CPL/IR PILOT LICENCE

THEORETICAL KNOWLEDGE SYLLABUS

CONTENTS

INTRODUCTION

1.1 This syllabus of training is effective in conjunction with Civil Aviation Regulations and this is an pre-requirement of the ATPL Syllabus.

1.2 The syllabus is primarily concerned with ground training objectives and standards and sets out the aeronautical knowledge required for the issue of CPL/IR. It assumes prior satisfactory knowledge of material set out in the CPL/IR Syllabus. Notwithstanding this assumption, certain material from the CPL/IR Syllabus is repeated in the CPL/IR syllabus. This has been done for the following reasons: in some cases, the material is seen to be of such fundamental importance that candidates at CPL/IR level will be required to confirm their knowledge and understanding of it, usually at a more advanced level, whilst in other cases, a review of previous material is seen to be necessary in order to clearly grasp new aspects of the same subject. All material contained in this syllabus is examinable at the CPL/IR level.

1.3 The syllabus is primarily directed towards air transport operations aircraft, with emphasis being placed on the knowledge required of the pilot-in-command.

010 AIR LAW AND ATC PROCEDURES (PARTs 022,023,025 & 026) OF RCARs

1.1 Documentation (Part 023 of RCARs)

1.1.1 Describe the method of obtaining publications and know why it is important to update these documents

1.1.2 Given an item of operational significance:

a. select from the list below the appropriate reference document: CARs AIP (Book)AIC

b. extract relevant and current information from these documents

1.1.3 Extract/decode information contained in ERS, NOTAMS and AIP supplements

1.1.4 Understand the terms and abbreviations in AIP GEN relevant to flight execution

1.2 Pilot licences, privileges and limitations

1.2.1 Know:

a. privileges and limitations of the licence

b. recent experience requirements

c. classification of operations

1.2.2 Extract/apply the rule s pertaining to flight and duty time limitations for CPL holders

1.3 Flight rules and conditions of flight (Part 022 of RCARs)

1.3.1 Select documents that must be carried on board an aircraft during flight in Rwandan airspace

1.3.2 Extract/apply the rules relating to:

a. carriage and discharge of firearms

b. aerodromes where operations are not restricted to runways

c the conditions relating to flight in PRD areas

1.3.3 Give examples of solutions which would require a security prefix prior to a radio call *

1.4 Air Service operations (Part 023 of RCARs)

1.4.1 Extract/apply the rules relating to

a. a pilot's responsibilities before flight

b. aerodromes meteorological minima

c. flight over water and in designated remote ar3eas

d. carriage of

I. cargo

ii. sick and handicapped persons

iii, parachutists

iv. floatation and survival equipment

v animals

vi dangerous goods

e requirements for passenger lists

1.4.2 State the requirements to test radio equipment prior to taxi and maintain a listening watch

1.5 Aerodromes (Part 026 of RCARs)

1.5.1 State a pilot's responsibilities with regard to the use of aerodrome

1.6 Airspace (Part 022 and 023 of RCARs)

1.6.1 Differentiate between the various classifications of airspace

1.6.2 With respect to the terms listed in (a) to (g):

- Explain each term and, if applicable
  - Identify airspace boundaries on appropriate charts
  - Extract vertical limits of designated airspace from charts

a . flight information service FIR

b air traffic control service CTA CTR controlled airspace

c radio "reports" and "broadcasts"

d VFR routes and lanes of entry

e PRD areas

f CTAF(R) areas

g controlled aerodromes

1.6.3 Extract/apply permitted tracking tolerances for VFR aircraft to avoid controlled airspace

1.6.4 Know the requirements and procedures to be adopted when operating:

a in any class of airspace

b from or into

I .any licenced aerodromes

Ii a CTR(R)

1.6.5 Altimetry

a. recall the datum from which an altimeter indicates height when the following are set on the

sub-scale:

- Area QNH
- Local QNH
- QFE
- Standard pressure setting
- QNE
- QFF

b recall the meaning of the following:

- Transition altitude
- Transition level
- Transition layer

C recall the procedures that are carried out with altimeter in the transition Altitude and the Transition Level on climb and descent

d derive the transition level for any given area QNH*

1.7 Emergencies, accidents, incidents

1.7.1 State the conditions under which a pilot may declare a mercy flight and select occasions when a mercy flight must not be undertaken.

1.7.2 Extract from the AIP the responsibilities of a pilot regarding the notification of accidents and incidents

1.7.3 Cite examples of “hazards to navigation “that must reported by pilots.

1.8 **Security**

1.8.1 Explain the term ADIZ and extract:

a. the general requirements for operate in this zone

b. the action by the pilot of an intercepted aircraft

1.8.2 State the powers vested in a pilot in command

020 AIRCRAFT GENERAL KNOWLEDGE

2.1 ENGINES

2.1.1 Carburetion

a. Describe the principle of operation of a simple carburettor in terms of:
   i. Fuel vaporization and distribution
   ii. Control of fuel/air charged:
      - Throttle butterfly
   iii. Idling, main and acceleration jets
      - Purpose of these jets
   iv. Mixture control

2.1.2 Supercharging

a. State the purpose of supercharging
b. List the type of superchargers:
   i. Geared mechanically driven)
   ii. Turbo (exhaust driven)
c. State the purpose/function of the following components:
   i. Geared superchargers
      - Impeller, diffuser
   ii. Turbo chargers
      - Compressor, waste gate (fixed, manual, automatic)
d. State the precautions to be observed to avoid detonation when operating a supercharge engine

2.2 PROPELLERS

2.2.1 Describe the following items

- Blade angle, helix angle/pitch

- Propeller thrust and torque
- Thrust horsepower (THP)
- Brake horsepower (BHP)
- Asymmetric blade effect

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

2.2.3 Describe the effect of using carburettor heat on aeroplanes fitted with a CSU

2.2.4 Describe how power out put is controlled when operating aeroplanes fitted with a variable pitch propeller and know how to monitor power using engine instruments

2.2.5 List the precautions necessary if operating a variable pitch propeller when

a. conducting ground checks

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

2.2.6 List reasons for propeller overspeed in aeroplanes fitted with:

a. fixed pitch propellers

b. variable pitch propellers

and state the associated remedial pilot action

2.2.7 Describe

a. the effect of CSU malfunctions on engine operation

b. the effect of using engine controls in the event of malfunctions

2.2.8 In aeroplanes fitted with a CSU, identify cockpit indications which could signify:

a. the presence of engine ice

b. that engine ice has been cleared after application of "carb heat"

2.3 POWER PLANTS

2.3.1 Explain the term "full throttle height"

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

a. fuel/air mixture strength

b. density height

c. altitude, on:

i. normally aspirated engines

ii. turbocharged/supercharged engines

2.3.3 compare the performance characteristics of:

a. aeroplanes with fixed pitch propellers and those fitted with CSU

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

c. normally aspirated and turbocharged/supercharge engines

2.4 AEROPLANE SYSTEMS

2.4.1 describe or state the function of the following typical components mentioned in pilot operating handbook:

a. Fuel system components

i. auxiliary/booster pumps

ii fuel drain

iii. fuel pressure gauge

iv fuel flow gauge

v check valves

b. Lubrication system

i. by-pass valves

ii. oil cooler

iii. wet sump system

iv dip stick

c. Stall warning devices

d Electric and Ignition Systems

v. Alternator generator
vi. Voltage regulator over voltage relay
vii. Ammeter voltmeter
viii. Circuit breaker fuse
ix. Battery ampere hours
x. Bus bar battery master switch
xi. Starter motor starter relay
xii. Dual ignition distributer ignition switch
xiii. External power receptacle, ground/flight switch

e Undercarriage System

i. Oleos/shock struts
ii. Shimmy dampers
iii. Nose wheel steering/castering
iv. Retractable undercarriage
v. Retractable undercarriage
- Uplocks/downlocks
- Anti-retraction devices
- Aural/visual warning devices
- Emergency systems
- Free fall
- Electric, hydraulic, pneumatic

f Hydraulic system

i. accumulator

ii. actuators

iii. brake master cylinder

iv check valve restrictors

g. Auto-Pilot

i. roll attitude heading pitch controls

ii trim indicators

iii cut-out mechanisms

Note: Includes the possibility of "overpowering" the system and associated precautions

h. Fire protection

i. typical detectors

- Overheat – thermal switches
- Rate of temperature rise-thermocouple
- Flame

Ii typical warning devices

- Lights
- Audio

Iii types of fire extinguisher and usage

Iv engine cooling

- Fins
- Baffles
- Cowl flaps

2.5 Flight Instruments

2.5.1 General

a. explain the following terms

I pitot -static system

Ii pitot pressure/static pressure

Ii alternate static source

Iv pressure error

b. explain the relationship between:

i. IAS CAS EAS TAS

c. have a basic knowledge of the principle of operation and construction of the:

i. ASI, VSI, altimeter

ii artificial horizon, direction indicator, rate of turn indicator, turn co-ordinator

2.5.2 State the effect of the following factors on the accuracy of pressure instrument indications

a. ASI

i. blockage/leaks (pitot or static)

ii manoeuvre induced errors (eg sharp pull out from a dive)

b. VSI

i. blockage of the static source

ii lag

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

c. Altimeter

i. blockage of the static source

ii lag

iii incorrect sub-scale setting

iv errors due to changes in atmospheric temperature and pressure

2.5.3 Gyroscopic principles

a. describe the gyroscopic properties of rigidity and precession

b compare the advantages and disadvantages of air driven and electrically driven gyroscopes

c state the effect on a Directional Indicator of:

- Apparent wander/drift
- Maximum at poles, zero at the equator
- Transport wander

2.5.4 Direct reading magnetic compass

Background knowledge

Principle of construction

- Magnetic needles point to magnetic north
- Fluid decreases oscillations and friction-should not contain bubbles
- Pendulosity of magnetic systems causes errors

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

a. turning errors

b. acceleration errors

2.5.6 State the purpose of and use a compass correction card to determine compass heading

2.6 AEROPLANE TYPE KNOWLEDGE

2.6.1 **Aeroplane knowledge**

2.6.2 Prior to cross- country flight training, a student should:

a. list aircraft equipment necessary for the flight

b. demonstrate a knowledge of:

i. tie down procedures

ii stowage of equipment/cargo

iii. knowledge of location and use of ELB (ELT)

iv. an awareness of survival procedures given in emergency response and survival guide

030 AIRCRAFT OPERATION, PERFORMANCE AND PLANNING

3.1 Aerodromes and Aeroplane landing areas

3.1.1 Explain and apply the following terms:

a. take- off safety speed

b. take-off distance available (TODA)

C. take off distance required (TODR)

d. landing distance available (LDA)

e. Landing distance required (LDR)

3.2 Density Height

3.2.1 Determine density height

a. given OAT and pressure height

b. using cockpit temperature and an altimeter setting of 1013.2 hPa

c. density altitude charts

3.3 Take -off and landing performance

3.3.1 Use the flight manual to extract maximum structural take-off and landing weights

3.3.2 Given a typical flight scenario, use performance charts to extract:

a. maximum take off weight

b. maximum landing weight

c. take-off distance required TODR)

d. landing distance required (LDR)

e. climb weight required

f. take-off parameters:

- Power, flap setting, take-off safety speed

g. landing parameters

- Flap, threshold speed

h. give reason for weight limitations

3.4 Climb, Cruise and Descent Performance

3.4.1 From typical charts or tables extract/determine the following data for climb, cruise and descent:

a. time, speed, distance, fuel/quantity

b. appropriate engine settings

c. rates of climb/descent

d. the conditions under which an aeroplane will achieve maximum range and endurance

3.5 Loading

3.5.1 Explain the following terms:

a. arm, moment, datum, station, index unit

b. centre of gravity (CG) and CG limits

c. mean aerodynamic chord

d. empty weight, zero fuel weight (ZFW), dry operating weight

e. maximum take off weight and maximum landing weight

f. floor loading limits

3.5.2 Demonstrate the ability to:

a. express CG as a % of MAC

b. determine CG position relative to the datum

c determine movement of CG with changes in load distribution and mass

d. by use of a typical loading system or load sheet distribute load to maintain CG within limits through out the flight

e. from a flight manual extract:

(i) maximum payload

(ii) maximum load per station

(iii) maximum floor loading capacities

(iv) fore and aft CG limits for a given/derived weight

(i) Weight of fuel/ballast to be carried

3.6 Flight plan preparation

a. weather considerations and operational briefing prior to planning a VFR flight

b. select safe VFR route and level

c. calculate minimum safe fuel required and endurance

d. flight time

e. maximum pay load

040 HUMAN PERFORMANCE AND LIMITATIONS

4.1 Basic health

4.1.1 Know the effect and importance on pilot performance of the following factors:

(a) diet, exercise

(b) coronary risk factors- smoking, cholesterol, obesity, hereditary factors

(c) upper respiratory tract infection eg. Colds, hay fever, congestion of air passages and sinuses

(d) food poisoning and other digestive problems

(e) headaches and migraines

(f) pregnancy

(i) when to stop flying

(ii) impact on cockpit ergonomics

(g) injuries

(h) ageing

(i) alcohol and smoking

(j) blood donations

(k) dehydration

(l) emotional

(i) anxiety, depression, fear

4.1.2 Know that the pilot is not to fly when on medication unless a medical clearance from an AME has been obtained

4.1.3 Know the responsibilities of pilots with regard to being medically fit for flight

4.2 Reserved

4.3 Health and fitness

4.3.1 Know the:

(a) the reasons for and frequency of physical examinations and that a KCAA network of Designated Aviation Medical Examiners exists

(b) process obtaining a medical a medical examination

(c) role of KCAA with to medical fitness and only those conditions which present a flight safety hazard are disqualifying

4.3.2 Alcohol

(a) Explain how alcohol is absorbed and excreted

(b) state and explain what a hangover is

(c) explain the effect a hangover may have on flying performance

(d) explain the relationship between a hangover and level of blood alcohol in a person

(e) explain the relationship between the level of blood alcohol and the recovery period from a hangover

(f) state the factors that affect the elimination of alcohol from the body and describe the effects of illicit drugs and alcohol on on proficiency eg.

(i) judgment, comprehension, attention to detail

(ii) the senses, co-ordination and reaction times

4.3.3 Drugs

Explain that:

Drug abuse is a behavioural problem and is independent of

(i) Dependence (addiction)
(ii) Frequent use

Define illicit or non-illicit psychoactive substances

(c) Explain the adverse effects of illicit or non –illicit psychoactive substances

(d) Explain the effects and duration of such effects on human performance related to perception, speed of processing information, and reaction time of drugs such as:

(i) cannabis- based substances eg. Marijuana, ganja

(ii) amphetamine-based substances eg. Ecstacy

(iii) Opium-based substances eg. Codeine, heroin.

(e) have a broad knowledge of the undesirable effects of over the counter and prescription drugs. In particular, the side effect of:

(i) aspirin, antihistamines, nasal decongestants

(ii) amphetamines, tranquillizers, sedatives, antibiotics

4.3.4 Blood donations

(a) state the effect on flying after giving a blood donation

(b) state the recommended period between giving blood and the next flight and that this period can vary between individuals

4.4 Hyperventilation

4.4.1 know how to recognize and combat hyperventilation

4.4.2 know what hyperventilation is and its causes

4.5 Atmospheric pressure changes

4.5.1 trapped gases

(a) know the effect of changes in pressure on gases trapped in the body cavities

(b) describe the effect on normal bodily function

(c) state/list measures for prevention /treatment

4.5.2 know the effects of flying after a period of underwater diving and state the precautions to be taken if intending to fly after underwater diving

4.6 Basic knowledge of the anatomy of the ear

(a) know its function in receiving sound transmissions

(b) explain the purpose of the Eustachian tube and effects of atmospheric /cabin pressure changes

(c) state the effects of noise exposure on:

(i) hearing loss- long/short term

(ii) speech intelligibility

(iv) Fatigue

(g) describe recommended methods of hearing protection

4.7 Vision. Spatial disorientation, illusions

4.7.1 have a basic knowledge of the anatomy of the eye and its function during the day and at night

4.7.2 Know the factors that affect night vision and identify methods of dark adaptation

4.7.3 Describe the limitations of the eye in discerning objects at night and the off centre method of identifying objects at night.

4.7.4 Know the limitations of the eye with respect to:

(a) the ability to discern objects during flight eg.

(i) other aircraft, transmission lines etc

(b) empty field myopia

(c) glare

(d) colour vision in aviation

(e) common visual problems, viz

(i) myopia, hyperopia, astigmatism, presbyopia

4.7.5 Be aware of the importance of:

(a) seeking experienced professional advice for spectacles prescriptions

(b) selecting suitable sunglasses

4.7.6 Knowledge of factors which are conducive to mid air collisions and describe /practice techniques for visual scanning

4.7.7 Understand and define the term ”disorientation”

4.7.8 Know the sensory systems involved in maintaining body equilibrium ie.that:

(i) equilibrium is normally maintained by use of the eyes, inner ear and proprioceptive system

4.7.9 Understand that these mechanisms were developed for use by land based mammals and not provide reliable information under all conditions of flight.

4.7.10 Describe illusions that may be associated with the factors listed below:

(a) leans

(b) linear and angular accelerations

(c) unperceived changes in the pitch roll yaw

(d) autokinetic illusions

(e) graveyard spin illusion

(f) somatogravic illusion

4.7.11 know:

(a) that the sensory illusions often occur when external visual clues are poor or ambiguous and that they are predictable

(b) the importance of an artificial visual reference system and a pilots ability to use the system

(c) the factors that may make a person more susceptible to disorientation

(d) how to overcome sensory illusions

4.7.12 Know what illusions may result from the following flight factors:

(a) false horizontal clues eg.

(i) sloping cloud formations and sloping terrain

(b) depth perception eg.

(i) flying over water, snow, desert and other featureless terrain

(ii) effect of fog, haze, dust

(c) optical characteristics of windscreens

(d) landing illusions

(i) approach angles- steep/shallow

(ii) width and slope of runway

(iii) approach slope

(v) Terrain approaches over water

(e) relative motion between objects

4.8 Motion sickness

4.8.1 state the basic cause of motion sickness

4.8.2 list factors which may aggravate motion sickness

4.8.3 list methods of combating motion sickness in flight

4.9 acceleration "g" effects

Know the effects of positive and negative acceleration on the human body

(a) On the cardiovascular systems
(b) Vision
(c) Consciousness

4.10 Toxic hazards

4.10.1 Know the sources ,symptoms, effects and treatment of carbon monoxide poisoning

4.10.2 Know the effect of breathing air contaminated by fuel and other noxious or toxic aviation products

4.11 The atmosphere and associated problems

4.11.1 State the chemical composition of the atmosphere and recall the variation of temperature and pressure with altitude

4.11.2 Have a basic concept of the circulatory and respiratory systems in terms of the distribution of oxygen and the excretion of carbon dioxide

4.11.3 Describe what is made by the partial pressure of oxygen

4.12 Hypoxia

4.12.1 (a) List the causes of hypoxia and recognize the symptoms of hypoxia particularly:

(i) its effect on night vision

(ii) the dangers of behavioural changes eg. Lack of self criticism, over-confidence and false sense of security

(b) Know that symptoms are difficult to detect in healthy individuals and develop much faster at higher altitude – eg 14,000 feet

(c) List factors which may increase a person's susceptibility to hypoxia

(d) state the approximate time of useful consciousness (Effective Performance Time – EPT)at 20,000, 25000 and 30000 feet and list factors which affect EPT

(e) list methods of combating various forms of hypoxia

4.13 Human factors considerations

4.13.1 Know the basic concepts of information processing and decision making including:

(a) how sensory information is used to form mental images

(b) the influence of the following factors on the decision making process:

(i) personality traits eg introvert/extrovert

(ii) pride, peer pressure, employer pressure

(iii) the desire to get the task done

(iv) anxiety, over-confidence, boredom, complacency

(vi) Types of memory – short/long term
(vii) Memory limitations
(viii) Aides memoire, rules of thumb
(ix) Workload/overload
(x) Skill, experience, currency

4.13.2 Discuss the general concepts behind decision making and the methods of enhancing decision making skills

4.13.3 concepts of stress

(a) know the interaction between stress and arousal and the effects of short and long term stress on pilot performance and health

(b) know the symptoms, causes and effects of environmental stress(working in an excessively hot, cold, vibrating or noisy environment

(c) know the symptoms and effects of domestic and work related stress

(d) the effects of stress on performance

(e) know the principles of stress management eg.

(i) cognitive/behavioural techniques

(ii) relaxation

(iii) time management

4.13.4 Concepts of fatigue

(a) identify causes of fatigue and describe its effects on pilot performance

(b) differentiate between acute and chronic fatigue

(c) discuss coping strategies eg.

(i) sleep management

(ii) relaxation

(iii) fitness and diet

4.13.5 Basic ergonomics

(a) discuss the principles of control design and the design features of conventional and modern displays

(b) discuss problems associated with:

(i) poorly designed controls/positioning of controls

(ii) interpreting instrument presentations

(c) know the following information regarding safety harness

(i) types how to assess their maintenance
(ii) inertia reel, how to assess their maintenance

4.13.6 basic principles of crew coordination

(a) discuss factors which:

(i) influence verbal and non-verbal communication between flight deck crew viz:

- barriers to communication
- listening skills
- assertion skills

(ii) affect the decision making process viz:

- communication – attitude
- personality
- judgement
- leadership style

(b) discuss ideal leadership qualities

(c) crew aircraft accidents which resulted from poor crew coordination

4.14 Threat and Error Management

4.14.1 Basic principles of TEM

(a) Explain the principles of TEM and detail a process to identify and mange threats and errors during single pilot operations

(b) Define “threat” and give examples of threats

(c) Give an example of a committed error and how action could be taken to ensure safe flight

(d) Explain how the use of checklist and standard operating procedures could prevent rrors

(e) Give examples of how an undesired aircraft state can develop from an unmanaged threat or error

(f) Explain what resources a pilot could identify and use to avoid or manage an undesired aircraft state such as being lost or entering adverse weather

(g) Explain the importance of ensuring that the tasks are prioritized to manage an undesired aircraft state

(h) Give examples of how establishing and maintaining interpersonal relationships can promote safe flight.

050 METEOROLOGY

5.1 Composition of the atmosphere

5.1.1 Student should know the following vertical divisions in the atmosphere:

(i) troposphere, tropopause, stratosphere

(ii) that most weather effect occur below the stratosphere

5.1.2 In the standard atmosphere, recall:

(a) sea level temperature and pressure

(b) temperature and pressure lapse rate in the tropopause

5.2 Heat, temperature, pressure and humidity

5.2.1 a student should :

(a) describe the method of measuring surface air temperature, and know that the actual temperatures may be much higher eg, above a runway

(b) know the meaning of the following terms:

(i) isotherm, temperature inversion

(ii) radiation , advection, convection, conduction

(iii) isobar, horizontal pressure gradient

(iv) saturated air, relative humidity, dew point

(v) evaporation, condensation, freezing

5.2.2 List the effect of changes in temperature, pressure and humidity on the air

5.2.3 List factors that influence the diurnal variation of surface air temperature and explain the temperature gradient between land sea surfaces.

5.3 Atmospheric stability

5.3.1 Differentiate between stable, unstable and conditionally atmospheric conditions.

(a) A basic understanding of adiabatic process and the parcel method of assessing stability is required.

5.4 Clouds and Precipitation

5.4.1 Identify and classify cloud types

Classifications required are:

b. High, medium, low
c. Cumuliform, stratform
    i. Examples of type are Cu, Ci etc

5.4.2 Sate the standard abbreviation for each cloud type and the method used to report cloud amount.

5.4.3 Describe the weather associated with each cloud type.

5.4.4 Differentiate between drizzle, rain, showers, and virga.

5.4.5 select statements that describe the conditions necessary for the formation of / dispersal of various types of cloud.

5.5 Visibility

5.5.1 Know the method used in meteorological forecast and reports to determine visibility

5.5.2 Describe the term " Runway Visual Range"

5.5.3 Give reasons for differences between in-flight and reported visibility

5.5.4 List meteorological factors that will reduce in-flight visibility

5.6 Winds – General

5.6,1 Describe the relationship between pressure and wind and apply Buys Ballot's law to assess the approximate location of high and low pressure systems.

5.6.2 Differentiate between:

(a) squalls and gusts

(b) backing and veering

5.6.3 compare surface and gradient winds in terms of direction and strength

5.6.4 List the factors that affect the diurnal variation of wind and describe typical variations in surface wind strength during a twenty hour period.

5.7 Air masses and winds

5.7.1 Describe typical "flying weather" associated with:

(a) cold fronts

(b) warm fronts

(c) wave depressions

(d) occluded fronts

(e) tropical cyclones

(f) the equatorial trough

Note: The above "flying weather" embraces

- Temperature (warmer/colder)
- Wind changes(back/veer, stronger/weaker)
- Stability and turbulence
- Cloud type and approximate amount, precipitation

5.8 Flight considerations

5.8.1 With respect to the phenomena listed below:

(a) state the conditions favourable to their development and where applicable their dispersal

(b) recognize signs which may indicate their presence

(c) describe their effect on flight characteristics

(d) where applicable, state the pilot actions required to minimise their effect on an aircraft in flight:

(i) thermal, turbulence

(ii) dust devils and dust storms

(iii) wind gradient, wind shear and low level jetstreams

(iv) anabatic and katabatic winds

(v) mountain waves and fohn winds

(vi) land and sea breezes

(vii) inversions and fog

(viii) thunderstorms and microbursts

(ix) downdrafts associated with terrain/cloud

(x) atmospheric stability and instability

(xii) hoar frost, rime and clear airframe ice

(xiii) tropical cyclones, tornadoes

5.9 Synoptic Meteorology

5.9.1 Given a Mean Sea Level analysis chart, identify:

(a) high and low pressure systems

(b) a trough, a ridge, a col

(c) warm, cold and occluded clouds

(d) a tropical cyclone

(e) approximate wind direction

5.9.2 Describe typical weather characteristics associated with the items listed below:

(a) high and low pressure systems

(b) a trough, a ridge, a col

- Eg.
- Approximate wind direction
- Moisture content (dry/humid)
- Cloud- stratiform and cumuliform
- Clear skies
- Turbulent or smooth air
- Good or poor visibility

5.10 Meteorological Services , report and forecasts

5.10.1 Meteorological reports (METAR/SPECI)

5.10.2 aerodrome forecasts (TAF)

5.10.3 SIGMET

5.10.4 automatic terminal information service (ATIS)

5.10.5 pilot reports (PIREPS)

5.11 Climatology

5.11.1 Describe typical seasonal weather conditions in different regions of East Africa with reference to:

(a) visibility (good / poor)

(b) prevailing winds

(c) typical cloud patterns and precipitation

(d) seasonal pressure and frontal systems including the ITCZ and equatorial trough

(e) tropical cyclones

060 NAVIGATION

6.1 Form of the earth

6.1.1 in order to apply this knowledge a student should have understanding of the items listed below a to h and if possible, their effect on:

- Position on the earth
- Time differences
- Distance and direction

a. the shape and rotation of the earth
b. latitude and longitude
c. meridians of longitudes, parallels of latitude
d. equator, Greenwich meridian
e. Great circles. Small circles, rhumb lines
f. Difference between true and magnetic north
g. Terrestrial magnetism, magnetic variation and change of variation with time
h. Distance on the earth i.e relationship between a minute of latitude and a nautical mile

6.2 Time

6.2.1 Explain the terms UTC, Local Mean Time, Local Standard Time, Local summer time*

6.2.2 Extract (within+/- 5 min)the beginning of day and night from the AIP

6.2.3 Carry out conversion between :

- LMT, UTC, Local standard time including local summer time*

6.2.4 List factors which may cause daylight to end earlier than the time extracted from the AIP darkness graphs.

6.2.5 Describe the effect of the earth's rotation and revolution around the sun on the:

a. beginning and the end of daylight

b. period of daylight

6.2.6 Describe the effect of changes in latitude on local time.

6.3 Charts and publications

6.3.1 a. Define the term conformality

b. Define a conformal projection

c. State different chart projections their application and where used

d. State where the following kind if projections are used

(i) plane

(ii) cylindrical

(ii) conical

e. State in terms of the earth's axis how the following projections are obtained:

(i) normal projection

(ii) Transverse projection

(iii) Oblique projection

f. Describe type of projection surface on and their origins:
   (i) Mercator
   (ii) Lambert conformal
g. Define scale on a chart
h. Use of scale of a chart to calculate distances
i. Describe how scale varies on an aeronautical chart
j. Define the following terms:
   i. Standard parallel
   ii. Constant of the cone
   iii. Parallel of origin
   iv. Chart convergence

6.3.2 Representation of meridians , parallels, great circles and rhumb lines

a. on all chart to be used.

b. Describe the appearance of parallels of latitude and meridians on charts

c. Calculate the angle, on the chart between a great circle and a straight line between two given positions (Mercator and Lambert's charts).

6.3.3 Use of current aeronautical charts

a. Enter position on chart using geographical co-ordinates or range and bearing

b. Derive co-ordinates of a position

c. derive true track angles and distances

d. Use of NDB bearings for plotting on an aeronautical chart

e. Use of VOR bearings for plotting on an aeronautical chart

f. Plotting of DME ranges on an aeronautical chart

6.3.4 Knowledge of the following charts:

a. Terminal area charts

b. Standard Instrument arrival chart (STAR)

c. Standard Instrument Departure chart (SID)

d. Instrument Approach and landing chart

e. Aerodrome chart

f. Airways route chart

6.4 Dead reckoning navigation

6.4.1 Basics of dead reckoning

a. Explain the difference between speed and velocity

b. Explain the concept of vectors (adding together and splitting in two directions)

c. triangle of velocities eg. TAS/Hdg, W/V, Trk, (Crs) GS and drift)

d. Derive TAS from IAS/RAS

e. Define and derive Mach number

f. Determine ETA from distance and GS

g. Define DR position versus a FIX

h. Use of a DR track plot to construct a DR position

6.4.2 Use of a navigational computer

a. calculate speed/time/distance

b. calculate fuel consumption

c. conversion of distances

d. conversion of volumes and weights including use of specific gravity

e. calculate IAS, CAS/RAS, TAS and Mach number(mental DR)

f. apply drift to give heading or track(course)

6.4.3 By use of Triangle of velocities, determine:

a. heading

b. Ground speed

c. Wind velocity

d. track (course)

e. Drift angle

f. head/tail/Cross wind component

6.4.4 Elements required for establishing DR position

a. Describe role and purpose of DR navigation

b. Illustrate mental DR techniques used to:

(i) calculate head/tailwind component

(ii) calculate wind correction angle (WCA)

(iii) Revise ETA's

b. Describe course of action when lost:

(i) Calculate average heading and TAS

(ii) Calculate average wind velocity vector

(iii) Calculate estimated ground position

d. Illustrate DR position graphically and by means of DR computer:

(ii) Find true heading and ground speed

(iii) Find true track and ground speed

(iv) Find wind velocity and vector

(v) Apply track (course), heading and wind symbols correctly

(vi) Discuss factors that affect DR position accuracy

6.4.5 Calculate DR elements

a. Calculate :

(i) True altitude given indicated altitude ,elevation, temperature, and pressure inputs.

(ii) Indicated altitude given true altitude , elevation, temperature and pressure inputs

(iv) Density altitude
(v) Height on a given flight path
(vi) Distance to touch down

d. Define and explain QFE, QNH and pressure altitude
e. Explain temperature
(i) expression ram-air/Total Air Temperature (TAT)
(ii) Term ram-rise
(iv) Term recovery coefficient
(v) Compare use of AOT and TAT in airspeed calculations
f. Airspeed
(i) Explain the relationship between IAS-CAS-EAS and TAS
(ii) Calculate CAS for given value of TAS or Mach number
(iii) calculate TAS by means of DR computer and given IAS or CAS with various temperature and pressure inputs
(iv) Calculate TAS and GS for use in DR navigation
(vi) Calculate mach number

6.4.6 Construct a DR position on a Mercator and Lambert charts

a. Solve practical DR navigation problems on any of the above charts

6.4.7 Maximum range

a. state maximum range given usable fuel, speed and meteorological condition

b. calculate maximum range of the aircraft

c. Point of no return

d. Define equipoint

e. calculate point of equal time

6.5 In-flight navigation

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

a. Map reading

b. visual check points

c. general features of a visual checkpoint and give examples

d. Establish fixes by drawing visually derived intersection lines of position on the navigation chart

e. Use of landmarks

f. selection of landmarks

g. State function of contour lines on topographical chart

h. Colour gradient in relation to chart topography

070 PRINCIPLES OF FLIGHT

7.1 Terminology

7.1.1 Identify descriptions/drawings of the following terms:

- Aerofoil span chord camber thickness/chord ratio
- Relative airflow angle of attack
- total reaction lift drag
- Laminar and turbulent boundary layers.

7.2 Design features

7.2.1 State the purpose of the following design features/controls

- Anhedral dihedral aspect ratio sweepback wash- out
- Wing spoilers flaps vortex generators
- Trim tabs

7.3 Bernoulli's theorem

7.3.1 Apply Bernoulli's theorem of constant energy flow to describe how an aerfoil produces lift

7.4 Changes in angle of attack

7.4.1 State/identify the effect of changes in angle of attack up to stalling angle on:

a. pressure changes above and below the wing

b. changes in air flow characteristics streamlined to turbulence

c. lift and drag

d. the boundary layer

7.5 Lift and Drag

7.5.1 State the meaning of the following terms used in the lift and drag formula viz:

a. C_L and C_D - depend on shape and angle of attack of an aerofoil

b. $\frac{1}{2}pV^2$ - defines dynamic pressure (IAS)

c. S – defines surface area

7.5.2 With reference to C_L, C_D, C_L/C_D graphs identify angles of attack associated with:

a. maximum drag – max level flight speed

b. max lift – stalling angle

c. best C_L/C_D-best glide range and still air range

7.5.3 Revise types of drag and state the effect on total drag resulting from changes in IAS, aircraft weight and height.

7.6 Manoeuvres

7.6.1 Draw/identify the forces of lift , weight, thrust and drag acting on an aeroplane in:

a. "steady" level flight

b. a "steady" climb

c. a steady" descent

d. a balanced level turn

7.6.2 State the relationship between speed, bank angle, radius and rate of turn during a balanced level turn.

7.6.3 For a given IAS use the rule of thumb to determine the approximate bank angle for a rate one turn.

7.6.4 State why:

a. power must be applied to maintain speed in a level turn

b. an aeroplane tends to overbank in a level and climbing turn and not in descending turns

7.6.5 State:

a. the effect of aileron drag on turn performance at low airspeed

b. how the design features offset this drag:

i. frise aileron

ii. differential ailerons

7.6.6 Stalling and spinning

7.6.7 Define stalling angle and describe:

a. the symptoms when approaching a stall

b. the characteristics of a stall

7.6.8 Explain:

a. the effect of using ailerons when approaching and during a stall

b. why an aeroplane may stall at different speeds

7.6.9 List the effect of (increase/decrease/nil)of the following variables on the level flight stall IAS:

a. power

b. flap

c. wind shear vertical gusts

d. manoeuvres

e. weight

f. frost and ice

g. altitude

7.6.10 Cite manoeuvres during which an aeroplane may stall at an angle which appears to be different to the true stalling angle.

7.6.11 Differentiate between a spin and a spiral dive in a light aircraft and describe the standard recovery technique for each manoeuvre.

7.7 Performance considerations

7.7.1 Give reason for flying for maximum still air range and endurance

7.7.2 list/identify aerodynamic and engine considerations which are required to achieve maximum still air range and endurance when operating an airplane with a:

a. normally aspirated engine

b. turbocharged/supercharged engine

7.7.3 From (theoretical) power required and power available graphs identify:

a. stall speed (power on)

b. best still air range speed

c. best endurance speed

d. maximum level flight speed

e. the region of reverse command (back of the power curve)

7.7.4 Revise the terms load factor", "g" and "wing loading" and cite situations that may result in an aeroplane exceeding load factor and wing loading.

7.7.5 Given that certain flight conditions remain constant, state the effect of:

a. changes in weight and altitude (height) on:

I. angle of attack and IAS in level flight

ii. level f light range and endurance

iii. turn rate and radius

iv. glide range and endurance

b changes in head/tail wind component on:

I level flight range and endurance

ii. glide range and endurance

c Changes in power on turn rate and radius

7.8 Stability and control

7.8.1 State the effect of the factors listed below on the stability and control of an aeroplane on each of the three planes of movement:

a. longitudinal stability:

i. position of CG

ii. movement of centre of pressure

iii. change in thrust

iv. tailplane movement

b lateral stability

I high versus low set wings

ii. dihedral versus anhedral

iii. sweepback

c directional stability

I. large fore/aft displacement of the CG

Ii. large versus small fin and rudder moment

7.8.2 Understand the relationship between the directional and lateral stability (spiral instability) and state the effect of spiral instability on the control of an aeroplane.

7.8.3 Recognize statements/diagrams which describe static and dynamic stability.

7.8.4 Describe the controllability problems associated with flight in the region of reverse command

7.8.5 Explain the purpose of:

a. trim tabs (fixed and cockpit controlled)

b. balance tabs

c. anti-balance tabs

d. aerodynamic balance

e. mass balance

7.8.6 Explain the function of the items mentioned above (5.8.5) in relation to the movement of the main control surface.

7.9 Taxi, take off and landing

7.9.1 Describe the stability and control characteristics of nose wheel aeroplanes during ground operation.

7.9.2 Describe the result of the following factors on the controllability of an aeroplane:

a. propeller torque and slipstream effect

b. gyroscopic effect

c. asymmetric blade effect

7.9.3 Describe the term “ground effect” and its effect on aeroplane performance.

0.8.0 RADIO AIDS AND INSTRUMENTS

8.1 Radio wave propagation

8.1.1 Terminology

(a) Understand general principles of radio propagation;

(b) Understand and be able to use in correct sense:

- wavelength
- amplitude
- frequency
- phase angle
- frequency bands
- sidebands
  - SSB.LSB.USB
- carrier
- modulation

- amplitude, frequency, pulse, multiplex
- demodulation

8.1.2 Wave propagation

(a) groundwaves, space (direct) waves, skywaves;
(b) propagation within the frequency bands;
(c) factors affecting reception:
- fading, static

(d) use of HF for communications:
- frequency prognosis
- SELCAL

8.1.3 Antennas:

a) function/purpose of antennas;
b) types of antennas in common use for aircraft:
- uses
- characteristics (outline only)
  - directionality
  - polarisation.

8.2 Radio Navigational Aids

8.2.1 ADF (including NDBs and use of RMI)

(a) application for navigation;
(b) principles;
(c) presentation and interpretation;
(d) coverage;

(e) range;
(f) errors and accuracy;
(g) factors affecting range and accuracy.

8.2.2 VOR and Doppler-VOR (including use of RMI)

(a) application for navigation;
(b) principles;
(c) presentation and interpretation;
(d) coverage;
(e) range;
(f) errors and accuracy;
(g) factors affecting range and accuracy.

8.2.3 DME (distance measurement equipment)

(a) application for navigation;
(b) principles;
(c) presentation and interpretation;
(d) range;
(e) errors and accuracy;
(f) factors affecting range and accuracy.

8.2.4 ILS (instrument landing system)

(a) application for navigation;
(b) principles;
(c) presentation and interpretation;
(d) coverage;
(e) range;
(f) errors and accuracy;
(g) factors affecting range and accuracy.

8.2.5 MLS (microwave landing system)

(a) application for navigation;
(b) principles;

(c) presentation and interpretation;
(d) coverage;
(e) range;
(f) errors and accuracy;
(g) factors affecting range and accuracy.

8.3 Basic Radar Principles

8.3.1 Pulse techniques and associated terminology

8.3.2 Ground radar

(a) coverage of ATC radars, factors affecting range and accuracy;
(b) facilities provided by Met radars for storm warning and avoidance.

8.3.3 Airborne weather radar

(a) principles;
(b) types;
(c) presentation and interpretation;
(d) factors affecting range and accuracy.

8.3.4 SSR (secondary surveillance radar) and transponder

(a) principles;
(b) application for traffic control;
(c) presentation and interpretation;
(d) advantages compared to primary radar for traffic control.

8.3.5 Radio Altimeter

(a) principle of operation;
(a) display;
(b) accuracy, errors.

8.4 Flight Instruments

8.4.1 Air Data Instruments:

(a) review of altimeter, ASI, VSI, IVSI and Machmeter:
- principles of operation
- errors
- relationship between IAS, CAS, EAS, TAS and TMN

(b) modern instrumentation:
- integrated displays
- EFIS
- standby instruments

8.4.2. Air Data Computer (ADC)

(a) principles of operation;
(b) input and output data;
(c) uses of output data.

8.4.3 Gyroscopic principles

(a) rigidity, precession:
- real and apparent precession
- correcting for precession (no mathematics required)

(b) types of gyros in common use:
- mechanical
- laser gyros

(c) gyro platforms:
- two- and three- dimensional stability

(d) introduce concept of self-contained instruments versus gyro-platform output displays.

8.4.4 Compasses

8.4.5 Direct Reading Compass (brief review only)

(a) principle of operation and errors;
(b) advantages and disadvantages.

8.4.6 Slaved Gyro-stabilised Compass

(a) principles of operation;
(b) errors;
(c) advantages and disadvantages;
(d) uses of output data.

8.4.7 Inertial heading

(a) use of a gyro platform to compute true heading:
- principles
- significance of initial positions insert

(b) magnetic heading as a modification of true heading.

8.5. Engine Instruments

8.5.1 Displays

(a) types of displays commonly available:
- pointer-and-dial
- vertical strip
- EICAS

(b) purpose of monitoring engine parameters:
- comparison of engine performance
- trends
- identification of malfunctions/failures

(c) desirability of rapidly being able to identify a gauge with its engine:
- examples of good/bad instrumentation layouts
- brief reference to misidentification of engine

8.5.2 EPR gauge

(a) inputs;
(b) displays:
- analogue/digital readout
- setting target EPR

- manual/auto settings

(c) typical appearance of a set of gauges in a modern multi-engine aircraft.

8.5.3 Torque meter

(a) inputs and methods of functioning;
(b) types of indicators and units of torque;
(c) typical appearance of a set of gauges in a modern multi-engine aircraft.

8.5.4 RPM indicator

(a) types of display:
- RPM, percent
- 100% not necessarily a limit

(b) multiple RPM displays - N1, N2, N3:
- conventional order of numbering

(c) typical appearance of a set of gauges in a modern multi-engine aircraft.

8.5.5 Turbine temperature indicator

(a) types of display:
- analogue/digital

(b) overtemp warnings;
(c) typical appearance of a set of gauges in a modern multi-engine aircraft.

8.5.6 Fuel consumption

(a) flowmeters:

- analogue/digital indications
- importance on start-up and shut-down

(b) fuel-used gauges:

- may be separate or incorporated with flowmeter

(c) typical appearance of a set of gauges in a modern multi-engine aircraft.

8.5.7 Total air temperature (TAT) gauge

(a) purpose and functioning of TAT gauge:

- ram rise, recovery factor

(b) typical indicators.

8.6 Flight Instrumentation Systems

8.6.1 Application of computers to aircraft

(discussion only)

(a) flight management systems;
(b) performance management systems;
(c) fly-by-wire aircraft.

8.6.2 Electronic Flight Instrument System (EFIS)

(d) advantages compared to conventional system;
(e) typical inputs and outputs;
(f) data input;
(g) control panel, display unit;
(h) example of a typical aircraft installation.

8.6.3 Flight Management System (FMS)

(i) advantages compared to conventional system;
(j) general principles of operation;
(k) typical inputs and outputs;
(l) control panel, display unit;
(m) example of a typical aircraft installation.

8.7 Automatic Flight Control System

8.7.1 Autopilot (AP)

(a) purpose/function of AP;
(b) common types (different axes);
(c) components;
(d) typical heavy aircraft AP controller;
(e) command and manual modes:

- typical sub-modes
  - ALT/HDG/IAS/MACH/VS hold
  - VORLOC/ILS/INS tracking
  - FMS coupling
  - autoland and auto-go-around

8.7.2 Flight Director (FD)

(a) purpose/function of FD;
(b) common types of presentation:

- V-bars, cross-bars

(c) typical components;
(d) typical heavy aircraft FD controller;
(e) typical modes of operation:

- mode indicator.

8.7.3 Auto-throttle (AT)

(a) purpose/function of AT;
(b) typical modes of operation:

- thrust hold
- speed hold
- VNAV coupling

(c) auto-derate of take-off power;
(d) typical engage/disengage/go-around controls;
(e) typical limitations/restrictions.

8.7.4 Autoflight

(a) relationship between AT, FD and AP;
(b) relationship between FMS and AT/FD/AP;
(c) redundancy requirements for autoland.

8.7.5 Flight envelope protection in autoflight

(a) types for protection available:
- high speed; low speed
- alpha floor
- flap/gear speed protection

(b) functioning of typical system:
- inputs and outputs

(c) modified functioning during flare and touchdown.

8.7.6 Associated autosystems

(a) yaw damper:
- purpose/function of yaw damper
  - typical low/high speed behaviour requiring installation of yaw damper
- method of functioning
  - input and output
- series and parallel types
  - advantages/disadvantages of each type
- typical yaw damper controls

(b) automatic pitch trim:
- purpose/function of auto-trim
- input and output
- typical auto-trim controls

(c) thrust computation:
- purpose/function of thrust computation system
- input and output
- relationship to FMS

8.8. Warning and Recording Equipment

8.8.1 Ground Proximity Warning Systems (GPWS) and Auto Voice Activated Decision System (AVADS)

(a) purpose/function of GPWS;
(b) modes of operation: operating envelopes;
(c) hard and soft warnings - aural and visual;
(d) inputs and outputs;
(e) limitations/restrictions;
(f) typical GPWS display/control panel;
(g) AVADS:
- principles of operation, warnings, limitations

8.8.2 Airborne Collision Avoidance System (ACAS)

(a) what is an ACAS
(b) purpose/function of TCAS
(c) TCAS versions and changes
(d) operating envelope:
(d) inputs and outputs
(e) aural and visual warnings;
(f) limitations/restrictions;
(g) typical TCAS display/control panel

8.8.3 Rotor over speed/under speed warning system components

- inputs/outputs

8.8.4 Digital Flight Data Recorder (DFDR)

(a) purpose/function of DFDR;

(b) typical data coverage available;

(c) physical appearance of a set of gauges of typical recorder and recorded data

8.8.5 Health Usage Monitoring System (HUMS)

- actuation
- down loading

8.8.6 Cockpit Voice Recorder (CVR)

(a) purpose/function of CVR;

(b) typical audio/radio channel coverage available in multi-seat flight deck environment

(c) physical appearance of a set of gauges of typical recorder and control panel

8.8.7 Master Warning Systems

(a) purpose/function of MWS;

(a) typical warning systems incorporated or covered by MWS;

(c) aural/visual outputs:

- warnings
- cautions

(d) typical displays provided;

(e) take-off inhibiting of MWS outputs

8.8.8 Fire Detection, Warning, Extinguishing Systems

- types
- warnings
- limitations
- actuation
- effects

8.9 Area Navigation Systems

8.9.1 Types of systems

(a) self-contained on-board systems:

- INS
- DOPPLER

(b) external sensor systems:

- VOR/DME
- GPS

8.9.2 General principles

(a) inputs required:

- air data inputs
- other inputs

(b) outputs generated:

- types of outputs
- uses

8.9.3 RNAV Systems

(a) principle of VOR/DME area navigation (RNAV);

(b) advantages and disadvantages;

(c) limitations and restrictions:

(d) errors, accuracy, reliability

(e) coverage

(f) range

(g) typical control panel.

8.9.4 Inertial Navigation Systems (INS)

(a) principle of INS navigation;

(b) advantages and disadvantages;

(c) limitations and restrictions:
errors, accuracy, reliability
coverage
range
(d) typical control panel.

8.9.5 Satellite Navigation Systems

(a) principle of GNSS navigation:
• elements of GNSS (eg. GPS, GLONASS)
(b) advantages and disadvantages;
(c) limitations and restrictions:
• errors, accuracy, reliability
• coverage
• range
(d) typical control panel
(e) approvals for IFR Navigation
(f) GPS system enhancements (eg. DGPS, GLS, WAAS)

8.9.6 Updating Area Navigation Systems

(a) need for updating position;
(b) requirements for updating:

- manual inserting
- automatic updating
- inhibiting updating common indications when system updates position.