



GOVERNMENT OF INDIA
OFFICE OF THE DIRECTOR GENERAL OF CIVIL AVIATION
TECHNICAL CENTRE, OPP. SAFDARJUNG AIRPORT, NEW DELHI

**CIVIL AVIATION REQUIREMENT
SECTION 7 – FLIGHT CREW STANDARDS
TRAINING & LICENSING,
SERIES 'B', PART II**

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Subject: Syllabus for Examination for Issue of Private Pilot's Licence for Aeroplanes and Pilot's Licence for Microlight Aircraft, Gliders and Balloons

1. INTRODUCTION

Section E of Schedule II of the Aircraft Rules, 1937 stipulate, amongst other requirements, that for issuance of Private Pilot's Licence (PPL) for Aeroplanes, the applicant shall have to pass a written examination as per the syllabus prescribed by the DGCA. Section G, H and I of Schedule II of Aircraft Rules 1937 lay down similar requirements for the issuance of Pilot's Licence for Microlight Aircraft, Balloons and Gliders respectively.

This CAR lays down the main topics of syllabus for the guidance of the candidates for appearing in the written examinations for issuance of these licenses for aeroplanes, microlight aircraft and balloons, and oral examination for Pilot's license (Gliders) under the above sections of Schedule II. The syllabus is in accordance with the knowledge requirements prescribed in ICAO Annex 1.

This CAR is issued under the provisions of Scheduled II and Rule 133A of the Aircraft Rules, 1937.

2. SYLLABUS

2.1 Private Pilot's Licence (Aeroplanes and Microlight Aircraft)

The applicant shall pass written examination conducted by DGCA. The detailed Syllabus for appearing in PPLG (Composite) is attached as Appendix 'A' and for PPLT (Technical) is attached as Appendix 'B'.

2.2 Radio Telephony

The Radio Telephony procedures and phraseology as applied for VFR operations; action to be taken in case of communication failure.

2.3 Pilot's Licence (Balloons)

The applicant shall pass written examination conducted by DGCA. The detailed syllabus for appearing in PPLG (Composite) is attached as Appendix 'A'

PLBT (Airmanship and Balloon System/Aerostatic)

- A. Balloon General Knowledge
 - a) Principles of operation of free balloon systems and instruments;
 - b) Operating limitations of free balloons; relevant operational information from the flight manual or other appropriate documents;
 - c) Physical properties and practical application of gasses used in free balloons.
 - d) Airmanship and Balloon systems/ aerostatics.

- B. Flight Performance and Planning
 - a) Effects of loading on flight characteristics; mass calculations;
 - b) Use and practical application of launching, landing and other performance data, including the effect of temperature;
 - c) Pre-flight and en-route flight planning appropriate to conditions under VFR; appropriate air traffic service procedures, position reporting procedures; altimeter setting procedures; operations in areas of high density traffic;

2.4 Radio Telephony

The Radio Telephony procedures and phraseology as applied for VFR operations; action to be taken in case of communication failure.

2.5 Pilot's Licence (Gliders)

The applicant shall pass an oral examination in the subjects of Air Regulations, Air Navigation, Aviation Meteorology, Aircraft and Instruments and engines in case of Motor Glider covering at least the following main topics

2.5.1 Air Regulations

- a) Aircraft Act, 1934 – Chapter 1, Short title and extent, definitions, power to detain aircraft, penalty for act in contravention of rules made under the Act, penalty for flying so as to cause danger;
- b) Aircraft Rules, 1937
- c) Rules of the Air;
- d) Appropriate Air Traffic Services practices and procedures.

2.5.2 Aircraft General Knowledge

- a) Principles of operation of Glider systems and instruments;
- b) Operating limitations of gliders; relevant operational information from the flight manual or other appropriate documents;

2.5.3 Flight Performance and Planning

- a) Effects of loading and mass distribution on flight characteristics; mass and balance consideration
- b) Use and practical application of launching, loading and other performance data;
- c) Pre-flight and en-route Flight Planning appropriate to operations under VFR; appropriate Air Traffic Service procedures, position reporting procedures; altimeter setting procedures; operations in areas of high density traffic.

2.5.4 Human Performance and Limitations

Human Performance and Limitations relevant to the glider pilot.

2.5.5 Aviation Meteorology

Application of elementary aeronautical meteorology; use of, and procedures for obtaining meteorology information; altimetry.

2.5.6 Air Navigation

Practical aspects of air navigation and dead reckoning techniques; use of aeronautical charts.

2.5.7 Operational Procedures

- a) Use of aeronautical documentation such as AIP, NOTAM, aeronautical codes and abbreviations;
- b) Different launch methods and associated procedures;
- c) Appropriate precautionary and emergency procedures, including action to be taken to avoid hazardous weather, wake turbulence and other operating hazards.

2.5.8 Principles of Flight

Principles of flight relating to gliders;

2.5.9 Radio Telephony

The Radio Telephony procedures and phraseology as applied for VFR operations; action to be taken in case of communication failure.



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**SYLLABUS FOR PRIVATE PILOT LICENSE
EXAMINATION**

- AEROPLANES**
- MICROLIGHT**

APPENDIX 'A'

**PRIVATE PILOT LICENCE EXAMINATION
(COMPOSITE)**

THE SYLLABUS OF PRIVATE PILOT LICENCE (COMPOSITE) IS AS FOLLOWS

1. Air Navigation

1.1 Form of the Earth

- axis, poles
- meridians of longitude
- parallels of latitude
- great circle, small circle, rhumb line
- hemispheres, north/south, east/west

1.2 Mapping

- aeronautical maps and charts (topographical)
- projections and their properties
- conformality
- equivalence
- scale
- great circles and rhumb lines

Conformal orthomorphic projection (ICAO 1:500,000 chart)

- main properties
- construction
- convergence of meridians
- presentation of meridians, parallels, great circles and rhumb lines
- scale, standard parallels
- depiction of height

Direction

- true north
- earth's magnetic field, variation – annual change
- magnetic north
- vertical and horizontal components
- isogonals, agonic lines

Aeroplane magnetism

- magnetic influences within the aeroplane
- compass deviation
- turning, acceleration errors
- avoiding magnetic interference with the compass

Distances

- units
- measurement of distance in relation to map projection

Charts in practical navigation

- plotting positions
- latitude and longitude
- bearing and distance
- use of navigation protractor
- measurement of tracks and distances

Chart reference material/map reading

- map analysis
- topography
- relief
- cultural features
- permanent features (e.g. line features, spot features, unique or special features)
- features subject to change (e.g. water)
- preparation
- folding the map for use
- methods of map reading
- map orientation
- checkpoint features
- anticipation of checkpoints
- with continuous visual contact
- without continuous visual contact
- when uncertain of position
- aeronautical symbols
- aeronautical information
- conversion of units

1.3 Principles of navigation

- IAS, CAS and TAS
- track, true and magnetic
- wind velocity, heading and groundspeed
- triangle of velocities
- calculation of heading and ground speed
- drift, wind correction angle
- ETA
- dead reckoning, position, fix

1.4 The navigation computer

- use of the circular slide rule to determine
- TAS, time and distance
- conversion of units
- fuel required
- pressure, density and true altitude
- time en-route and ETA
- use of the computer to solve triangle of velocities
- application of TAS and wind velocity to track
- determination of heading and ground speed
- drift and wind correction angle

1.5 Time

- relationship between universal co-ordinated (standard) (UTC) time and local mean time (LMT)
- definition of sunrise and sunset times

1.6 Flight planning

- selection of charts
- route and aerodrome weather forecasts and reports
- assessing the weather situation
- plotting the route
- considerations of controlled/ regulated airspace, airspace restrictions, danger areas, etc.
- use of AIP and NOTAMS
- ATC liaison procedures in controlled/ regulated airspace
- fuel considerations
- en-route safety altitude(s)
- alternate aerodromes
- communications and radio/navaid frequencies
- compilation of flight log
- compilation of ATC flight plan
- selection of check points, time and distance marks
- weight and balance calculations
- weight and performance calculations

1.7 Practical navigation

- compass headings, use of deviation card
- organization of in-flight workload
- departure procedure, log entries, altimeter setting and establishing IAS
- maintenance and heading of altitude
- use of visual observations
- establishing position, checkpoints
- revisions to heading and ETA
- arrival procedures, ATC liaison
- completion of flight log and aeroplane log entries.

2. Flight Performance and Planning

2.1 Mass and Balance

Mass and Balance

- limitations on maximum mass
- forward and aft limitations of centre of gravity, normal and utility operation
- mass and centre of gravity calculations – aeroplane manual and balance sheet

2.2 Performance

Take-off

- take-off run and distance available
- take-off and initial climb
- effects of mass, wind and density altitude
- effects of ground surface and gradient
- use of flaps

Landing

- effects of mass, wind, density altitude and approach speed
- use of flaps
- ground surface and gradient

In-flight

- relationship between power required and power available
- performance diagram
- maximum rate and maximum angle of climb
- range and endurance
- effects of configuration, mass, temperature and altitude
- reduction of performance during climbing turns
- gliding
- adverse effects
- icing, rain
- condition of the airframe
- effect of flap

3 Aviation Meteorology

3.1 The Atmosphere

- Composition and structure
- vertical divisions

- Pressure, density and temperature
 - barometric pressure, isobars
 - changes of pressure, density and temperature with altitude
 - altimetry terminology
 - diurnal variation of temperature
 - adiabatic process
 - temperature lapse rate
 - stability and instability

- 3.2 Humidity and precipitation
 - water vapour in the atmosphere

 - vapour pressure
 - dew point and relative humidity
 - condensation and vaporization
 - precipitation

- 3.3 Pressure and wind
 - high and low pressure areas
 - motion of the atmosphere, pressure gradient
 - vertical and horizontal motion, convergence, divergence
 - surface and geostrophic wind
 - effect of wind gradient and windshear on take-off and landing
 - relationship between isobars and wind, Buys Ballot's law
 - turbulence and gustiness
 - local winds, fahn, land and sea breeze

- 3.4 Clouds formation
 - cooling by advection, radiation and adiabatic expansion
 - cloud types
 - convection clouds
 - orographic clouds
 - stratiform and cumulus clouds
 - flying conditions in each cloud type

- 3.5 Fog, mist, haze
 - radiation, advection, frontal, freezing fog
 - formation and dispersal
 - reduction of visibility due to mist, snow, smoke, dust and sand
 - assessment of probability of reduced visibility
 - hazards in flight due to low visibility, horizontal and vertical

- 3.6 Air masses
 - description of and factors affecting the properties of air masses
 - classification of air masses, region of origin

- modification of air masses during their movement
- development of low and high pressure system
- weather associated with pressure systems

3.7 Ice accretion

- conditions conducive to ice formation
- effects of hoar frost, rime ice, clear ice
- effects of icing on aeroplane performance
- precautions and avoidance of icing conditions
- powerplant icing
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- precautions, prevention and clearance of induction and carburetor icing

3.8 Thunderstorms

- formation – air mass, frontal, orographic
- conditions required
- development process
-
- recognition of favourable conditions for formation
- hazards for aeroplanes
- effects of lightning and severe turbulence
- avoidance of flight in the vicinity of thunderstorms

3.9 Flight over hilly or mountainous areas

- hazards
- influence of terrain on atmospheric processes
- mountain waves, windshear, turbulence, vertical movement, rotor effects, valley winds

3.10 Indian Climatology

- general seasonal circulation in the troposphere
- local seasonal weather and winds
 - tropopause influence on aircraft performance
 - effect of ozone, radioactivity
 - development and effect of valley inversions
 - reduction of visibility caused by low drifting and blowing snow

3.11 Altimetry

- operational aspects of pressure settings,
- pressure altitude, density altitude
- height, altitude, flight level
- ICAO standard atmosphere

- QNH, QFE, standard setting
- transition altitude, layer and level

- 3.12 The meteorological organization
 - aerodrome meteorological offices
 - aeronautical meteorological stations
 - forecasting service
 - meteorological services at aerodromes
 - availability of periodic weather forecasts
- 3.13 Weather analysis and forecasting
 - weather charts, symbols, signs
 - significant weather charts
 - prognostic charts for general aviation

- 3.14 Weather information for flight planning
 - reports and forecasts for departure, en-route, destination and alternate(s)
 - interpretation of coded information METAR, TAF

 - availability of ground reports for surface wind, windshear, visibility

- 3.15 Meteorological broadcasts for aviation
 - VOLMET, ATIS, SIGMET

4. Radio Navigation

- Ground D/F
 - application
 - principles
 - presentation and interpretation
 - coverage
 - errors and accuracy
 - factors affecting range and accuracy

- ADF, including associated beacons (NDBs) and use of the radio magnetic indicator (RMI)
 - application
 - principles
 - presentation and interpretation
 - coverage
 - errors and accuracy
 - factors affecting range and accuracy

- VOR/DME

- application
- principles
- presentation and interpretation
- coverage
- errors and accuracy
- factors affecting range and accuracy

- GPS
 - application
 - principles
 - presentation and interpretation
 - coverage
 - errors and accuracy
 - factors affecting reliability and accuracy

- Ground Radar
 - principles
 - presentation and interpretation
 - coverage
 - errors and accuracy
 - factors affecting reliability and accuracy

- Secondary Surveillance Radar
 - principles (transponders)

 - application
 - presentation and interpretation
 - modes and codes

5. Communications

Radio Telephony and Communications

- use of AIP and frequency selection
- microphone technique
- phonetic alphabet
- station/aeroplane callsigns/abbreviation
- transmission technique
- use of standard words and phrases
- listening out
- required 'readback' instructions

Departure procedures

- radio checks
- taxi instructions

- holding on ground
- departure clearance

En-route procedures

- frequency changing
- position, altitude/flight level reporting
- flight information service
- weather information
- weather reporting
- procedures to obtain bearings, headings, position
- procedural phraseology
- height/range coverage

Arrival and traffic pattern procedures

- arrival clearance
- calls and ATC instructions during the:
 - circuit
 - approach and landing
 - vacating runway

Communication failure

- action to be taken
- alternate frequency
- serviceability check, including microphone and headphones
- in-flight procedures according to type of airspace

Distress and urgency procedures

- distress (Mayday), definition and when to use
- frequencies to use
- contents of Mayday message
- urgency (Pan), definition and when to use
- frequencies to use
- relay of messages
- maintenance of silence when distress/urgency call heard
- cancellation of distress/urgency

6. General Flight Safety

Aeroplane

- seat adjustment and security

- harnesses and seat belts
- emergency equipment and its use
- fire extinguisher
- engine/cabin fires
- de-icing systems
- survival equipment, life jackets, life rafts

- carbon monoxide poisoning
- re-fuelling precautions
- flammable goods/pressurized container

Operational

- wake turbulence
- aquaplaning
- windshear, take-off, approach and landing
- passenger briefings
- emergency exits
- evacuation from the aeroplane
- forced landings
- gear-up landing
- ditching

7. Instrumentation

7.1 Flight Instruments

Pitot / Static System

- pitot tube, function
- pitot tube, static source
- alternate static source
- position error
- system drains
- errors caused by blockage or leakage

Airspeed indicator

- principles of operation
- relationship between pitot and static pressure
- definitions of indicated, calibrated and true airspeed
- instrument errors,
- airspeed indications, colour coding
- pilot's serviceability checks

Altimeter

- principles of operation and construction

- function of the sub-scale
- effects of atmospheric density
- pressure altitude
- true altitude
- international standard atmosphere
- flight level

- presentation (three needle)
- instrument errors
- pilot's service ability checks

Vertical Speed Indicator (VSI)

- principles of operation and construction
- function
- inherent lag
- instantaneous VSI
- presentation
- pilot's serviceability checks

Gyroscopes

- principles
- rigidity
- precession

Turn indicator

- rate gyro
- purpose and function
- effect of speed
- presentation
- turn coordinator
- limited rate of turn indications
- power source
- balance indicator
- principle
- presentation
- pilot's serviceability checks

Altitude indicator

- earth gyro
- purpose and function
- presentations
- interpretation
- operating limitations

- power source pilot's serviceability checks

Heading indicator

- Directional gyro
- Purpose and function
- Presentation
- Use with Magnetic compass
- Setting mechanism
- Apparent drift
- Operating limitation
- Power source
- Pilot's serviceability checks

Magnetic Compass

- construction and function
- earth's magnetic field

- variation and deviation
- turning, acceleration errors
- precautions when carrying magnetic items
- pilot's service ability checks

Engine Instruments

- principles, presentation and operational use of:
 - oil temperature gauge
 - oil pressure gauge
 - cylinder head temperature gauge
 - exhaust gas meter
 - manifold pressure gauge
 - fuel pressure gauge
 - fuel flow gauge
 - fuel quantity gauge (s)
- tachometer

Other Instruments

- principles, presentation and operational use of:
 - vacuum gauge
 - voltmeter and ammeter
 - warning indicators
 - others relevant to aeroplane type

7.2 Airworthiness

- certificate to be in force
- compliance with requirements
- periodic maintenance inspections
- compliance with flight manual (or equivalent), instructions, limitations, placards
- flight manual supplements
- provision and maintenance of documents
- aeroplane, engine and propeller log books
- recording of defects
- permitted maintenance by pilots

8 Air Regulation

8.1 Legislation

- The Convention of International Civil Aviation

- The International Civil Aviation Organization
- Documents to be carried in aircraft
- Use of aircraft radio equipment
- Certificate of airworthiness
- Licences of personnel
- Recognition of certificates and licences
- Journey log books
- Cargo restrictions
- Restrictions on use of photographic equipment
- Endorsement of certificates of licences
- Validity of endorsed certificates and licences

Annexes to the Convention ('ICAO Annexes')

Annex 7 Aircraft Nationality and Registration Marks

- definitions

8.2 Rules of the Air

Annex 2 Rules of the Air

- definitions
- applicability
- general rules
- visual flight rules
- signals (Appendix 1)
- interception of civil aircraft (Appendix 2)

8.3 Air Traffic regulations and Air Traffic Services

Annex 11 Air Traffic Regulations and Air Traffic Services

- definitions
- objectives of air traffic services
- classification of airspace
- flight information regions, control areas and control zones
- air traffic control services
- alerting service
- visual meteorological conditions
- instrument meteorological conditions
- in-flight contingencies

Annex 14 Aerodrome Data

- definitions
- conditions of the movement area and related facilities
- Visual aids for navigation
- indicators and signaling devices
- markings
- lights
- signs
- markers
- signal area
- Visual aids for denoting obstacles
- marking of objects
- lighting of objects
- Visual aids for denoting restricted use of areas
- Emergency and other services : fire and rescue service
- Aerodrome ground lights and surface marking colours
- Colours for aeronautical ground lights
- Colours for surface markings

ICAO Document 4444 – Rules of the Air and Air Traffic Services

General provisions

- definitions
- ATS operating practices
- Flight plan clearance and information
- Control of air traffic flow
- Altimeter setting procedures
- Wake turbulence information
- Meteorological information

- Air reports (AIREP)
- Area control service
- Separation of controlled traffic in the various classes of airspace
- Pilots, responsibility to maintain separation in VMC
- Emergency and communications failure procedures by the pilot
- Interception of civil aircraft

Approach control service

- Departing and arriving aircraft procedures in VMC

Aerodrome control service

- Function of aerodrome control towers
- VFR operations
- Traffic and circuit procedures
- Information to aircraft
- Control of aerodrome traffic

Flight information and alerting service

- Air traffic advisory service
- Objectives

8.4 Aircraft Rules and Civil Aviation Requirements

- Validity of licences and ratings
- Medical fitness
- Decrease in medical fitness
- Crediting of flight time
- State of licence issue
- Requirements

- Minimum age
- Privilege and conditions
- Ratings for special purposes
- Experience and crediting
- Training course
- Theoretical knowledge examination
- Skill test
- Circumstances in which an instrument rating is required
- Type and class ratings
- Division of class ratings
- Circumstances in which type or class ratings are required
- Validity, revalidation and renewal

- Instructor ratings
- Instruction – general

8.5 Contravention of Aviation Regulations

- Offences
- Penalties

8.6 National Law – National Law and differences to relevant ICAO Annexes and CARs.

Indian aircraft act 1934-section 1,2,8,10,11A,11B, 17&18(3/9)
Aircraft Rule 1937- Rule No. 1-19,21-29A,30,33,37A,38-48,50,52,53,55,65,67,67A,67B,68-70,76,79-89,133A,134,140,140(AB&C)15&161
Schedule I, II, VI, & XI
INDAIN AIRCRAFT RULES 1920-RULE NO 53-64
AIRCRAFT RULES 1954 (Public Health Rules)
AIRCRAFT RULES 2003 (Carriage of Dangerous Goods)

9 Human Performance & Limitations

9.1 Basic Physiology

Basic concepts of:

- composition of the atmosphere
- respiration and blood circulation
- Effects of partial pressure
- Hearing
- Motion sickness
- Flying and health
- Toxic hazards
 - dangerous goods
 - carbon monoxide from heaters

9.2 Basic psychology

The information process and its concepts

Stress

Judgment and decision making

10. Operational Procedures

- a) ICAO Annex 6, Parts II and DGCA India CARs on Operations in Section 2, 7 and 8
 - operation of aircraft
- b) ICAO Annex 12 – Search and Rescue
 - definitions
 - alerting phases
 - procedures for pilot-in-command intercepting a distress transmission
 - search and rescue signals
- c) ICAO Annex 13 – Aircraft Accident Investigation
 - definitions

APPENDIX 'B'

**PRIVATE PILOT LICENCE EXAMINATION
(AIRCRAFT & ENGINE – TECHNICAL GENERAL)**

1. Aircraft General Knowledge

1.1 Airframe

Airframe Structure

- Components
- Fuselage, wings, tailplane, fin
- primary flying controls
- trim and flap/slat systems
- landing gear
- nose wheel, including steering
- tyres, condition
- braking systems and precautions in use
- retraction system

Airframe loads

- Static strength
- Safety factor
- control lock and use
- ground/flight precaution

1.2 Powerplant

Engines - general

- principles of the four stroke internal combustion engine
- basic construction
- causes of pre-ignition and detonation
- power output as a function of RPM

1.3 Engine cooling

- air cooling
- cowling design and cylinder baffles
- design and use of cowl flaps
- cylinder head temperature gauge

1.4 Engine lubrication

- function and methods of lubrication
- lubrication systems
- methods of oil circulation
- oil pump and filter requirements
- qualities and grades of oil
- oil temperature and pressure control
- oil cooling methods

- recognition of oil system malfunctions
- 1.5 Ignition systems
- principles of magneto ignition

 - construction and function
 - purpose and principle of impulse coupling
 - serviceability checks, recognition of malfunctions
 - operational procedures to avoid spark plug fouling
- 1.6 Carburation
- principles of float type carburetor
 - construction and function methods to maintain correct mixture ratio
 - operation of metering jets and accelerator pump
 - effect of altitude
 - manual mixture control
 - maintenance of correct mixture ratio
 - limitation on use at high power
 - avoidance of detonation
 - idle cut-off valve
 - operation and use of primary engine controls
 - air induction system
 - carburetor icing, use of hot air
 - injection systems, principles and operation
- 1.7 Aero Engine Fuel
- classifications of fuels
 - grades and identification by colour
 - quality requirements
 - inspection for contamination
 - use of fuel strainers and drains
- 1.8 Fuel Systems
- fuel tanks and supply lines
 - venting system
 - mechanical and electrical pumps
 - gravity feed tank selection
 - system management
- 1.9 Propellers

- propeller nomenclature
- conversion of engine power to thrust
- design and construction of fixed pitch propeller
- forces acting on propeller blade
- variation of RPM with change of airspeed

- thrust efficiency with change of speed
- design and construction of variable pitch propeller
- constant speed unit operation
- effect of blade pitch changes
- windmilling effect

1.10 Engine Handling

- starting procedures and precautions
- recognition of malfunctions
- warming up, power and system checks
- oil temperature and pressure limitations
- cylinder head temperature limitations
- ignition and other system checks
- power limitations
- avoidance of rapid power changes
- use of mixture control

1.11 Systems

Electrical System

- operations of alternators/generators
- direct current supply
- batteries, capacity and charging
- voltmeters and ammeters
- circuit breakers and fuses
- electrically operated services and instruments
- recognition of malfunctions
- procedure in the event of malfunctions

1.12 Vacuum System

- components
- pumps
- regulator and gauge
- filter system
- recognition of malfunction
- procedures in the event of malfunctions

2. Principles of Flight

2.1 The Atmosphere

- composition and structure
- ICAO standard atmosphere
- Atmospheric pressure

2.2 Airflow around a body, sub-sonic

- air resistance and air density
- boundary layer
- friction forces
- laminar and turbulent flow
- Bernoulli's principle – venturi effect

2.3 Airflow about a two dimensional aerofoil

- airflow around a flat plate
- airflow around a curved plate (aerofoil)
- description of aerofoil cross section
- lift and drag
- C_L and C_D and their relationship to angle of attack

2.4 Three dimensional flow about an aerofoil

- aerofoil shapes and wing planforms
- induced drag
- downwash angle, vortex drag, ground effect
- aspect ratio
- parasite (profile) drag
- form, skin friction and interference drag
- lift/drag ratio

Distribution of the four forces

- balance and couples
- lift and weight
- thrust and drag
- methods of achieving balance

2.5 Flying controls

- The three planes
- Pitching about the lateral axis

- Rolling about the longitudinal axis
- Yawing about the normal axis
- Effects of the elevators (stabilators), ailerons and rudder
- Control in pitch, roll and yaw
- Cross coupling, roll and yaw
- Weight and aerodynamic balance of control surfaces

2.6 Trimming controls

- Basic trim tab, balance tab and anti-balance tab
- Purpose and function
- Method of operation

2.7 Flaps and slats

- Simple, split, slotted and fowler flaps
- Purpose and function
- Operational use
- Slats, leading edge
- Purpose and function
- Normal/automatic operation

2.8 The stall

- Stalling angle of attack
- Disruption of smooth airflow
- Reduction of lift, increase of drag
- Movement of centre of pressure
- Symptoms of development
- Aeroplane characteristics at the stall
- Factors affecting stall speed and aeroplane behaviour at the stall
- Stalling from level, climbing, descending and turning flight
- Inherent and artificial stall warnings
- Recovery from the stall

2.9 Avoidance of spins

- Wing tip stall
- The development of roll
- Recognition at the incipient stage
- Immediate and positive stall recovery

2.10 Stability

- Definitions of static and dynamic stability

- Longitudinal stability
- Centre of gravity effect on control in pitch
- Lateral and directional stability
- Inter-relationship, lateral and directional stability

2.11 Load factor and manoeuvres

- Structural considerations
- Manoeuvring and gust envelope
- Limiting load factors, with and without flaps
- Changes in load factor in turns and pull-ups
- Manoeuvring speed limitations
- In-flight precautions

2.12 Stress loads on the ground

- Side loads on the landing gear
- Landing
- Taxiing, precautions during turns