1. AIR LAW AND ATC PROCEDURES
International law: conventions, agreements and organisations

The Convention on international civil aviation (Chicago) Doc. 7300/6
- Part I Air Navigation: relevant parts of the following chapters:
  (a) general principles and application of the convention;
  (b) flight over territory of Contracting States;
  (c) nationality of aircraft;
  (d) measures to facilitate air navigation;
  (e) conditions to be fulfilled on aircraft;
  (f) international standards and recommended practices;
  (g) validity of endorsed certificates and licences;
  (h) notification of differences.
- Part II The International Civil Aviation Organisation (ICAO): objectives and composition

Annex 8: Airworthiness of aircraft
- Foreword and definitions
- Certificate of airworthiness

Annex 7: Aircraft nationality and registration marks
- Foreword and definitions
- Common and registration marks
- Certificate of registration and aircraft nationality

Annex 1: Personnel licensing
- Definitions
- Relevant parts of Annex 1 connected to Part- FCL and Part-Medical

Annex 2: Rules of the air
- Essential definitions, applicability of the rules of the air, general rules (except water operations), visual flight rules, signals and interception of civil aircraft

Procedures for air navigation: aircraft operations doc. 8168-ops/611, volume 1
Altimeter setting procedures (including IACO doc. 7030 – regional supplementary procedures)
- Basic requirements (except tables), procedures applicable to operators and pilots (except tables)

Secondary surveillance radar transponder operating procedures (including ICAO Doc. 7030 – regional supplementary procedures)
- Operation of transponders
- Phraseology

Annex 11: Doc. 4444 air traffic management
- Definitions
- General provisions for air traffic services
- Visual separation in the vicinity of aerodromes
- Procedures for aerodrome control services
- Radar services
- Flight information service and alerting service
- Phraseologies
• Procedures related to emergencies, communication failure and contingencies

**Annex 15: Aeronautical information service**
- Introduction, essential definitions
- AIP, NOTAM, AIRAC and AIC

**Annex 14, volume 1 and 2: Aerodromes**

**Definitions**
- Aerodrome data: conditions of the movement area and related facilities
- Visual aids for navigation:
  (a) indicators and signalling devices;
  (b) markings;
  (c) lights;
  (d) signs;
  (e) markers.
- Visual aids for denoting obstacles:
  (a) marking of objects;
  (b) lighting of objects.
- Visual aids for denoting restricted use of areas
- Emergency and other services:
  (a) rescue and fire fighting;
  (b) apron management service.

**Annex 12: Search and rescue**
- Essential definitions
- Operating procedures:
  (a) procedures for PIC at the scene of an accident;
  (b) procedures for PIC intercepting a distress transmission;
  (c) search and rescue signals.
- Search and rescue signals:
  (a) signals with surface craft;
  (b) ground or air visual signal code;
  (c) air or ground signals.

**Annex 17: Security**
- General: aims and objectives

**Annex 13: Aircraft accident investigation**
- Essential definitions
- Applicability

**National law**
- National law and differences to relevant ICAO Annexes and relevant EU regulations.
2. HUMAN PERFORMANCE

Human factors: basic concepts

Human factors in aviation

• Becoming a competent pilot

Basic aviation physiology and health maintenance

• The atmosphere:
  (a) composition;
  (b) gas laws.

• Respiratory and circulatory systems:
  (a) oxygen requirement of tissues;
  (b) functional anatomy;
  (c) main forms of hypoxia (hypoxic and anaemic):
    (1) sources, effects and counter-measures of carbon monoxide;
    (2) counter measures and hypoxia;
    (3) symptoms of hypoxia.
  (d) hyperventilation;
  (e) the effects of accelerations on the circulatory system;
  (f) hypertension and coronary heart disease.

Man and environment

• Central, peripheral and autonomic nervous systems

• Vision:
  (a) functional anatomy;
  (b) visual field, foveal and peripheral vision;
  (c) binocular and monocular vision;
  (d) monocular vision cues;
  (e) night vision;
  (f) visual scanning and detection techniques and importance of ‘look-out’;
  (g) defective vision.

• Hearing:
  (a) descriptive and functional anatomy;
  (b) flight related hazards to hearing;
  (c) hearing loss.

• Equilibrium:
  (a) functional anatomy;
  (b) motion and acceleration;
  (c) motion sickness.

• Integration of sensory inputs:
  (a) spatial disorientation: forms, recognition and avoidance;
  (b) illusions: forms, recognition and avoidance:
    (1) physical origin;
    (2) physiological origin;
    (3) psychological origin.
  (c) approach and landing problems.
Health and hygiene

- Personal hygiene: personal fitness
- Body rhythm and sleep:
  (a) rhythm disturbances;
  (b) symptoms, effects and management.
- Problem areas for pilots:
  (a) common minor ailments including cold, influenza and gastro-intestinal upset;
  (b) entrapped gases and barotrauma, (scuba diving);
  (c) obesity;
  (d) food hygiene;
  (e) infectious diseases;
  (f) nutrition;
  (g) various toxic gases and materials.
- Intoxication:
  (a) prescribed medication;
  (b) tobacco;
  (c) alcohol and drugs;
  (d) caffeine;
  (e) self-medication.

Basic aviation psychology

Human information processing

- Attention and vigilance:
  (a) selectivity of attention;
  (b) divided attention.
- Perception:
  (a) perceptual illusions;
  (b) subjectivity of perception;
  (c) processes of perception.
- Memory:
  (a) sensory memory;
  (b) working or short term memory;
  (c) long term memory to include motor memory (skills).

Human error and reliability

- Reliability of human behaviour
- Error generation: social environment (group, organisation)

Decision making

- Decision-making concepts:
  (a) structure (phases);
  (b) limits;
  (c) risk assessment;
  (d) practical application.

Avoiding and managing errors: cockpit management

- Safety awareness:
(a) risk area awareness;
(b) situational awareness.
• Communication: verbal and non-verbal communication

**Human behaviour**

• Personality and attitudes:
  (a) development;
  (b) environmental influences.
• Identification of hazardous attitudes (error proneness)

**Human overload and underload**

• Arousal
• Stress:
  (a) definition(s);
  (b) anxiety and stress;
  (c) effects of stress.
• Fatigue and stress management:
  (a) types, causes and symptoms of fatigue;
  (b) effects of fatigue;
  (c) coping strategies;
  (d) management techniques;
  (e) health and fitness programmes;
3. METEOROLOGY
The Atmosphere
Composition, extent, vertical division
- Structure of the atmosphere
  - Troposphere
Air temperature
- Definition and units
- Vertical distribution of temperature
- Transfer of heat
- Lapse rates, stability and instability
- Development of inversions, types of inversions
- Temperature near the earth’s surface, surface effects, diurnal and seasonal variation, effect of clouds, effect of wind
Atmospheric pressure
- Barometric pressure, isobars
- Pressure variation with height
- Reduction of pressure to mean sea level
- Relationship between surface pressure centres and pressure centres aloft
Air density
- Relationship between pressure, temperature and density
  - ICAO Standard Atmosphere (ISA)
ICAO Standard Atmosphere
Altimetry
- Terminology and definitions
- Altimeter and altimeter settings
- Calculations
  - Effect of accelerated airflow due to topography
Wind
Definition and measurement of wind
- Definition and measurement
Primary cause of wind
- Primary cause of wind, pressure gradient, Coriolis force, gradient wind
- Variation of wind in the friction layer
- Effects of convergence and divergence
General global circulation
- General circulation around the globe
Local winds
- Anabatic and katabatic winds, mountain and valley winds, Venturi effects, land and sea breezes
Mountain waves (standing waves, lee waves)
- Origin and characteristics
Turbulence
• Description and types of turbulence
• Formation and location of turbulence

THERMODYNAMICS

Humidity
• Water vapour in the atmosphere
• Mixing ratio
• Temperature/dew point, relative humidity

Change of state of aggregation
• Condensation, evaporation, sublimation, freezing and melting, latent heat

Adiabatic processes
• Adiabatic processes, stability of the atmosphere

CLOUDS AND FOG

Cloud formation and description
• Cooling by adiabatic expansion and by advection
• Cloud types and cloud classification
• Influence of inversions on cloud development

Fog, mist, haze
• General aspects
• Radiation fog
• Advection fog
• Steaming fog
• Frontal fog
• Orographic fog (hill fog)

PRECIPITATION

Development of precipitation
• Processes of development of precipitation

Types of precipitation
• Types of precipitation, relationship with cloud types

AIR MASSES AND FRONTS

Air masses
• Description, classification and source regions of air masses
• Modifications of air masses

Fronts
• General aspects
• Warm front, associated clouds and weather
• Cold front, associated clouds and weather
• Warm sector, associated clouds and weather
• Weather behind the cold front
• Occlusions, associated clouds and weather
• Stationary front, associated clouds and weather
• Movement of fronts and pressure systems, life cycle
• Changes of meteorological elements at a frontal wave
PRESSURE SYSTEMS

Anticyclone
• Anticyclones, types, general properties, cold and warm anticyclones, ridges and wedges, subsidence

Non frontal depressions
• Thermal, orographic, polar depressions, troughs

CLIMATOLOGY

Climatic zones
• General seasonal circulation in the troposphere

Typical weather situations in the mid-latitudes
• Westerly situation
• High pressure area
• Flat pressure pattern

Local winds and associated weather
• e.g. Foehn

FLIGHT HAZARDS

Icing
• Conditions for ice accretion
• Types of ice accretion
• Hazards of ice accretion, avoidance

Turbulence
• Effects on flight, avoidance

Wind shear
• Definition of wind shear
• Weather conditions for wind shear
• Effects on flight, avoidance

Thunderstorms
• Conditions for and process of development, forecast, location, type specification
• Structure of thunderstorms, life history, squall lines, electricity in the atmosphere, static charges
• Electrical discharges
• Development and effects of downbursts
• Thunderstorm avoidance

Inversions
• Influence on aircraft performance

Hazards in mountainous areas
• Influence of terrain on clouds and precipitation, frontal passage
• Vertical movements, mountain waves, wind shear, turbulence, ice accretion
• Development and effect of valley inversions

Visibility reducing phenomena
• Reduction of visibility caused by precipitation and obscuration
• Reduction of visibility caused by other phenomena
METEOROLOGICAL INFORMATION

Observation
- Surface observations
- Radiosonde observations
- Satellite observations
- Weather radar observations
- Aircraft observations and reporting

Weather charts
- Significant weather charts
- Surface charts

Information for flight planning
- Aviation weather messages
- Meteorological broadcasts for aviation
- Use of meteorological documents
- Meteorological warnings

Meteorological services
- World area forecast system and meteorological offices
4. COMMUNICATIONS

VFR COMMUNICATIONS

Definitions

• Meanings and significance of associated terms
• ATS abbreviations
• Q-code groups commonly used in RTF air-ground communications
• Categories of messages

General operating procedures

• Transmission of letters
• Transmission of numbers (including level information)
• Transmission of time
• Transmission technique
• Standard words and phrases (relevant RTF phraseology included)
• R/T call signs for aeronautical stations including use of abbreviated call signs
• R/T call signs for aircraft including use of abbreviated call signs
• Transfer of communication
• Test procedures including readability scale
• Read back and acknowledgement requirements

Relevant weather information terms (VFR)

• Aerodrome weather
• Weather broadcast

Action required to be taken in case of communication failure

Distress and urgency procedures

• Distress (definition, frequencies, watch of distress frequencies, distress signal and distress message)
• Urgency (definition, frequencies, urgency signal and urgency message)

General principles of VHF propagation and allocation of frequencies
5. PRINCIPLES OF FLIGHT
5.1. PRINCIPLES OF FLIGHT: AEROPLANE

Subsonic aerodynamics

Basics concepts, laws and definitions

- Laws and definitions:
  (a) conversion of units;
  (b) Newton’s laws;
  (c) Bernoulli’s equation and venture;
  (d) static pressure, dynamic pressure and total pressure;
  (e) density;
  (f) IAS and TAS.

- Basics about airflow:
  (a) streamline;
  (b) two-dimensional airflow;
  (c) three-dimensional airflow.

- Aerodynamic forces on surfaces:
  (a) resulting airforce;
  (b) lift;
  (c) drag;
  (d) angle of attack.

- Shape of an aerofoil section:
  (a) thickness to chord ratio;
  (b) chord line;
  (c) camber line;
  (d) camber;
  (e) angle of attack.

- The wing shape:
  (a) aspect ratio;
  (b) root chord;
  (c) tip chord;
  (d) tapered wings;
  (e) wing planform.

The two-dimensional airflow about an aerofoil

- Streamline pattern
- Stagnation point
- Pressure distribution
- Centre of pressure
- Influence of angle of attack
- Flow separation at high angles of attack
- The lift – \( \alpha \) graph

The coefficients

- The lift coefficient \( C_L \): the lift formula
- The drag coefficient \( C_D \): the drag formula
The three-dimensional airflow round a wing and a fuselage

- Streamline pattern:
  (a) span-wise flow and causes;
  (b) tip vortices and angle of attack;
  (c) upwash and downwash due to tip vortices;
  (d) wake turbulence behind an aeroplane (causes, distribution and duration of the phenomenon).

- Induced drag:
  (a) influence of tip vortices on the angle of attack;
  (b) the induced local angle of attack;
  (c) influence of induced angle of attack on the direction of the lift vector;
  (d) induced drag and angle of attack.

Drag

- The parasite drag:
  (a) pressure drag;
  (b) interference drag;
  (c) friction drag.

- The parasite drag and speed

- The induced drag and speed

- The total drag

The ground effect

- Effect on take off and landing characteristics of an aeroplane

The stall

- Flow separation at increasing angles of attack:
  (a) the boundary layer:
    (1) laminar layer;
    (2) turbulent layer;
    (3) transition.
  (b) separation point;
  (c) influence of angle of attack;
  (d) influence on:
    (1) pressure distribution;
    (2) location of centre of pressure;
    (3) CL;
    (4) CD;
    (5) pitch moments.
  (e) buffet;
  (f) use of controls.

- The stall speed:
  (a) in the lift formula;
  (b) 1g stall speed;
  (c) influence of:
    (1) the centre of gravity;
    (2) power setting;
(3) altitude (IAS);
(4) wing loading;
(5) load factor n:
   i. definition;
   ii. turns;
   iii. forces.

• The initial stall in span-wise direction:
  (a) influence of planform;
  (b) geometric twist (wash out);
  (c) use of ailerons.

• Stall warning:
  (a) importance of stall warning;
  (b) speed margin;
  (c) buffet;
  (d) stall strip;
  (e) flapper switch;
  (f) recovery from stall.

• Special phenomena of stall:
  (a) the power-on stall;
  (b) climbing and descending turns;
  (c) t-tailed aeroplane;
  (d) avoidance of spins:
     (1) spin development;
     (2) spin recognition;
     (3) spin recovery.
  (e) ice (in stagnation point and on surface):
     (1) absence of stall warning;
     (2) abnormal behaviour of the aircraft during stall.

CL augmentation
• Trailing edge flaps and the reasons for use in take-off and landing:
  (a) influence on CL - \( \alpha \)-graph;
  (b) different types of flaps;
  (c) flap asymmetry;
  (d) influence on pitch movement.

• Leading edge devices and the reasons for use in take-off and landing

The boundary layer
• Different types:
  (a) laminar;
  (b) turbulent.

Special circumstances
• Ice and other contamination:
  (a) ice in stagnation point;
  (b) ice on the surface (frost, snow and clear ice);
  (c) rain;
(d) contamination of the leading edge;
(e) effects on stall;
(f) effects on loss of controllability;
(g) effects on control surface moment;
(h) influence on high lift devices during take-off, landing and low speeds.

**Stability**

**Condition of equilibrium in steady horizontal flight**
- Precondition for static stability
- Equilibrium:
  - (a) lift and weight;
  - (b) drag and thrust.

**Methods of achieving balance**
- Wing and empennage (tail and canard)
- Control surfaces
- Ballast or weight trim

**Static and dynamic longitudinal stability**
- Basics and definitions:
  - (a) static stability, positive, neutral and negative;
  - (b) precondition for dynamic stability;
  - (c) dynamic stability, positive, neutral and negative.
- Location of centre of gravity:
  - (a) aft limit and minimum stability margin;
  - (b) forward position;
  - (c) effects on static and dynamic stability.

**Dynamic lateral or directional stability**
- Spiral dive and corrective actions

**Control**

**General**
- Basics, the three planes and three axis
- Angle of attack change

**Pitch control**
- Elevator
- Downwash effects
- Location of centre of gravity

**Yaw control**
- Pedal or rudder

**Roll control**
- Ailerons: function in different phases of flight
- Adverse yaw
- Means to avoid adverse yaw:
  - (a) frise ailerons;
  - (b) differential ailerons deflection.

**Means to reduce control forces**
Aerodynamic balance:
(a) balance tab and anti-balance tab;
(b) servo tab.

Mass balance
• Reasons to balance: means

Trimming
• Reasons to trim
• Trim tabs

Limitations
Operating limitations
• Flutter
• Vfe
• Vno, Vne

Manoeuvring envelope
• Manoeuvring load diagram:
  (a) load factor;
  (b) accelerated stall speed;
  (c) va;
  (d) manoeuvring limit load factor or certification category.
• Contribution of mass

Gust envelope
• Gust load diagram
• Factors contributing to gust loads

Propellers
Conversion of engine torque to thrust
• Meaning of pitch
• Blade twist
• Effects of ice on propeller

Engine failure or engine stop
• Windmilling drag

Moments due to propeller operation
• Torque reaction
• Asymmetric slipstream effect
• Asymmetric blade effect

Flight mechanics
Forces acting on an aeroplane
• Straight horizontal steady flight
• Straight steady climb
• Straight steady descent
• Straight steady glide
• Steady coordinated turn:
  (a) bank angle;
(b) load factor;
(c) turn radius;
(d) rate one turn.
6. OPERATIONAL PROCEDURES

General
Operation of aircraft: ICAO Annex 6, General requirements

- Definitions
- Applicability

Special operational procedures and hazards (general aspects)

Noise abatement

- Noise abatement procedures
- Influence of the flight procedure (departure, cruise and approach)
- Runway incursion awareness (meaning of surface markings and signals)

Fire or smoke

- Carburettor fire
- Engine fire
- Fire in the cabin and cockpit, (choice of extinguishing agents according to fire classification and use of the extinguishers)
- Smoke in the cockpit and (effects and action to be taken) and smoke in the cockpit and cabin (effects and actions taken)

Windshear and microburst

- Effects and recognition during departure and approach
- Actions to avoid and actions taken during encounter

Wake turbulence

- Cause
- List of relevant parameters
- Actions taken when crossing traffic, during take-off and landing

Emergency and precautionary landings

- Definition
- Cause
- Passenger information
- Evacuation
- Action after landing

Contaminated runways

- Kinds of contamination
- Estimated surface friction and friction coefficient
7. FLIGHT PERFORMANCE AND PLANNING
7.1. MASS AND BALANCE: AEROPLANES OR HELICOPTERS

Purpose of mass and balance considerations

Mass limitations
• Importance in regard to structural limitations
• Importance in regard to performance limitations

CG limitations
• Importance in regard to stability and controllability
• Importance in regard to performance

Loading

Terminology
• Mass terms
• Load terms (including fuel terms)

Mass limits
• Structural limitations
• Performance limitations
• Baggage compartment limitations

Mass calculations
• Maximum masses for take-off and landing
• Use of standard masses for passengers, baggage and crew

Fundamentals of CG calculations
• Definition of centre of gravity
• Conditions of equilibrium (balance of forces and balance of moments)
• Basic calculations of CG

Mass and balance details of aircraft

Contents of mass and balance documentation
• Datum and moment arm
• CG position as distance from datum

Extraction of basic mass and balance data from aircraft documentation
• BEM
• CG position or moment at BEM
• Deviations from standard configuration

Determination of CG position

Methods
• Arithmetic method
• Graphic method

Load and trim sheet
• General considerations
• Load sheet and CG envelope for light aeroplanes and for helicopters

7.2. PERFORMANCE: AEROPLANES

Introduction
• Performance classes
FREEDOM AVIATION LAPL/PPL/NPPL THEORETICAL KNOWLEDGE SYLLABUS

• Stages of flight
• Effect of aeroplane mass, wind, altitude, runway slope and runway conditions
• Gradients

SE aeroplanes
• Definitions of terms and speeds

Take-off and landing performance
• Use of aeroplane flight manual data

Climb and cruise performance
• Use of aeroplane flight data
• Effect of density altitude and aeroplane mass
• Endurance and the effects of the different recommended power or thrust settings
• Still air range with various power or thrust settings

7.3. FLIGHT PLANNING AND FLIGHT MONITORING

Flight planning for VFR flights

VFR navigation plan
• Routes, airfields, heights and altitudes from VFR charts
• Courses and distances from VFR charts
• Aerodrome charts and aerodrome directory
• Communications and radio navigation planning data
• Completion of navigation plan

Fuel planning
• General knowledge

Pre-flight calculation of fuel required
• Calculation of extra fuel
• Completion of the fuel section of the navigation plan (fuel log) and calculation of total fuel

Pre-flight preparation

AIP and NOTAM briefing
• Ground facilities and services
• Departure, destination and alternate aerodromes
• Airway routings and airspace structure

Meteorological briefing
• Extraction and analysis of relevant data from meteorological documents

ICAO flight plan (ATS flight plan)

Individual flight plan
• Format of flight plan
• Completion of the flight plan
• Submission of the flight plan

Flight monitoring and in-flight re-planning
• Flight monitoring
• Monitoring of track and time
• In-flight fuel management
• In-flight re-planning in case of deviation from planned data
8. AIRCRAFT GENERAL KNOWLEDGE
8.1. AIRFRAME AND SYSTEMS, ELECTRICS, POWERPLANT AND EMERGENCY EQUIPMENT

System design, loads, stresses, maintenance
• Loads and combination loadings applied to an aircraft’s structure

Airframe
Wings, tail surfaces and control surfaces
• Design and constructions
• Structural components and materials
• Stresses
• Structural limitations

Fuselage, doors, floor, wind-screen and windows
• Design and constructions
• Structural components and materials
• Stresses
• Structural limitations

Hydraulics
Hydromechanics: basic principles

Hydraulic systems
• Hydraulic fluids: types and characteristics, limitations
• System components: design, operation, degraded modes of operation, indications and warnings

Landing gear, wheels, tyres and brakes

Landing gear
• Types and materials

Nose wheel steering: design and operation

Brakes
• Types and materials
• System components: design, operation, indications and warnings

Wheels and tyres
• Types and operational limitations

Flight controls
• Mechanical or powered
• Control systems and mechanical
• System components: design, operation, indications and warnings, degraded modes of operation and jamming

Secondary flight controls
• System components: design, operation, degraded modes of operation, indications and warnings

Anti-icing systems
• Types and operation (pitot and windshield)

Fuel system
Piston engine
FREEDOM AVIATION LAPL/PPL/NPPL THEORETICAL KNOWLEDGE SYLLABUS

- System components: design, operation, degraded modes of operation, indications and warnings

**Electrics**

**Electrics: general and definitions**
- Direct current: voltage, current, resistance, conductivity, Ohm’s law, power and work
- Alternating current: voltage, current, amplitude, phase, frequency and resistance
- Circuits: series and parallel
- Magnetic field: effects in an electrical circuit

**Batteries**
- Types, characteristics and limitations
- Battery chargers, characteristics and limitations

**Static electricity: general**
- Basic principles
- Static dischargers
- Protection against interference
- Lightning effects

**Generation: production, distribution and use**
- DC generation: types, design, operation, degraded modes of operation, indications and warnings
- AC generation: types, design, operation, degraded modes of operation, indications and warnings

**Electric components**
- Basic elements: basic principles of switches, circuit-breakers and relays

**Distribution**
- General:
  - (a) bus bar, common earth and priority;
  - (b) AC and DC comparison.

**Piston engines**

**General**
- Types of internal combustion engine: basic principles and definitions
- Engine: design, operation, components and materials

**Fuel**
- Types, grades, characteristics and limitations
- Alternate fuel: characteristics and limitations

**Carburettor or injection system**
- Carburettor: design, operation, degraded modes of operation, indications and warnings
- Injection: design, operation, degraded modes of operation, indications and warnings
- Icing

**Air cooling systems**
- Design, operation, degraded modes of operation, indications and warnings

**Lubrication systems**
- Lubricants: types, characteristics and limitations
- Design, operation, degraded modes of operation, indications and warnings
Ignition circuits
• Design, operation, degraded modes of operation

Mixture
• Definition, characteristic mixtures, control instruments, associated control levers and indications

Propellers
• Definitions and general:
  (a) aerodynamic parameters;
  (b) types;
  (c) operating modes
• Constant speed propeller: design, operation and system components
• Propeller handling: associated control levers, degraded modes of operation, indications and warnings

Performance and engine handling
• Performance: influence of engine parameters, influence of atmospheric conditions, limitations and power augmentation systems
• Engine handling: power and mixture settings during various flight phases and operational limitations

8.2. INSTRUMENTATION

Instrument and indication systems

Pressure gauge
• Different types, design, operation, characteristics and accuracy

Temperature sensing
• Different types, design, operation, characteristics and accuracy

Fuel gauge
• Different types, design, operation, characteristics and accuracy

Flow meter
• Different types, design, operation, characteristics and accuracy

Position transmitter
• Different types, design, operation, characteristics and accuracy

Tachometer
• Design, operation, characteristics and accuracy

Measurement of aerodynamic parameters

Pressure measurement
• Static pressure, dynamic pressure, density and definitions
• Design, operation, errors and accuracy

Temperature measurement: aeroplane
• Design, operation, errors and accuracy
• Displays

Altimeter
• Standard atmosphere
• The different barometric references (QNH, QFE and 1013.25)
• Height, indicated altitude, true altitude, pressure altitude and density altitude
vertical speed indicator
- Design, operation, errors and accuracy
- Displays

air speed indicator
- The different speeds IAS, CAS, TAS: definition, usage and relationships
- Design, operation, errors and accuracy
- Displays

magnetism: direct reading compass
earth magnetic field

direct reading compass
- Design, operation, data processing, accuracy and deviation
- Turning and acceleration errors

gyroscopic instruments

gyro scope: basic principles
- Definitions and design
- Fundamental properties
- Drifts

turn and bank indicator
- Design, operation and errors

attitude indicator
- Design, operation, errors and accuracy

directional gyroscope
- Design, operation, errors and accuracy

communication systems
transmission modes: VHF, HF and SATCOM
- Principles, bandwidth, operational limitations and use

voice communication
- Definitions, general and applications

alerting systems and proximity systems

flight warning systems
- Design, operation, indications and alarms

stall warning
- Design, operation, indications and alarms

display units
- Design, different technologies and limitations
9. NAVIGATION
9.1. GENERAL NAVIGATION

Basics of navigation

The solar system
- Seasonal and apparent movements of the sun

The earth
- Great circle, small circle and rhumb line
- Latitude and difference of latitude
- Longitude and difference of longitude
- Use of latitude and longitude co-ordinates to locate any specific position

Time and time conversions
- Apparent time
- UTC
- LMT
- Standard times
- Dateline
- Definition of sunrise, sunset and civil twilight

Directions
- True north, magnetic north and compass north
- Compass deviation
- Magnetic poles, isogonals, relationship between true and magnetic

Distance
- Units of distance and height used in navigation: nautical miles, statute miles, kilometres, metres and ft
- Conversion from one unit to another
- Relationship between nautical miles and minutes of latitude and minutes of longitude

Magnetism and compasses

General principles
- Terrestrial magnetism
- Resolution of the earth’s total magnetic force into vertical and horizontal components
- Variation-annual change

Aircraft magnetism
- The resulting magnetic fields
- Keeping magnetic materials clear of the compass

Charts

General properties of miscellaneous types of projections
- Direct Mercator
- Lambert conformal conic

The representation of meridians, parallels, great circles and rhumb lines
- Direct Mercator
- Lambert conformal conic

The use of current aeronautical charts
• Plotting positions
• Methods of indicating scale and relief (ICAO topographical chart)
• Conventional signs
• Measuring tracks and distances
• Plotting bearings and distances

**DR navigation**

**Basis of DR**

• Track
• Heading (compass, magnetic and true)
• Wind velocity
• Air speed (IAS, CAS and TAS)
• Groundspeed
• ETA
• Drift and wind correction angle
• DR position fix

**Use of the navigational computer**

• Speed
• Time
• Distance
• Fuel consumption
• Conversions
• Air speed
• Wind velocity
• True altitude

**The triangle of velocities**

• Heading
• Ground speed
• Wind velocity
• Track and drift angle

**Measurement of DR elements**

• Calculation of altitude
• Determination of appropriate speed

**In-flight navigation**

**Use of visual observations and application to in-flight navigation**

**Navigation in cruising flight, use of fixes to revise navigation data**

• Ground speed revision
• Off-track corrections
• Calculation of wind speed and direction
• ETA revisions
• Flight log

**9.2. RADIO NAVIGATION**

**Basic radio propagation theory**
Antennas
  • Characteristics

Wave propagation
  • Propagation with the frequency bands

Radio aids
Ground DF
  • Principles
  • Presentation and interpretation
  • Coverage
  • Range
  • Errors and accuracy
  • Factors affecting range and accuracy

NDB/ADF
  • Principle
  • Presentation and interpretation
  • Coverage
  • Range
  • Errors and accuracy
  • Factors affecting range and accuracy

VOR
  • Principles
  • Presentation and interpretation
  • Coverage
  • Range
  • Errors and accuracy
  • Factors affecting range and accuracy

DME
  • Principles
  • Presentation and interpretation
  • Coverage
  • Range
  • Errors and accuracy
  • Factors affecting range and accuracy

Radar
Ground radar
  • Principles
  • Presentation and interpretation
  • Coverage
  • Range
  • Errors and accuracy
  • Factors affecting range and accuracy

Secondary surveillance radar and transponder
FREEDOM AVIATION LAPL/PPL/NPPL THEORETICAL KNOWLEDGE SYLLABUS

• Principles
• Presentation and interpretation
• Modes and codes

GNSS
GPS, GLONASS OR GALILEO
• Principles
• Operation
• Errors and accuracy
• Factors affecting accuracy