## Appendix 2.0

**COMBINED SYLLABUS OF THEORETICAL KNOWLEDGE FOR THE INSTRUMENT RATING, COMMERCIAL AND AIRLINE TRANSPORT PILOT LICENCE (AEROPLANE) AND (HELICOPTER)**

Legend:  
I = Instrument Rating,  
C = Commercial Pilot,  
A = Airline Transport Pilot

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ICA

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7. Land and Sea Heating/Cooling
8. Diurnal Variations
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ICA

4. DENSITY
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2. Pressure
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General Global Upper Wind Circulation

AIR

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3. Orographic Depressions
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3. Some World Weather Systems
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22. **METEOROLOGICAL ORGANISATIONS**

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2. International Civil Aviation Organisation
4. Central Forecasting Office – CFO
5. Main Forecasting Offices – MFO
7. Subsidiary Stations
8. Automatic Weather Stations (AWS)
9. Weather Services for Aviation

ICA 2. FLIGHT PLANNING AND PERFORMANCE

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ICA 2.1.1 Airspeed Terminology and Symbols
  - RIAS, RCAS, RTAS, Mach number
  - VA, VFO, VFE, VF
  - VLO, VLE
  - VNO, VNE
  - VX, VY
  - VMO, MMO
  - VMCA, VMCG
  - VS, VSO
  - VSSE
  - VI, VR, V2, VREF, VLOF, VMBE

ICA 2.1.2 Meteorological Terminology (ISA, JSA)
  - OAT, IOAT, TAT, SAT, RAT
  - Temperature deviation from ISA
  - Pressure altitude
  - Density altitude
  - Aerodrome pressure

ICA 2.1.3 Aerodrome Terminology
- Balanced and unbalanced field lengths
- Clearway, stopway
- TORA (take-off run available)
- TODA (take-off distance available)
- EMDA (emergency distance available)
- WAT limits
- LDA (landing distance available)
- Displaced threshold
- Runway slope
- Runway strength
- Single isolated wheel loading

ICA 2.1.4 Take-off flight path

2.2 Aeroplane Manuals

Use of graphs or tables to determine –

ICA 2.2.1 Take-off

- Take-off run (TORA)
- Take-off distance (TODA)
- Take-off speeds (V1, VR, V2)
- Maximum take-off mass
- Accelerate-go distance
- Accelerate-stop distance (ASDA)
- VMCA, VMCG limits

CA Anti-skid inoperative

ICA Reduced braking capability

CA Tyre speed limits

ICA Power settings

ICA 2.2.2 Climb

- Initial climb
- Obstacle clearance requirements
- Time, distance and fuel used
- Rate of climb
- Angle of climb

ICA 2.2.3 Cruise

- Constant power cruise
- Constant speed cruise
- Long range cruise
- Optimum altitude
- Range
- Endurance
- Fuel consumption, fuel used, fuel flow
- ANM/fuel ratio
- GNM/fuel ratio
- wind components, wind range correction/trade-off

Mid-zone weights

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Integrated range tables

Simplified flight planning graphs

Step climb to optimum altitude

Power settings

Fuel management

Alternate planning

Re-dispatch planning

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2.2.4 Descent

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2.3 Mass and balance

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Maximum ramp and taxi mass

Maximum take-off mass

Maximum zero fuel mass

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Cargo pallets
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Calculation of CG
Movement of CG in flight maximum load at station
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2.4 PET and PNR

2.4.1 PET (Point of equal time)
- all engines operating
- one engine inoperative (critical point)

2.4.2 PNR (Point of no return)
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3. RADIO AIDS

3.1 Basic Radio Theory

3.1.1 Electromagnetic waves
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- frequency bands
- sidebands, double sideband, single sideband, band width
- carrier wave, modulation, demodulation
- amplitude modulation
- frequency modulation
- pulse modulation
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3.1.2 Antennas
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- polar diagram
- types of antennas

3.1.3 Wave propagation
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- sky waves
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- fading
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ICA 3.2.1 Communication
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- Selcal

ICA 3.3.1 Ground direction Finding (VDF)
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ICA 3.3.2 ADF (Automatic Direction Finding)

NDB (Non-Directional beacon)
- A1A, A2A emissions, frequencies

ICA ADF loop theory
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- fixed loop antenna

Range and coverage
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- accuracy
- factors affecting range and accuracy
- RBI (Relative Bearing Indicator)
- RMI (Relative Magnetic Indicator)
- calculations
I C A 3.3.3 VOR

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Range and coverage
Errors and accuracy
Factors affecting range and accuracy
Doppler VOR
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CDI (Course Deviation Indicator)
Calculations
Frequencies

I C A 3.3.4 ILS (Instrument Landing System)

Principles
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Back beam
Range and coverage
Errors and accuracy
Factors affecting range and accuracy
Categories
Calculations

3.3.5 MLS (Microwave Landing System)

Principles
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Range and coverage
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I C A 3.3.6 Radio Altimeter

Principle
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Errors and accuracy
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C A 3.3.7 GPWS (Ground Proximity Warning System)

Principles
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I C A 3.3.8 ELT (Emergency Locator Transmitter)

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I C A 3.4.2 Ground Radar
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Range and coverage
Errors and accuracy
Factors affecting range and accuracy
Calculations

ICA 3.4.3 DME (Distance Measurement Equipment)

Principles
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ICA 3.4.4 Airborne Weather Radar

Principles
Presentation and interpretation
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ICA 3.4.5 SSR (Secondary Surveillance Radar)

Principles
Modes and codes

A 3.4.6 TCAS (Traffic Alert and Collision Avoidance System)

Principles

A 3.4.7 Doppler Radar

Principles
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3.5 AREA NAVIGATION SYSTEMS

3.5.1 RNAV VOR/DME Area Navigation

Principles
Range and coverage
Errors and accuracy
Approach mode
Calculations

ICA 3.6 GPS/GNSS

3.6.1 GPS (Global Positioning System) components and principle of operation

GPS system components, constellation, control and user
Aircraft equipment requirements
GPS satellite signal and pseudo random code
Principle of position fixing
Method of minimising receiving clock error
Minimum satellites required for navigation functions
Masking function
Performance limitations of various equipment types
GPS use of WGS84 co-ordinate system
3.6.2 Navigation system performance requirements

Accuracy
Integrity
Means of providing GPS integrity; RAIM; procedural systems integration
Availability
Continuity of service

3.6.3 GPS errors and limitations

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Clock
Receiver
Atmospheric/Ionospheric
Multipath
SA (selected availability)
Typical total error associated with C/A code
Effect of PDOP/GDOP on position accuracy
Susceptibility to interference
Comparison of vertical and horizontal errors
Tracking accuracy and collision avoidance

3.6.4 Human Factors and GPS

Mode errors
Data entry errors
Data validation and checking including independent cross-checking procedures
Automation induced complacency
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Human information processing and situational awareness

3.6.5 GPS equipment – Specific navigation procedure

Select appropriate operational modes
Recall categories of information contained in the navigation database
Predict RAIM availability
Enter and check user defined waypoints
Enter/retrieve and check flight plan data
Interpret typical GPS navigation displays LAT/LONG, distance and bearing to waypoint, CDI
Intercept and maintain GPS defined tracks
Determine TMG, GS, ETA, time and distance to WPT, WV in flight
Indications of waypoint passage
Use of direct to function
Use of nearest aerodrome function
Use of GPS in GPS and VOR/DME/GPS arrival procedures

3.6.6 GPS equipment checks

TSO status
Satellites required
RAIM status
PDOP/GDOP status
IFR database currency
Receiver serviceability
CDI sensitivity
Position indication

3.6.7 GPS warning and messages

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2D Navigation
In Dead Reckoning mode
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Barometric input fail
Power/battery fail
Parallel offset on
Satellite fail

4. NAVIGATION

4.1 THE EARTH

ICA 4.1.1 Latitude, difference of latitude

Longitude, difference of longitude
Use of latitude and longitude co-ordinates to locate any specific position

CA 4.1.2 Great circle, small circle, rhumbline, convergency, conversion angle, great circle and rhumbline tracks and bearings calculations

ICA 4.1.3 Direction

True north, magnetic north, compass north, isogonals, variation, compass deviation.

ICA 4.1.4 Distance

Units of distance and height used in navigation
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Conversion from one unit to another
Standard nautical mile (6080 feet)
International nautical mile (1852 metres)
Geographical nautical mile (6087 feet)

CA 4.1.5 Departure

Relationship between nautical miles and minutes of longitude, calculations

ICA 4.1.6 Radio bearings

QTE, QDR, QDM, QUJ

ICA 4.1.7 Navigational computer (slide rule), electronic navigation computers, units used

4.2 CHARTS

CA 4.2.1 Chart projection theory

ICA

Orthomorphism Scale, chart length, earth distance, scale factor, representative fraction, scale problems

ICA 4.2.2 Mercator chart

CA

Construction and properties, representation of great circle, rhumblines, meridians, parallels of latitude

CA

Plotting radio bearings
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Track
Heading (true, magnetic, compass)
Wind velocity
Airspeed (IAS, RAS, TAS, Machnumber)
Groundspeed
ETA
Drift, wind correction angle
DR Position, fix

ICA 4.5.2 Use of the navigational computer

Speed, distance, time
Fuel consumption
Conversions
Heading, track, groundspeed
RAS, TAS, compressibility correction
Wind velocity

ICA 4.5.3 Triangle of velocities, determination of

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Track
Groundspeed
Wind velocity
Drift
Track error

ICA 4.6 NAVIGATION PLOTTING

4.6.1 Navigation on the climb and descent

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Mean climb wind velocity
Groundspeed
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ICA 4.6.2 En route navigation

Air plot
Track plot
DR position
Use of single position lines, groundspeed check, back bearing, track made good
Running fix, transfer of position lines
Off-track corrections
Revised ETA
1 in 60 rule, alteration of heading
Double the angle on the bow
Relative bearing when abeam NDB
Air plot wind velocity
Track and groundspeed wind velocity
Doppler wind velocity

ICA 4.6.3 Simple searches, square search

ICA 4.6.4 PNR and PET (ATPL only)

PNR with alternate aerodrome
PET with alternate aerodrome

5. OPERATIONAL PROCEDURES

5.1 DEFINITIONS AND ABBREVIATIONS APPLICABLE TO
## Instrument Flying

### ICA


#### Approach Procedures

Chapter 1 – General Criteria

1.2 The instrument approach procedure

1.3 Categories of aircraft

1.4 Obstacle clearance

1.5 Obstacle clearance altitude/height (OCA/H)

1.6 Factor affecting operational minima

Chapter 2 – Approach Procedure Design

2.1 Instrument approach areas

Chapter 3 – Approach Segments

3.1 General

3.2 Standard instrument arrivals

3.3 Initial approach segment

3.4 Intermediate approach segment

3.5 Final approach segment

3.6 Missed approach

#### Holding Procedures

Chapter 1

1.1 Shape and terminology associated with holding pattern

1.2 Speeds, rate of turn, timing, distance and limiting radial

1.3 Entry

1.4 Holding

Chapter 2

2.1 Holding area

2.2 Buffer area

2.3 Minimum holding level

### Altimeter Setting Procedures

Chapter 1 – Basic Requirements

Chapter 2 – Procedures applicable to operators and pilots

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### Aeronautical Information Publication (AIP) South Africa
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127.09.2  Helicopter maintenance schedule

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135.01.1  Applicability

135.01.3  Admission to flight deck

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135.04.3 – Aeroplane operating manual

135.04.5 – Operational flight plan

135.04.6 – Flight time and duty period records

*135.04.7 – Records of emergency and survival equipment

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#135.05.2 – Flight, navigation and associated equipment for aeroplanes operated under VFR

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SUBPART 6: OPERATING CERTIFICATE

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SUBPART 7: FLIGHT OPERATIONS

#135.07.1 – Routes and areas of operation

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C SUBPART 8: AEROPLANE OPERATING LIMITATIONS

135.08.1 - Classification

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C *DIVISION ONE: CLASS A AEROPLANE

135.08.3 - General

135.08.4 - Take-off

135.08.5 - Net take-off flight path

135.08.6 - En route with one engine inoperative

135.08.7 - Landing at destination and alternate aerodromes

135.08.8 - Landing on dry runways

135.08.9 - Landing on wet and contaminated runways

C *DIVISION TWO: CLASS B AEROPLANE

135.08.10 - General

135.08.11 - Take-off

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#139.01.1  –  Applicability
#139.01.2  –  Use of military aerodromes and heliports
#139.01.3  –  Restrictions
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#SUBPART 2: DESIGNATION AND CLASSIFICATION OF AIRSPACE
172.02.1  –  Designation of airspace
172.02.2  –  Classification of airspace
172.02.3  –  Designation of control areas
172.02.4  –  Designation of flight information regions
ICAO
7.3 SOUTH AFRICAN CIVIL AVIATION TECHNICAL STANDARDS (CATS)

#PART 91 – GENERAL OPERATING AND FLIGHT RULES

91.06.10 – Lights to be displayed by aircraft

91.06.21 – Visibility and distance from cloud

91.06.29 – Identification and interception of aircraft

91.06.33 – Semi-circular rule

91.07.12 – Fuel and oil supply

ICAO
PART 172 – AIR TRAFFIC SERVICES: AIRSPACE AND AIR TRAFFIC SERVICES

172.02.2 – Classification of airspace

ICAO
7.4 AERONAUTICAL INFORMATION CIRCULARS

#20.2 – Altimeter setting procedures

#42.1 – Filing of flight plans and wake turbulence separation data

ICAO
8. HUMAN PERFORMANCE

8.1.1 Basic concepts

Metabolism
Oxygen requirement of tissues
Composition of the atmosphere
The gas laws

8.1.2 The respiratory system and circulation of the blood

Interrelationship of respiration and circulation
Composition and function of the blood
Blood pressure
  – control of blood pressure
  – hypotension and hypertension
  – hemodynamic effects of acceleration

Functional anatomy of the respiratory system
  – ventilation of the alveolar space, respiratory control

ICAO
Hypoxia
  – definition and cause of hypoxia
  – symptoms of oxygen deficiency and treatment
  – time of useful consciousness
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I C A  8.2.3 Integration of sensory inputs; spatial disorientation and illusions

- detection of rotary and linear acceleration
- the subjective vertical
- motion sickness

I C A  8.2.4 Memory

- Functional description
- Information storage and recall
  - short term memory
  - long term memory
  - working memory
  - effects of stress and time of day

I C A  8.3 HUMAN BEHAVIOUR

8.3.1 General concepts

- Personality
  - characteristics
  - individual differences in personality
  - self concept
  - altitude development
  - cognitive dissonance

- Behaviour and skills
  - drives
  - learning
  - motivation and performance

- Human error and reliability
  - human error model
- types of errors
- prevention and counter measures
- reliability of human behaviour
- errors induced by external factors (ergonomics, organisations)
- identification of hazardous altitudes
- working in an automated cockpit
- advantages/disadvantages
- coping behaviour

ICA 8.3.2 Cockpit management

Crew co-ordination
- distribution of responsibilities
- work with a crew concept

Crew co-operation
- small group dynamics (norms, atmosphere, pressure, communication, structure)
- conflict management

Leadership, style of management
- concern for performance
- concern for people
- democratic vs autocratic style
- encouraging inputs and feedback
- optimising of crew performance in flight
- correcting crew co-ordination deficiencies

Communication
- verbal and non-verbal communication
- one- and two-way communication
- effects of different communication styles
- miscommunication (including cultural differences)

ICA 8.3.3 Judgement and decision making

Pilot judgement concepts
- types of judgement
Aeronautical decision making
- decision making concepts
- pilot responsibilities
- behavioural aspects

Identification of hazardous altitudes
- physical factors
- physiological factors
- social influences and interface between people

Pilot judgement awareness
- risk assessment
- cockpit stress management

Applying decision making concepts
- practical application
- managing resources
- safety awareness

ICA 8.4 FLYING AND HEALTH

8.4.1 The high-altitude environment (ozone, radiation, humidity)

8.4.2 Physiological and mental fitness

8.4.3 Incapacitation
- causes and symptoms
- gastro-intestinal
- cardio-vascular
- side effects of drugs and medication
- migraine
- epilepsy
- brain disorders

Recognition: insidious and sudden incapacitation

Procedures for dealing with incapacitation

ICA 8.4.4 Intoxication

Tobacco
Alcohol
Drugs and self medication
Various toxic materials

ICA 8.4.5 Body rhythm disturbances

The biological clock
Disturbances of circadian rhythms
- causes (shift work, time-zone crossing)
- symptoms
- treatment

ICA Sleep
- functions
- patterns
- effects of disturbances and treatment

ICA 8.4.6 Fatigue

Definition
Causes
Types and symptoms
Prevention and treatment

ICA 8.4.7 Stress and anxiety

Definition of stress
Stress components
Causes, stressors
Coping behaviour
- identifying and reducing stress
- life stress management

Effects on performance
Anxiety
Defence mechanisms
Effects of anxiety and defence mechanism

ICA 8.4.8 General health aspects

Common minor ailments (colds, influenza, gastrointestinal upsets)
Tropical climates; risk, regulatory aspects
Personal hygiene; oral, external, internal hygiene
Diabetes
Hyper/hypotension
Obesity, lack of exercise
Epidemic diseases

ICA 8.4.9 Body temperature and its variations

ICA 8.5 HYGIENE OF SURVIVAL

8.5.1 Survival in extreme climatological conditions
- tropical
9 AIRCRAFT TECHNICAL GENERAL

9.1 PRINCIPLES OF FLIGHT

CA 9.1.1 Elements of Physics relating to aerodynamics

Review of units of measurement
Mass, weight, force, resolution and composition of forces, speed, acceleration inertia, momentum, motion on a curved track, work, power, energy, pressure, air density, moments and couples, velocity, temperature

CA 9.1.2 Derivation of Lift

Equation of continuity
Bernoulli’s theorem
Streamline flow
Angle of attack
Pressure distribution about a wing (transverse and longitudinal)
Centre of pressure
Wing shape (plan and section) and its effect on lift
Lift formula
Lift/drag ratio

CA 9.1.3 Drag

Profile drag
- causes
- variation with speed
- methods of minimising

Induced drag
- causes
- vortices
- variation with speed
- design factors affecting

Total effect of the combination of profile and induced drag

CA 9.1.4 Distribution of forces – balance of couples

Lift/mass and thrust/drag couples
Necessity of achieving balance
Methods of achieving balance

CA 9.1.5 Stability
Axes and planes of rotation
Static stability
Dynamic stability
Effects of design features on stability
Interaction between stability in different planes
Effect of altitude/speed on stability
Roll and yaw dampers

9.1.6 Stalling

Angle of attack
Boundary layer and causes of stalling
Variation of lift and drag in the stall
Movement of the centre of pressure
Tip stalling, its dangers and methods of minimising
The spin (autorotation)
Symptoms of the stall
Stall warning devices
Stall recovery
Effect of turbulent flow over tail surfaces on stall recovery
Stick pushers
Enhanced stalling speed in manoeuvre

9.1.7 Lift augmentation

Flaps
- leading and trailing edge
- effects of
- advantages and disadvantages

Slots and slats
- effects of
- advantages and disadvantages

Effects of lift augmentation devices on lift/drag ratio

9.1.8 Flying controls

Ailerons, elevators, rudders, spoilers
- primary effects of
- secondary effects

Balancing of controls
- aerodynamic balance
- mass balance

Powered controls
- methods of transmitting demands to control surfaces
- feedback of control surface displacement (feel)

Trim (including variable incidence tail plane)

9.2 PERFORMANCE (factors affecting)
9.2.1 Take-off and Climb

9.2.2 Level flight

Maximum range
Maximum endurance

9.2.3 Descending gliding, landing

- landing techniques

- considerations, factors affecting

9.2.4 Turning, manoeuvres

9.2.5 High speed flight

Speed of sound, compressibility of air, airflow distribution and pressure wave formation, detached and attached shock waves, mach line, separation Aerofoils in compressible flows, boundary conditions, subsonic, transonic and supersonic flow patterns Wings and wing-fuselage combinations in compressible flow, influence of sweepback, change of aspect ratio. Variable incidence tail plane, large CG range, large speed range and large trim range, trim drag. Dutch roll, yaw and yaw dampers. Spiral stability, direction and lateral trim, high lift devices. Powered controls and artificial feel, stick pushers

Free stream-mach number, local Mach number, critical Mach number, use of the Machmeter, shock stall – behaviour of aeroplane, effect of increasing Mach number, coefficients of lift and drag at transonic speeds

9.3 AIRCRAFT ELEMENTS

9.3.1 Valves

Check valves
Pressure release valves
Selector valves
Restrictors
Thermal relief valves

9.3.2 Bearings

Plain bearings, split bearings and bushes
Ball and roller bearings

9.3.3 Pumps

Gear type
Diaphragm type
Vane type
Piston type
Wobble type
Centrifugal
Pump drives

9.4 AIRFRAME AND SYSTEMS

9.4.3 Filters

Strainers
Sediment traps
9.4.1 Fuselage
Types of construction
Structural components and materials

9.4.2 Cockpit and cabin windows
Construction (laminated glass)
Structural limitations
Window heating

9.4.3 Aerofoils
Types of construction
Structural components and materials

9.4.4 Control surfaces
Vertical, horizontal and V tail surfaces

9.4.5 Landing gear
Types
Construction
Locking devices
Emergency extension systems
Accidental retraction prevention systems
Position, movement lights and indicators
Nose wheel steering
Wheels and tyres (construction, limitations)
Braking systems
- construction
- parking brake
- operation of anti-skid system
- operation of auto-brake system
- operation, indications and warning systems
- limitations and precautions

9.4.6 Flight controls
Primary controls
- elevator, aileron, wing spoilers, rudder
- trim
- mode of actuation
- operation, indicators
- warning devices and controls
Secondary controls lift augmentation and wing flaps
- lift dumping and speed brakes
- variable elevator
Basic principles of hydromechanics
- hydraulic fluids
- schematic construction and functioning

Hydraulic systems
- main, stand-by, and emergency systems
- accumulators
- reservoirs
- operation, indicators, warning systems
- ancillary systems

Pneumatic systems
- Power sources
- schematic construction and functioning of pneumatic

De-ice systems
Pneumatic leading edge de-icing of wings and control
- schematic construction
- operational limitations
- initiation/timing of de-icing system usage

Pneumatic system
- power sources
- schematic construction
- potential failures, safety devices
- operation, indicators, warning systems
- pneumatic operated systems

Anti-ice systems
- airfoil and control surfaces, power plant, air intakes

Windshield
- schematic construction, operating limitations and
Non-pneumatic operated de-ice and anti-ice systems
Schematic construction, functioning and operation of
- air intake
- propeller
- pitot static pressure sensor and stall warning devices
- windshield
- weeping anti-ice wing system
- rain repellent system

C A 9.4.10 Pressurisation
- cabin altitude, maximum cabin altitude
- differential pressure
- operation and indicators
- safety devices and warning systems
- rapid decompression, cabin altitude warning
- emergency procedures

C A 9.4.11 Air conditioning system
- construction, functioning, operation
- indicators and warning devices
- heating and cooling
- temperature regulation
- automatic and manual
- ram air ventilation

C A 9.4.12 Fuel system
Fuel tanks
- structural components and types
- location of tanks on single and multi-engine aircraft
- sequence and type of refuelling
Fuel feed
- gravity and pressure feed
- crossfeed
- schematic construction

Fuel dumping system
- fuel system monitoring
- operation, indicators, warning systems
- fuel management (sequencing of fuel tank switching)
- dipstick

9.4.13 Electrics – direct current (DC)
General
- electric circuits
- voltage, current, resistance
- Ohm’s law
- resistive circuits
- resistance as a function of temperature
- electrical power, electrical work
- fuses (function, type and operation)
- the electrical field
- the capacitor (function)

Batteries
- theory, types, characteristics
- capacity
- uses, servicing
- hazards

Magnetism
- permanent magnetism
- electromagnetism
- relay, circuit breaker, solenoid valve (principle, function and application)
- electromagnetic power
- electromagnetic induction

Generators
- principle, function and application
- monitoring devices
- regulation, control and protection
- modes of excitation
- starter generator

Current distribution
- buses
- monitoring of electrical flight instruments
- ammeter, voltmeter
- annunciators
- electrical consumers
- power distribution
- operation and system monitoring

- elementary switching circuits

The aircraft structure as an electrical conductor

Electrics – alternating current (AC)

General
- single and multi-phase AC

- frequency
- phase shift
- AC components

Alternator
- 3 phase
- brushless (construction and operation)
- drive
- constant speed drive
- integrated drive

AC power distribution
- construction, operation and monitoring
- protection circuits, paralleling of AC generators

**C A** Transformers and inverters
- function
- types and application

Synchronous and asynchronous motors
- operation
- application

**C A** Transformer/rectifier units

**C A** Semiconductors
- principles of semiconductors
- semiconductor resistors (properties and application)
- rectifier (function and application)
- transistor (function and application)
- diode (function and application)

**C A** 9.4.15 Fire warning and extinguisher systems

- Fire warning lights
- Test switches, live wire system
- Extinguisher systems
- Extinguishing agents
- Fire fighting methods
- Extinguishants
- Types of fires and preferred extinguishing agents

**C A** 9.4.16 Oxygen systems

- High and low pressure systems

**C A** 9.5 POWERPLANT – PISTON ENGINE

**C A** 9.5.1 Engine nomenclature

- Major parts and assemblies
- Cylinder arrangements
- Cylinder numbering
- Bore, stroke, engine displacement
- Swept volume
- Compression ratio

**C A** 9.5.2 Four stroke cycle

- Compression ignition, spark ignition, valve lead, lag and overlap, ignition timing

**C A** 9.5.3 Combustion process, factors necessary for efficient combustion, mixture ratios, temperatures

**C A** 9.5.4 Cylinder pressure in normal operation engine indicators/instruments

**C A** 9.5.5 Supercharging and turbo-supercharging
9.5.6 Detonation

Factors contributing to detonation
Effect and indications
Stopping and prevention

9.5.7 Pre-ignition

Factors contributing to pre-ignition
Effects and indication
Stopping and prevention

9.5.8 Relationship between detonation and pre-ignition

9.5.9 Cylinder construction

Barrel, cylinder head, head valves, valve operating mechanism, valve timing, valve clearances

9.5.10 Pistons

Piston rings, piston pin, connecting rods

9.5.11 Crankshafts and camshaft gearing

Dynamic dampers, bearings, camshafts

9.5.12 Crankcase

Construction, accessories, supercharger, breather systems

9.5.13 Ignition system

Battery (coil) ignition, HT magnetos, LT magnetos
Ignition timing, single point and dual point ignition, flame pattern, staggered ignition, Impulse coupling, booster coil, induction vibrator
High energy ignition burners, electric and battery power requirements
Spark plugs, ignition harness, shielding

9.5.14 Lubrication and Cooling

Lubrication for reduction of friction and cooling, wet and dry sump system, lubrication method (splash, spray, pressure, mist), oil pressure pump, scavenge pump, oil pressure relief valve, lubrication system, lubrication of components, oil grades, oil cooling system, heat removal, temperature regulator, factors affecting viscosity of oil
Air cooling, fins, importance of airflow ground handling, control of airflow

9.5.15 Fuels: carburetion and fuel injection system

Properties of fuel, fuel grades, air-fuel mixture ratio
Basic carburettor
- float chamber, main jet, air bleeds, idling system,
accelerator pump, power enrichment system, mixture controls, altitude controls, idle cut-off
Fuel injection system, swirl atomisation
Fuel loss through evaporation and boiling
Control of fuel flow, pressure control system
Flow control systems, barometric pressure control
Air-fuel ratio control
9.5.16 Icing

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Physical principle of ice formation
Prevention and removal of ice
Carburettor heat

9.5.17 Engine power

Power measurement
Indicated horse power
Development of formula
Brake horse power
Torque measuring devices
Calculation of power
Determination of friction horse power
Engine efficiency
- Thermal, mechanical, volumetric

9.5.18 Propellers

General theory
Conversion of engine torque to thrust
Meaning of Pitch
Reasons for blade twist
Reasons for variable pitch/constant speed
Propeller efficiency
Windmilling drag
Feathering
Design features for power absorption
Adverse effects of torque reaction
Gyroscopic precession
Asymmetric slipstream effect
Asymmetric blade effect
Fixed-pitch wood or metal propellers
Variable speed and controllable pitch propellers
Constant speed propeller, action of governor
Propeller shaft, direct drive, reduction gear
Unfeathering

9.5.19 Piston engine handling

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Testing of engines and systems
Engine limitations
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- MAP/RPM relationship
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9.6.13 Auxiliary gearbox – function

9.6.14 Ignition

Function, types, components, operation, safety aspects

9.6.15 Starter

Function, type, construction and mode of operation
Control and monitoring
Self sustaining and idle speeds

9.6.16 Engine start malfunctions

Cause and avoidance

9.6.17 Fuel system

Construction, components
Operation and monitoring
Malfunctions

9.6.18 Lubrication

Construction, components
Operation and monitoring
Malfunctions

9.6.19 Fuel

Effects of temperature
Impurities
Additives

9.6.20 Thrust

Thrust formula
Flat rated engine
Thrust as a function of airspeed, air density, pressure, temperature, RPM

9.6.21 Engine operation and monitoring

9.6.22 Auxiliary power Unit (APU)

Function, types
Location
Operation and monitoring

9.6.23 Ram air turbine – function

9.7 SPECIAL OPERATIONAL PROCEDURES

9.7.1 Minimum equipment list

9.7.2 Ground de-icing

Icing conditions
Definition and recognition, on ground/in flight
De-icing, anti-icing, types of de-icing fluids
Performance deterioration, on ground/in flight

9.7.3 Bird strike and avoidance
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10. **CPL (H) ATG**

10.1 Aircraft general knowledge

10.1.1 Airframe and systems, electrics, powerplant and emergency

Equipment

(1) Airframe and systems

(a) Fuselage

   (i) types of construction; and

   (ii) structural components and materials

(b) Cockpit and cabin windows

   (i) construction (laminated glass); and

   (ii) structural limitations

(c) Aerofoil

   (i) rotor blades;

   (ii) types of construction;

   (iii) properties of different aerofoil sections; and

   (iv) rotor balance, static and dynamic

(d) Control surfaces

   (i) vertical and horizontal stabilisers

(e) Landing gear

   (i) Types

      skid landing gear;
      float landing gear;
      emergency flood landing gear;

   (ii) construction;

   (iii) locking devices and emergency extension systems;

   (iv) accidental retraction prevention devices;

   (v) position, movement lights and indicators;

   (vi) nose wheel steering;

   (vii) wheels and tyres (construction and
(viii) braking systems,

construction;
parking brake;
method of operation of anti-skid
system;
method of operation of auto brake
system; and
operation, indications and warning
systems.

(f) Flight controls (construction and operation)

(i) Flight controls

Collective pitch control;
throttle/fuel control;
cyclic pitch control;
mixing unit;
yaw pedals;
power assisted flight controls;
swash plate assembly;
rotating star;
non-rotating stop;
main rotor head system;
fully articulated system;
semi-rigid rotor system; and
rigid rotor systems

(ii) Dynamic transmission system

Main gear box;
intermediate gear box;
tail rotor gear box and drive shaft;
freewheel unit;
clutch unit;
engine to main gear box coupling; and
rotor brake system.

(g) Hydraulics

(i) Basic principles of hydromechanics

Hydraulic fluids; and
schematic construction and functioning
of hydraulic systems.

(ii) Hydraulic systems

Main, standby and emergency
systems;
operation, indicators and warning
systems; and ancillary systems.

(h) Air driven systems (piston engines only)

(i) Pneumatic systems

Power sources; and
Schematic construction and functioning
of
Pneumatic systems

(ii) De-ice systems

Pneumatic leading edge de-icing of wings and control surfaces; schematic construction; operational limitations; and initiation/timing of de-icing system usage.

(i) Air Driven Systems – Turbo-propeller and Jet aircraft

(i) Pneumatic system

Power sources; schematic construction; potential failures, warning and devices; operation, indicators, warning systems; and pneumatic operated systems.

(ii) Air conditioning system

Construction, functioning, operation, indicators and warning devices; heating and cooling; temperature regulation; automatic and manual; and ram air ventilation.

(j) Fuel system

(i) Fuel tanks

Structural components and types; location of tanks on single and multi-engine aircraft; sequence and types of refuelling; and unusable fuel

(ii) Fuel feed

Gravity and pressure feed; crossfeed; and schematic construction

(iii) Fuel dumping system

Fuel system monitoring Operation, indicators, warning systems;

(iv) fuel management (sequencing of fuel tank switching); and

dip stick
Elements *EXCLUDED* for the CPL (VFR) examination:

As contained in the Composite Examination Syllabus for the various aircrew examinations Edition 1: 2002

**METEOROLOGY**

Paragraph 1:
4, 7, and 8

**FLIGHT PLANNING & PERFORMANCE**

Paragraph 2.1.1:
For the CPL (VFR)(H) V terms applicable to aeroplanes

Paragraph 2.1.3:
For the CPL (VFR)(H) the entire paragraph

Paragraph 2.2.1:
For the CPL (VFR)(H) the entire paragraph

Paragraph 2.2.3:
For the CPL (VFR)(H) –
Midzone weights
Step climb to optimum altitude
Redispatch planning

Paragraph 2.2.6
For the CPL (VFR)(H) the entire paragraph

Paragraph 2.3.1
Maximum ramp and taxi mass

**RADIO AIDS**

Paragraph 3.3.4
Paragraph 3.3.5

**NAVIGATION**

Paragraph 4.2.2 as indicated

Paragraph 4.2.4
Paragraph 4.2.5

Paragraph 4.6.4

**INSTRUMENTS AND MAGNETISM**

Paragraph 6.3.1

Paragraph 6.4.2 – as indicated

**AIR LAW**

In this subject the elements excluded are those pertaining to the specific category, i.e. class ratings for aeroplanes will be applicable to the CPL (A).
PART 91
91.06.27
91.06.34

SUBPART 8

SUBPART 9 as applicable to the category

PART 135

For both CPL (A) and CPL (H)

Paragraph 7.5 – as indicated

AIRCRAFT TECHNICAL

As indicated for the category

STUDY MATERIAL FOR THE INSTRUMENT RATING, COMMERCIAL AND AIRLINE TRANSPORT PILOT LICENCE SYLLABUS AEROPLANE AND HELICOPTER

The following is a list of publications that users may find helpful as reference material for the Instrument Rating, Commercial and Airline Transport Pilot Licence Syllabus. This list does not imply that ATO’s must purchase the complete selection, nor does it claim to be comprehensive, or necessarily to give the best treatment of particular subjects, but has been drawn from commercial sources as suitable reference material. Alternative reference sources, including existing study material, may also be used provided that the contents of the syllabus is used as the ultimate guide in the preparation of such material.

Air Pilots Manual – Volumes 2, 3 and 4 (UK) (previously known as Air Pilots Manual by Trevor Thom)


The Private Pilot’s Licence Course – Jeremy M Pratt (UK) Volumes 3, 4 and 5

The Private Pilot – C S Hames (Australia)

The Commercial Pilot – C S Hames – (Australia)

A Pilot’s Guide to Aircraft and Their Systems – Dale Crane (USA)

South African Air Law for Private Pilots – Lilith A Seals (RSA)

Mechanics of Flight – A C Kermode (USA)

Southern Africa’s Weather Patterns – J Van Heerden and L Hurry (RSA)

Aircraft Systems for Pilots – Dale De Remer (USA)

Flight Theory for Pilots – Charles E Dole (USA)

The Commercial Pilot’s Study Manual Series – Mike Burton (UK)

South African AIP and AIC’s (RSA)

Aviation Legislation in South Africa – Cor Beek (RSA)

ICAO Document 8168 Volume 1

ICAO Annex 14

Instrument Rating, Commercial and Airline Transport Pilot Licence study notes published by Aeronav Academy, Avex Air Training and Central Flying Academy or other similar institutions, provided that such notes have been compiled to comply with the relevant syllabus (RSA)

Ground Studies for Pilots, Volumes: Radio Aids, Meteorology, Navigation, Flight Instruments,
Flight Planning – (UK)
Aircraft Instruments and Integrated Systems – E H J Pallett
Principles of Helicopter Flight – W J Wagtendonk
Rotorcraft Flying Handbook – Federal Aviation Administration (USA)
Rotary Wing Flight – Nicholas Ean (USA) available from ASA
The Helicopter Pilot’s Handbook – G D P Worthington/K Piggott (RSA)
Handling the Big Jets – D.P. Davies (UK)
Aircraft Performance Theory – P.J Swatton (UK)
The Aircraft Performance Requirements Manual – R.V Davies (UK)
Human Performance and Limitations in Aviation – R.D Campbell and M Bagshaw (UK)
Human Factors for Pilots – Roger Green and Associates (UK)
Human Factors and Pilot Performance – Air Pilot’s Manual (UK)
Human Factors for General Aviation – Trollip/Jensen (USA)
Aviation Medicine and other Human Factors for Pilots – Dr Ross Ewing (NZ)
Aviation Medicine Manual (CAP 567) – UK Civil Aviation Authority (UK)
Principles of Avionics – Albert Helfrick (USA)
The Jet Engine – Rolls Royce (UK)
Avionics and Flight Management Systems for the Airline Transport Pilot – Threvor Thom (Australia)
Gas Turbine Engines – R.E.Birch (USA)
Avionics For The Pilot – Joe Johnston (UK)
Jet Engines – Klaus Hunecke (UK)
Aircraft Gas Turbine Technology – Irwin E Treager (USA)
Modern Airmanship – Van Sickle (USA)
AP3456 Vol 1-9, Ministry of Defence (UK)
ATPL Series (15 volumes) – Jeppesen (Europe)