experience and awareness it is desirable that the student experience flight:

- • In the clean and poor visibility configuration.
- • In both calm and at instructor discretion, wind conditions greater than15kts.
- • In clear conditions and in conditions of some precipitation.
- • Performing turns through 180° & 360° both clockwise and anti-clockwise.

***Note:*** *Wind below 15kts is generally predictable. It is important that instructor discretion is applied in wind conditions above 15kts when the ability to accurately predict conditions is more challenging and very affected by the terrain shape, size and presentation to the airflow.*

### Topic I - Operating where the horizon must be 'superimposed' on terrain

***Aim:*** To consistently identify a useable horizon and superimpose it on variable backgrounds.

***Exercise:*** Fly a constant altitude while maintaining a constant wing tip distance from terrain to develop the skill of accurately superimposing the horizon onto varied backgrounds. Simultaneously develop awareness of space and position, appreciation of inertia, maintenance of escape options, right of way, lookout techniques etc while smoothly coordinating all control inputs in variable weather conditions.

Fly a constant height above a valley floor to appreciate gradient and shifting horizon perspective.

***Principles:*** The development of confidence and competence to operate in variable terrain where 'reaction' to cues is replaced by consistent 'anticipation' of an imaginary horizon.

Application of the "Horizon" topic content in the *Mountain Flying Training Standards Guide* would meet the requirements of Stage I.

### Topic II - Operating in a valley, including turning

***Aim:*** To appropriately position an aircraft in a valley considering all relevant variables and to conduct level, climbing and descending turns within a valley environment.

***Exercise:*** While valley flying position the aircraft to conduct level, climbing and descending turns considering lookout, right of way, wind and other relevant aspects of weather, space, horizon and any potential illusions.

***Principles:*** To apply the ground and flight training "Valley Turns" topic content of the *Mountain Flying Training Standards Guide.*

### Topic III - Crossing ridges, spurs, saddles or passes

***Aim:*** To safely approach, cross and position after crossing ridges, spurs, saddles or passes applying appropriate decision making to determine the safest compromise of options and principles involved.

***Exercise:*** Apply a CPL standard to the previously established principles of assessing the appropriate flight path for approach, crossing and after crossing, that applies the safest compromise of the options and principles involved. Experience where safely possible, the merits of approaching both left to right and right to left, and safely returning back over an area just crossed.

***Principles:*** Apply sound decision making as per the *Mountain Flying Training Standards Guide* to the process of assessing the approach to the saddle, the crossing of the saddle, and the flight path after crossing, from the perspective of having escape routes available at all times (except during the period of commitment to the actual ridge crossing) in both calm and windy conditions.

### Topic IV - Route finding

***Aim:*** Experience real or simulated circumstances of disorientation that may occur when flying below a ridgeline and the strategies for reorienting in place and time.

***Exercise:*** While conducting mountain flying training or during dual cross country training allow the student to experience their own real disorientation and guide them through strategies for reorientation, or simulate the exercise.

***Principles:*** Refer to the *Mountain Flying Training Standards Guide.*

## Topic V - Emergencies

***Aim:*** To practice emergencies where options may be limited, where terrain and or weather are intrusive to the ideal.

***Exercise:*** While conducting mountain flying training or during dual cross country training, experience simulated forced landings and precautionary landings when flying below a ridgeline.

***Principles:*** Refer to the *Mountain Flying Training Standards Guide.*

### References:

*Mountain Flying Training Standards Guide*

*Flight Instructor Guide*

*Mountain Flying*

*In, Out and Around Milford*

*In, Out and Around Mount Cook*

*In, Out and Around Queenstown*

*Mountain Flying DVD*

# Appendix VI – Helicopter Basic Mountain Flying Training Syllabus

## Theory Component

The theory component of helicopter basic mountain flying includes a number of objectives from the (PPL) helicopter mountainous terrain awareness theory syllabus in addition to new objectives for specific CPL(H) requirements. A CPL(H) candidate should be able to answer all of the objectives to a level appropriate for commercial operations. However, depending on the circumstances, revision and assessment may be an acceptable means of instruction for some of the objectives previously covered as part of helicopter mountainous terrain awareness training.

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|---|---|
| **1.0** | **AIRCRAFT HANDLING** |
| **1.1.0** | **Horizon awareness** |
| 1.1.1 | Define the natural horizon and estimate where a virtual horizon should be on a variable background |
| 1.1.2 | Outline the illusions associated with inaccurate horizon definition |
| **1.2.0** | **Height and altitude considerations** |
| 1.2.1 | State the visual cues used for lateral and vertical clearances |
| 1.2.2 | Outline how a barometric altimeter is used to gauge height above terrain |
| 1.2.3 | Describe the effect of density altitude on the following aspects of performance: |
| a | power available/required |
| b | effect on TAS, rate of climb, turn radius |
| c | inertia |
| d | Vne and other limitations |
| e | collective pitch angle, retreating blade stall |
| 1.2.4 | State the conditions conducive for engine inlet/carburettor icing |
| **2.0** | **WEATHER PATTERNS AND WIND AWARENESS** |
| **2.1.0** | **Mountain weather** |
| 2.1.1 | Evaluate the general weather situation and pressure systems in terms of likely mountain weather |
| 2.1.2 | Outline typical seasonal differences in mountain weather |
| 2.1.3 | Describe how to recognise mountain waves and rotor zones and the hazards they pose |
| 2.1.4 | Describe the likely flying conditions associated with various cloud types |
| 2.1.5 | Outline the rapidity of weather changes, including the importance of those behind the aircraft |

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| 2.1.6 | State how free air & surface temperature vary with altitude |
| 2.1.7 | State the environmental factors that influence visibility plus the effect of precipitation on windscreen |
| **2.2.0** | **Wind awareness** |
| 2.2.1 | Describe, in fluid terms, the flow of air that is obstructed by terrain |
| 2.2.2 | Describe the difference between wind over flat land and in the mountains |
| 2.2.3 | Outline the formation and characteristics of local winds, including katabatic and anabatic winds |
| 2.2.4 | Describe updraughts, down draughts, funnelling, mechanical/thermal turbulence, gusts and turbulence, rotors and lee waves |
| 2.2.5 | Describe the behaviour of wind at less than ~15kts and above 15kts |
| 2.2.6 | Define the demarcation line |
| 2.2.7 | Outline the following methods of wind-finding: |
| a | cloud shadows as indicators of upper winds |
| b | indicators of lower level wind, e.g.: |
| | (1) smoke/dust/precipitation |
| | (2) drift and groundspeed/airspeed correlation |
| | (3) updraughts and downdraughts |
| | (4) cloud/mist formation |
| | (5) movement of vegetation |
| | (6) water ripples/lanes/shadows on bodies of water |
| **3.0** | **TRANSIT FLYING** |
| **3.1.0** | **Pre-flight planning** |
| 3.1.1 | Select the appropriate map (type & scale) for the intended flight |
| 3.1.2 | Select an appropriate route and height, taking into account: |
| a | VFR minima |
| b | terrain & map interpretation |
| c | wind, turbulence etc |
| d | cloud base |
| e | sun/shadow |
| f | power available |

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| g | forced landing areas |
| h | wires |
| i | radio coverage |
| j | alternate/escape routes |
| k | legal requirements (incl. the minimum height/lateral separation specified in CAR 91.311) |
| **3.2.0** | **Flying techniques** |
| 3.2.1 | Describe valley flying techniques for: |
| a | entering & manoeuvring in a wide valley |
| b | selecting where in valley, and how far up the side, to fly |
| c | anticipating the effect of sudden shadow / sun effects |
| d | flying up a valley compared to flying down a valley |
| e | entering a narrow valley/re-entrant/gully |
| f | flying at reduced airspeed, with particular attention to translational lift and turning downwind |
| g | making reversal turns, including the use of valley width and the effect of airspeed and wind on radius of a balanced turn; the benefits and dangers of using yaw/pitch |
| 3.2.2 | Describe techniques for maintaining orientation: |
| a | how to maintain situational awareness: map reading, sun, valley alignment, compass. Note the limitations of GNSS |
| b | using a kneeboard and map. Map folding |
| c | lost procedure: escape route downstream |
| 3.2.3 | Describe saddle/ridge crossing techniques: |
| a | the variables determining how to cross, and the relative importance of each. |
| b | assessing up and down draughts |
| c | safest approach direction and escape route |
| d | difference between a knife edge saddle and a prolonged commitment area saddle |
| e | aircraft attitude and altitude at saddle/ridge |
| f | anticipation of turbulence |

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| g | estimating a safe height to cross by appropriate use of parallax and horizon |
| h | effect of different backgrounds |
| 3.2.4 | State the importance of prompt and effective decision making for crossing saddles/ridges, including the consideration of the following factors: |
| a | identify and consider all options |
| b | select the best approach direction |
| c | select and review a fixed committal point |
| d | identify a safe escape route |
| e | consider the helicopter position and options after crossing |
| **4.0** | **APPROACH AND LANDING TO UNPREPARED SITE** |
| **4.1.0** | **Reconnaissance** |
| 4.1.1 | State how permission to land/approach is obtained |
| 4.1.2 | State how "confined area" considerations may be applied |
| 4.1.3 | State the requirement to conduct a low approach and overshoot |
| **4.2.0** | **Power checks** |
| 4.2.1 | Use flight manual/supplements/performance graphs & tables to accurately determine power requirements |
| 4.2.2 | State the appropriate height above touchdown point to conduct a power check |
| 4.2.3 | State why OGE power should be available for all approach or landings to any unprepared site in the mountains |
| **4.3.0** | **Wind direction & demarcation line** |
| 4.3.1 | Illustrate the general wind flow and local disturbances over a mountain feature and identify the demarcation line |
| **4.4.0** | **Approach direction and angle** |
| 4.4.1 | State the benefits of remaining above the demarcation line |
| 4.4.2 | Describe how a constant angle/straight-in approach should be flown |
| **4.5.0** | **Committal point and escape route** |
| 4.5.1 | Describe the points to consider before commencing an approach |
| 4.5.2 | State how translational lift can be differentiated from turbulence |

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| **4.6.0** | **Aiming point/hover or touchdown point** |
| 4.6.1 | State the need to positively identify the point |
| 4.6.2 | State the factors to be considered in assessing suitability of the point |
| **4.7.0** | **Typical terrain features** |
| 4.7.1 | Describe the following typical terrain features and associated considerations: |
| a | river flat, open ground above the tree line |
| b | rounded knoll/crown |
| d | plateau |
| e | rounded ridge, razorback, saddle |
| h | valley/creek bed (with consideration of rocks, boulders, sand etc) |
| **4.8.0** | **Main/tail rotor awareness** |
| 4.8.1 | Describe the techniques for landing on uneven ground and considerations for clearances |
| 4.8.2 | State when hover-loading or an out-of wind landing may be required |
| 4.8.3 | State the dangers involved in backing up |
| 4.8.4 | Describe how tail rotor effectiveness can be lost at high density altitude |
| **5.0** | **TAKE OFF FROM UNPREPARED SITE** |
| **5.1.0** | **Power checks** |
| 5.1.1 | Use flight manual/supplements/performance graphs & tables to accurately determine power requirements |
| 5.1.2 | State why sufficient power should normally be available to conduct at least a shallow towering take-off from any unprepared site in the mountains. |
| 5.1.3 | State the requirement to maintain RRPM within the normal operating range. |
| 5.1.4 | State the requirement to check hover power available |
| **5.2.0** | **Take-off and climb-out** |
| 5.2.1 | Describe how to safely lift from rough terrain into the hover |
| 5.2.2 | Describe the standard take-off technique; including take-off direction with respect to wind, when to transition forward, the height to climb to or when a descent may be initiated, and the climb-out path to follow |
| 5.2.4 | Outline tail rotor considerations |

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| **6.0** | **EMERGENCIES** |
| **6.1.0** | **Controlled flight into terrain** |
| 6.1.1 | Outline the consequences of poor decision making, resulting in reaction instead of anticipation |
| 6.1.2 | Describe how to recover from sink/overpitching/settling with power |
| 6.1.3 | Describe how to recover from the loss of visual reference or entry into inadvertent IMC |
| **6.2.0** | **Forced/Precautionary Landings** |
| 6.2.1 | Describe the actions to be taken in the event of a complete engine failure or catastrophic failure requiring immediate landing: |
| a | immediate actions |
| | (1) lower collective, or as required by flight manual |
| | (2) effect of altitude on: collective position; RRPM; ROD |
| b | know the (often limited) options, including: |
| | (1) wind direction/strength/turbulence |
| | (2) possibility that no open flat ground is available |
| | (3) landing on valley floor versus ridgeline |
| | (4) landing upslope/downslope |
| | (5) type of engine-off landing |
| | (6) autorotation distance |
| c | have a plan |
| 6.2.2 | Describe the actions to be taken in the event of a partial engine failure or other helicopter or weather emergencies requiring landing as soon as possible including; Loss of Tail Rotor Effectiveness, low or high RRPM, low G, exceeding Vne |
| a | immediate actions |
| b | know the options |
| c | have a plan |
| **7.0** | **HUMAN FACTORS** |
| **7.1.0** | **Situational awareness** |
| 7.1.1 | Describe the importance of correct orientation and how to maintain it |
| 7.1.2 | Outline the impact of the scale of the landscape and clear visibility on estimating heights and distances |

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| 7.1.3 | Describe the psychological stresses of operating in the mountains, particularly for inexperienced pilots |
| **7.2.0** | **Aircraft management** |
| 7.2.1 | Outline the additional factors required in fuel planning |
| 7.2.2. | Detail the factors that lead to airframe/engine icing and how to avoid or minimise them |
| **7.3.0** | **Airmanship** |
| 7.3.1 | Explain the need for positive action rather than reaction to events |
| 7.3.2 | Explain the need for, and techniques of, effective decision-making |
| 7.3.3 | Outline the need to apply fundamental principles: aviate- navigate – communicate |
| 7.3.4 | Outline radio communications/flight follow considerations |
| 7.3.6 | Outline the requirements to ensure the care, comfort and safety of passengers |
| **7.4.0** | **Aviation medicine** |
| 7.4.1 | Outline the physiological effects relating to pressure & temperature |
| 7.4.2 | Outline the causes and effects of hypoxia/anxiety/load-shedding |
| 7.4.3 | Outline the effect of glare on effective vision |
| 7.4.4 | Describe the type of clothing/footwear that should be worn |
| **7.5.0** | **SAR aspects** |
| 7.5.1 | Outline typical aircraft and personal survival kits, their use and contents with respect to basic principles of survival, the area of operations and the likely time before pickup |
| 7.5.2 | Outline the principles of survival: First Aid; Protection; Location; Water; Food; Will to Survive |

## Flight Component

The flight component of helicopter basic mountain flying includes a number of objectives from the '(PPL) Helicopter Mountainous Terrain Awareness Flight Syllabus' in addition to new objectives for specific CPL(H) requirements. A CPL(H) candidate should be able to execute all of the objectives to a level appropriate for commercial operations. However, depending on the circumstances, revision and assessment may be an acceptable means of instruction for some of the objectives previously covered in helicopter mountainous terrain awareness training. This will allow the instruction to focus on "Approach and Landing to Unprepared Site".

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| **1.0** | **AIRCRAFT HANDLING** |
| 1.1 | Fly at constant height above a contour line for: |
| | horizon identification and to maintain appropriate disc/nose attitude |
| | maintaining constant altitude |
| | awareness of lateral and vertical distance from terrain |
| | appreciation of inertia |
| | appreciation of available escape routes |
| 1.2 | Estimate height by visual means, use of barometric or radio altimeters |
| **2.0** | **WEATHER PATTERNS AND WIND AWARENESS** |
| 2.1 | Recognise up and down draughts and areas of likely turbulence |
| 2.2 | Estimate wind strength and direction using visual indicators |
| 2.3 | Estimate wind strength and direction using groundspeed/airspeed correlation |
| 2.4 | Experience flight in inclement weather |
| **3.0** | **TRANSIT FLYING** |
| 3.1 | Fly at an appropriate height for the conditions |
| 3.2 | Select and fly an appropriate route/position for wind or weather conditions etc |
| 3.3 | Fly in a confined valley |
| 3.4 | Cross a ridge/saddle |
| **4.0** | **APPROACH AND LANDING TO UNPREPARED SITE** |
| 4.1 | Carry out a reconnaissance and power check |
| 4.2 | Accurately determine the surface wind |
| 4.3 | Experience flight ahead of and behind demarcation line |
| 4.4 | Conduct an approach to an open flat area (normal circuit) |
| 4.5 | Conduct a straight-in constant angle ("gun barrel") approach |

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| 4.6 | Execute an overshoot to the pre-planned escape route |
| **5.0** | **TAKE OFF FROM UNPREPARED SITE** |
| 5.1 | Calculate power required and check power available in hover |
| 5.2 | Conduct a towering take-off directly into wind |
| **6.0** | **EMERGENCIES** |
| 6.1 | Enter and sustain an autorotation from high altitude, recovering as required |
| 6.2 | Experience LTE and low RRPM and recovery from both |
| **7.0** | **HUMAN FACTORS** |
| 7.1 | Maintain situational awareness |
| 7.2 | Demonstrate good aircraft management |
| 7.3 | Demonstrate good airmanship |
| 7.4 | Carry a personal first aid and survival kit |