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AMETHI

B Sc Aviation

THE SYLLABUS OF AIR NAVIGATION IS AS FOLLOWS:

1. **Air Navigation**

a) **Basics of Navigation**

- The solar system
  - seasonal and apparent movements of the sun
- The earth
  - great circle, small circle, rhumb line
  - convergency, conversion angle
  - latitude, difference of latitude
  - longitude, difference of longitude
  - use of latitude and longitude co-ordinates to locate any specific position
- Time and time conversions
  - apparent time
  - UTC
  - LMT
  - standard times
  - international dateline
- Directions
  - terrestrial magnetism: declination, deviation and compass variations
  - magnetic poles, isogonals, relationship between true and magnetic
- Distance
  - units of distance and height used in navigation: nautical miles, statute miles, kilometers, metres, yards and feet
  - conversion from one unit to another
  - relationship between nautical miles and minutes of latitude

b) **Magnetism and Compasses**

- General principles
  - terrestrial magnetism
  - resolution of the earth's total magnetic force into vertical and horizontal components
  - the effects of change of latitude on these components
  - directive force

- magnetic dip
- variation

- Aircraft magnetism
  - hard iron and vertical soft iron
  - the resulting magnetic fields
  - the variation in directive force

- Change of deviation with change of latitude and with change in aircraft's heading
- turning and acceleration errors
- keeping magnetic materials clear of the compass
- knowledge of the principles, standby and landing or main compasses and remote reading compasses
  - detailed knowledge of the use of these compasses
  - serviceability tests
  - advantages and disadvantages of the remote indicating compasses
  - adjustment and compensation of direct reading magnetic compass

c) **Charts**

- General properties of miscellaneous type of projections
  - Mercator
  - Lambert conformal conic
  - Polar stereographic
  - Transverse mercator
  - Oblique mercator

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

- The use of current aeronautical charts
  - plotting positions
  - methods of indicating scale and relief
  - conventional signs
  - measuring tracks and distances
  - plotting bearings

d) Dead Reckoning Navigation (DR)

- Basics of dead reckoning
  - track
  - heading (compass, magnetic, true, grid)
  - wind velocity
  - airspeed (IAS, CAS, TAS, Mach number)
  - ground speed
  - ETA
  - drift, wind correction angle
  - DR-position, fix

- Use of the navigational computer
  - speed
  - time
  - distance
  - fuel consumption
  - conversions
  - heading
  - airspeed
  - wind velocity

- The triangle of velocities, methods of solution for the determination of
  - heading
  - ground speed
  - wind velocity
  - track and drift angle, track error
  - time and distance problems

- Determination of DR position
  - need for DR
  - confirmation of flight progress (mental DR)
  - lost procedures
  - heading and TAS vector since last confirmed position
  - application of wind velocity vector
  - last known track and ground speed vector
  - assessment of accuracy of DR position

- Measurement of DR elements
  - calculation of altitude, adjustments, corrections, errors
  - determination of temperature
  - determination of appropriate speed
  - determination of mach number

- Resolution of current DR problems by means of
  - mercator charts
  - lambert charts
  - polar stereographic projections

- Measurement of
  - maximum range
  - radius of action
  - point-of-safe-return and point-of-equal-time

- Miscellaneous DR uncertainties and practical means of correction

e) In-flight Navigation

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

- Navigation in climb descent
  - average airspeed
  - average wind velocity
  - ground speed/distance covered during climb or descent

- Navigation in cruising flight, use of fixes to revise navigation data as
  - ground speed revision
  - off-track corrections
  - calculation of wind speed and direction
  - ETA revisions

- Flight log (including navigation records)

2. **Mass and Balance - Aeroplanes**

a) Introduction to Mass and Balance

- Centre of gravity (cg): Definition, importance in regard to aircraft stability (Aeroplane)
- Mass and balance
- consult aeroplane flight manual for: cg limits for take-off, landing, cruise configurations
- maximum floor load
- maximum ramp and taxi mass (Aeroplane)

- factors determining maximum permissible mass : structural limitations, performance limitations such as – runway available for take-off and landing, weather conditions (temperature, pressure, wind, precipitation); rate-of-climb and altitude requirements for obstacle clearance; engine-out performance requirements
- factors determining cg limits: aircraft stability, ability of flight controls and surfaces to overcome mass and lift pitching moments under all flight conditions, changes in cg location during flight due to consumption of fuel, raising and lowering of undercarriage, and intentional relocation of passengers or cargo, transfer of fuel, movement of centre of lift because of changes in position of wing flaps

b) Loading

- Terminology: empty mass, dry operating mass (empty mass + crew + operating items + unusable fuel), zero fuel mass, standard mass – crew, passengers and baggage, fuel, oil water (volume/mass conversion factors), carry-on luggage, useful load (traffic load + usable fuel
- Effects of overloading: high take-off and safety speeds, longer take-off and landing distances, lower rate-of-climb, influence on range and endurance, decreased engine-out performance, possible structural damage in extreme cases

c) Centre of Gravity (cg)

- basic of cg calculations (load and balance documentation)
  - Datum – explanation of term, location, use in cg calculation
  - Moment arm – explanation of term, determination of algebric signs, use
  - Moment – explanation, moment = mass x moment arm
  - Expression in percentage of mean aerodynamic chord (% MAC)
- Calculation of cg
  - Effect of load-shift
    - movement of cg. Possible out of limits
    - possible damage due to inertia of a moving load
    - effect of acceleration of the aircraft load

3. **Performance**

a) Performance of Single-Engine Aeroplanes

- definitions of terms and speeds used

- Take-off and landing performance
  - Effect of aeroplane mass, wind, density, altitude, runway slope, runway conditions
  - Use of aeroplane flight manual data

- Climb and cruise performance
  - use of aeroplane flight data
  - effect of density altitude and aeroplane mass
  - endurance and the effects of the different recommended power settings
  - still air range with various power settings

b) Performance of Multi-Engine Aeroplanes

- definitions of terms and speeds used
  - any new terms used for multi-engine aeroplane performance

- Importance of performance calculations
  - determination of performance under normal conditions
  - consideration of effects of pressure altitude, temperature, wind, aeroplane mass, runway slope, and runway conditions

- Elements of performance
  - take-off and landing distances
    - obstacle clearance at take-off

  - rate of climb and descent
    - effects of selected power settings, speeds, and aircraft configuration

  - Cruise altitudes and altitude ceiling
    - en-route requirements

  - Payload/range trade-offs
  - Speed/economy trade-offs

- Use of performance graphs and tabulated data
  - performance section of flight manual

4. **Flight Planning and Monitoring – Aeroplanes**

a) Flight Plans for Cross Country Flights

- Navigation Plan
  - selection of routes, speeds, heights (altitudes) and alternate airfield/landing sites
    - terrain and obstacle clearance
    - cruising levels appropriate for direction of flight
    - navigation check points, visual or radio
  - measurement of tracks and distances
  - obtaining wind velocity forecast for each leg
  - computations of headings, ground speeds, and time en-route from tracks, true airspeed and wind velocities
  - completion of pre-flight portion of navigation flight log

- Fuel Plan

  - computation of planned fuel usage for each leg and total fuel usage for the flight
    - flight manual figures for fuel flow during climb, en-route and during descent
    - navigation plan for times en-route
  - fuel for holding and diversion to alternate airfield
  - reserves
  - total fuel requirements for flight
  - completion of pre-flight portion of fuel log

- Flight monitoring and in-flight re-planning
  - in-flight fuel computations
    - recording of fuel quantities remaining at navigational checkpoints
  - calculation of actual consumption rate
    - comparison of actual and planned fuel consumption and fuel state
  - Revision of fuel reserve estimates
  - in-flight re-planning in case of problems
    - selection of cruise altitude and power settings for new destination
    - time to new destination
    - fuel state, fuel requirements, fuel reserves

  - Radio communication and navigation aids

- communication frequencies and call signs for appropriate control agencies and in-flight service facilities such as weather stations
- radio navigation and approach aids, if appropriate
- type
- frequencies
- identification

b) ICAO ATC Flight Plan

- types of flight plan
  - ICAO flight plan – format
- completing the flight plan
- Filling the flight plan
  - procedures for filing
  - agency responsible for processing the flight plan
- Adherence to flight plan

c) Practical Flight Planning

- Chart preparation
  - Plot tracks and measure directions and distances
- Navigation plans
  - Completing the navigation plan using:
    - tracks and distances from prepared charts
    - wind velocities as provided
    - true airspeeds as appropriate
- Simple fuel plans
  - Preparation of fuel logs showing planned values for:
    - fuel used on each leg
    - fuel remaining at the end of each leg
    - endurance, based on fuel remaining and planned consumption rate, at end of each leg
- Radio planning practice
  - Communications
    - frequencies and call signs of air traffic control agencies and facilities and for in-flight services such as weather information

d) Practical Completion of a 'Flight Plan' (flight plan, flight log, nav log ATC plan, etc.)

- Extraction of data
  - extraction of navigational data
  - extraction of meteorological data
  - extraction of performance data
  - completion of navigation flight plan
  - completion of fuel plan
    - time and fuel to top-of-climb
    - cruise sector times and fuel used
    - total time and fuel required to destination
    - fuel required for missed approach, climb en-route altitude, and cruise alternate
    - reserve fuel

- Completion of air traffic flight plan

5. Radio Navigation

a) Radio Aids

- Ground D/F (including classification of bearings)
  - principles
  - presentation and interpretation
  - coverage
  - range
  - errors and accuracy
  - factors affecting range and accuracy

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

- VOR and Doppler – VOR (including the use of the radio magnetic indicator)
  - principles
  - presentation and interpretation

- coverage
- range
- errors and accuracy
- factors affecting range and accuracy

- DME (distance measuring equipment)
  - principles
  - presentation and interpretation
  - coverage
  - range
  - errors and accuracy
  - factors affecting range and accuracy

- ILS (Instrument Landing System)
  - principles
  - presentation and interpretation
  - coverage
  - range
  - errors and accuracy
  - factors affecting range and accuracy

b) **Basic Radar Principles**

- SSR secondary surveillance radar and transponder
  - principles
  - presentation and interpretation
  - modes and codes, including mode S

c) **Self-contained and External-Referenced Navigation Systems**

- Satellite assisted navigation: GPS / GLONASS
  - principle of operation
  - advantages and disadvantages

6 Instrumentation

6.1 Flight Instruments

a) Air data instruments

- pitot and static system
  - pitot tube, construction and principles of operation
  - static source
  - malfunction
  - heating

- alternate static source

- Altimeter
  - construction and principles of operation
  - display and setting
  - errors
  - correction tables
  - tolerances

- Airspeed indicator
  - construction and principles of operation
  - speed indications (IAS)
  - meaning of coloured sectors
  - maximum speed indicator, V_{MO}, M_{MO} pointer
  - errors

- Vertical Speed Indicator (VSI)
  - aneroid and instantaneous VSI (IVSI)
  - construction and principles of operation
  - display

b) Gyroscopic instruments

- Gyro fundamentals
  - theory of gyroscopic forces (stability, precession)
  - types, and principles of operation:
    - vertical gyro
    - directional gyro
    - rate gyro
    - rate integrating gyro
  - single degree-of-freedom gyro
  - ring laser gyro
  - apparent drift
  - random drift
  - mountings
  - drive types, monitoring

- Directional gyro
  - construction and principles of operation

- Slaved gyro compass
  - construction and principles of operation
  - components
  - mounting and modes of operation
  - turn and acceleration errors

- application, uses of output data

- Attitude indicator (vertical gyro)
  - construction and principles of operation
  - display types
  - turn and acceleration errors
  - application, uses of output data

- Turn and bank indicator (rate gyro)
  - construction and principles of operation
  - display types
  - application, uses of output data
  - turn coordinator

c) Magnetic Compass
- construction and principles of operation
- errors (deviation, effect of inclination)

d) Radio Altimeter
- components
- frequency band
- principle of operation
- displays
- errors

6.2 Power Plant and System Monitoring Instruments

- Pressure Gauge
  - sensors
  - pressure indicators
  - meaning of coloured sectors

- Temperature Gauge
  - ram rise, recovery factor

- RPM Indicator
  - interfacing of signal pick-up to RPM gauge
  - RPM indicators, piston and turbine engines
  - meaning of coloured sectors

- Consumption Gauge
  - high pressure line fuel flowmeter (function, indications, failure warnings)

- Fuel Gauge

- measurement of volume/mass, units
- measuring sensors
- content, quantity indicators
- reasons for incorrect indications

- Torque Meter
  - indicators, units
  - meaning of coloured sectors

- Basics of Electronic Displays
  - EFIS
  - EICAS
  - ECAM
  - FMS
- Basic radio propagation theory
  - Basic principles
  - Electromagnetic waves
  - Wave length, amplitude, phase angle, frequency
  - Frequency bands, side band, single side band
  - Pulse characteristics
  - Carrier, modulation, demodulation
  - Kind of modulation (amplitude, frequency, pulse, multiplex)
  - Oscillation circuit
- Antennas
  - Characteristics
  - Polarization
  - Types of antennas
- Wave propagation
  - Ground wave
  - Space wave
  - Propagation with the frequency bands
  - Frequency prognosis (MUF)
  - fading
  - Factors affecting propagation (reflection, absorption, interference, twilight, shoreline, mountain, static)

APPENDIX 'B'

AVIATION METEOROLOGY

THE SYLLABUS OF AVIATION METEOROLOGY IS AS FOLLOWS :

1. Aviation Meteorology

1.1 The Atmosphere

a) Composition, extent, vertical division

b) Temperature

- vertical distribution of temperature
- transfer of heat: solar and terrestrial radiation, conduction, convection, advection and turbulence
- lapse rate, stability and instability
- development of inversions, types of inversions
- temperature near the earth's surface, surface effects, diurnal
- variation, effect of clouds, effect of wind

c) Atmospheric pressure

- barometric pressure, isobars
- pressure variation with height, contours (isohypses)
- reduction of pressure to mean sea level, QFF
- surface low/upper-air low, surface high/upper-air high-precipitation

d) Atmospheric density : interrelationship of pressure, temperature and density

e) International Standard Atmosphere (ISA)

f) Altimetry

- pressure altitude, true altitude
- height, altitude, flight level
- altimeter settings: QNH, QFE, 1013.25 hPa
- effect of accelerated airflow due to topography

1.2 Wind

a) Definition and measurement

b) Primary cause of wind

- primary cause of wind, pressure gradient, coriolis force, gradient wind
- relationship between isobars and wind

c) General circulation

- general circulation around the globe

d) Turbulence

- Turbulence and gustiness, types of turbulence
- origin and location of turbulence

e) Variation of wind with height

- variation of wind in the friction layer

f) Local winds: Anabatic and katabatic winds, land and sea breezes, venturi effects

g) Standing waves

- origin of standing waves

1.3 Thermodynamics

a) Humidity

- water vapour in the atmosphere
- temperature / dew point, mixing ratio, relative humidity

1.4 Clouds and Fog

a) Clouds formation and description

- cloud types, cloud classification
- influence of inversions on cloud development

b) Fog, mist, haze

- radiation fog
- advection fog
- steaming fog
- frontal fog
- orographic fog

1.5 Precipitation

a) Development of precipitation
- development of precipitation
- types of precipitation
- type of precipitation, relationship with cloud types

1.6 Airmasses and Fronts

a) Types of airmasses
- description, factors, affecting the properties of an airmass
- classification of airmasses, modifications of airmasses, areas of origin

b) Fronts

- boundaries between airmasses (fronts), general situation, geographic differentiation
- warm front, associated clouds and weather
- cold front, associated clouds and weather
- Warm sector, associated clouds and weather
- weather behind the cold front
- occlusions, associated clouds and weather
- stationary front, associated clouds and weather
- movement of fronts and pressure systems, life cycle

1.7 Pressure Systems

a) Location of the principal pressure areas
b) Anticyclone: Anticyclones, types, general properties, cold and warm anticyclones, ridges and wedges, subsidence
c) Non frontal depressions
- thermal, orographic – and secondary depressions, cold air pools, trough

d) Tropical revolving storms

1.8 Climatology

a) Typical weather situations in mid-latitudes
- westerly waves
- high pressure area
- uniform pressure pattern

b) Local seasonal weather and wind

- SE & NE Monsoon, Pre-Monsoon, Northwesters, Kalbaisakhi
- Western Disturbance

1.9 Flight Hazards

a) Icing
- weather conditions for ice accretion, topographical effects

b) Turbulence
- effects on flight, avoidance

c) Windshear
- definition of windshear
- weather conditions for windshear
- effects on flight

d) Thunderstorms
- structure of thunderstorms, squall lines, life history, storm cells, electricity in the atmosphere, static charges
- conditions for and process of development, forecast, location, type specification
- Thunderstorm avoidance, ground/airborne radar, storm scope
- development and effect of down bursts
- development of lightning discharge and effect of lightning strike on aircraft and flight execution

e) Low and high level inversions: Influence on aircraft performance

f) Hazards in mountainous areas
- influence of terrain on clouds and precipitation, frontal passage
- vertical movements, mountain waves, windshear, turbulence, ice accretion
- development and effect of valley inversions

g) Visibility reducing phenomena
- reduction of visibility caused by mist, smoke, dust, sand and precipitation
- reduction of visibility caused by low drifting and blowing snow

1.10. Meteorological Information

a) Observation

- On the ground – surface wind, visibility and runway visual range, transmissometers; Clouds – type, amount, height of base and tops, movement; Weather – including all types of precipitation, air temperature, relative humidity, dew point, atmospheric pressure
- aircraft observations and reporting, data link systems, PIREPS
-

b) Weather Charts

- significant weather charts
- surface charts
- upper air charts
- symbols and signs on analysed and prognostic charts
-

c) Information for Flight Planning

- Aeronautical codes: METAR, TAF, SPECI, SIGMET, SNOWTAM, runway report
- Meteorological broadcasts for aviation: VOLMET, ATIS, HFVOLMET, ACARS
- Content and use of pre-flight meteorological documents
- Meteorological briefing and advice
- measuring and warning systems for low level windshear, inversion
- Special meteorological warnings

APPENDIX 'C'

AIR REGULATION

THE SYLLABUS OF AIR REGULATION IS AS FOLLOWS:

1. Air Regulation

1.1 International Agreements and Organizations

a) The Convention of Chicago

Air Navigation

- General principles and application: sovereignty, territory
- Flight over territory of Contracting states: right of non-scheduled flight, scheduled air services, cabotage, landing at customs airports, applicability of air regulations, rules of the air, search of aircraft.
- Documents to be carried in aircraft
- International standards and recommended practices: adoption of international standards and procedures, endorsement of certificates and licenses, validity of endorsed certificates and licenses: departure from international standards and procedures (notification of differences)

b) The International Civil Aviation Organization

- objective and composition
- duties in relation to – annexes to the convention, standards and recommended practices, procedures for air navigation services, regional supplementary procedures, regional air navigation, manuals and circulars

c) Other International Agreements

- The International Air Transport Agreement - the five freedoms
- The Convention of Tokyo, La Haye, Montreal – Jurisdiction, authority of pilot-in-command of the aircraft
- DGCA India: Organization and Structure – Indian organizations name, composition, objectives and relevant documents (Aircraft Act 1934, Indian Aircraft Rules 1937)
- Civil Aviation Requirements
- Warsaw Convention

d) PIC authority and responsibility regarding safety and security

e) Operators and pilots liabilities towards persons and goods on the ground, in case of damage and injury caused by the operations of the aircraft

f) Commercial practices and associated rules

1.2 **Annex 8 – Airworthiness of Aircraft**

- applicability

1.3 **Annex 7 – Aircraft Nationality and Registration Marks**

- applicability

1.4 **Annex 1 – Personnel Licensing**

- applicability
- relation between Annex 1 and CARs

1.5 **Rules of the Air (Based on Annex 2)**

- Annex 2: essential definitions, applicability of the rules of the air, general rules (except water operations), visual flight flights, instrument flight rules, signals, interception of civil aircraft, table of cruising levels

1.6 **Procedures for Air Navigation – Aircraft Operations Doc. 8168, Volume 1**

a) Foreword – introduction
b) Definitions and abbreviations (see general statements)
c) Departure procedures - general criteria, standard instrument departures, omni-directional departures, published information, simultaneous operations on parallel or near-parallel instrument runways, area navigation (RNAV) departure procedures based on VOR/DME, use of FMS/RNAV equipment to follow conventional departure procedures
d) Approach procedures
   - general criteria (except tables)
   - approach procedures design : instrument approach areas, accuracy of fixes (only intersection fix tolerance factors, other fix tolerance factors, accuracy of facility providing track, approach area splays, descent gradient)
   - arrival and approach segments : general, standard instrument arrival, initial approach segment (only general), intermediate approach segment, final approach segment (except tables), missed approach segment (only general)
   - visual manoeuvring (circling) in the vicinity of the aerodrome: general, the visual manoeuvring (circling) area (except table), visual manoeuvring (circling) area not considered for obstacle clearance (except table), minimum

descent altitude/height, visual flight manoeuvre, missed approach whilst circling.
- Simultaneous ILS operations on parallel or near-parallel runways
- Area navigation (RNAV) approach procedures based on VOR/DME
- Use of FMS/RNAV equipment to follow conventional non-precision approach procedures

e) Holding procedures

- in-flight procedures (except table), entry, holding
- obstacle clearance (except table)

f) Altimeter setting procedures (including ICAO Doc. 7030-Regional Supplementary Procedures) – basic requirements (except tables), procedures

g) Secondary surveillance radar transponder operating procedures (including ICAO Doc. 7030 – Regional Supplementary Procedures)

- operation of transponders
- operation of ACAS equipment
- phraseology

1.7 Air Traffic Services (based on Annex 11 and Doc. 4444)

a) Air Traffic Services – Annex 11 : Definitions (see general statements)

b) General

- objectives of ATS, divisions of ATS, designation of the portions of the airspace and controlled aerodromes where ATS will be provided, classification of airspaces (appendix 4 of Annex 11), required navigation performance (RNP), establishment and designation of the units providing ATS, specifications for flight information regions, control areas and control zones, minimum flight altitudes, priority in the event of an aircraft in emergency, in-flight contingencies, time in ATS

c) Air Traffic Control

- application
-
-

- provision of air traffic control service, operations of air traffic control service, separation minima, contents of clearances, co-ordination of clearances

d) Flight Information Service

- application
- scope of flight information service

e) Alerting Service: application, notification of rescue co-ordination centres (only INCERFA, ALERFA, DETRESFA), information to aircraft operating in the vicinity of an aircraft in a state of emergency

f) Principles governing the identification of RNP types and the identification of ATS routes other than standard departure and arrival routes (Appendix 1)

g) Rules of the Air and Air Traffic Services (ICAO Doc. 4444 – RAC/501/11 and ICAO Doc. 7030 – Regional Supplementary Procedures)

- definitions (See general statements)
- relationship to other document

h) General provisions

- general air traffic services operating practices: submission of a flight plan, clearances and information, control of air traffic flow, altimeter setting procedures, indication of heavy wake turbulence category, position reporting, air traffic incident report, procedures in regard to aircraft equipped with airborne collision avoidance systems (ACAS)
- Appendix 1

i) Area Control Service

- general provisions for the separation of control traffic
- vertical separation : vertical separation application, vertical separation minimum, minimum cruising level, assignment of cruising level, vertical separation during ascent or descent
- horizontal separation: lateral separation application, lateral separation application, longitudinal separation application
- reduction in separation minima
-

- air traffic control clearances: contents, description of air traffic control clearances, clearance to fly maintaining own separations while in visual meteorological conditions, essential traffic information, clearance of a requested change in flight plan
- emergency and communication failure: emergency procedures (only general priority, emergency descent, action by pilot-in-command), air-ground communication failure (only concerning the actions by pilot-in-command), interception of civil aircraft

j) Approach Control Service

- departing aircraft: general procedures for departing aircraft, clearances for departing aircraft to climb maintaining own separation while in visual meteorologica conditions, information for departing aircraft
- arriving aircraft: general procedures for arriving aircraft, clearance to descend subject to maintaining own separation in visual meteorological conditions, visual approach, instrument approach, holding, approach sequence, expected approach time, information for arriving aircraft

k) Aerodrome Control Service

- functions of aerodrome control towers: general, alerting service provided by aerodrome control towers, suspension of VFR operations by aerodrome control towers
- traffic and taxi circuits: selection of runway-in-use
- information to aircraft by aerodrome control towers: information related to the operation of the aircraft, information on aerodrome conditions
- control of aerodrome traffic: order of priority for arriving and departing aircraft, control of departing and arriving aircraft, wake turbulence categorization of aircraft and increased longitudinal separation minima, authorization of special VFR flights

l) Flight Information Service and Altering Service

- Flight information service
- Alerting service

m) Use of radar in Air Traffic Services

- general provisions: limitations in the use of radar, identification procedures (only establishment of radar identity), position information, radar vectoring
- use of radar in the air traffic control service

1.8 Aeronautical Information Service (based on Annex 15 and AIP, India)

- essential definitions
- applicability

1.9 Aerodromes (Based on Annex 14, Vol. 1 & 2)

a) Annex 14

- definitions
- aerodrome data
- conditions of the movement area and related facilities

b) Visual aids for navigation

- indicators and signaling devices
- markings
- lights
- signs
- markers

c) Visual aids for denoting obstacles

- marking of objects
- lighting of objects

d) Visual aids for denoting restricted use of areas

e) Emergency and other services

- Rescue and fire fighting
- Apron management services
- Ground servicing of aircraft

f) Attachment A to Annex 14

- calculation of declared distances
- radio altimeter operating areas
- approach lighting systems

1.10 Facilitation (based on Annex 9)

- definitions
- entry and departure of aircraft – description, purpose and use of aircraft documents general declaration

- entry and departure of persons and their baggage – entry requirement and procedures for crew and other operator's personnel

1.11 Search and Rescue (based on Annex 12)

a) Annex 12 – definitions
b) Organization
c) Operating procedures

- procedures for pilots-in-command at the scene of an accident
- procedures for pilot-in-command intercepting a distress transmission
- search and rescue signals

d) Search and Rescue Signals

- signals with surface craft
- ground/air visual signal code
- air/ground signals

1.12 Security (based on Annex 17)

a) Annex 17 – General – aims and objectives

1.13 Aircraft Accident Investigation (based on Annex 13)

a) Annex 13 – definitions, applicability

1.14 CARs : Sections 2, 7 and 8

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

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

2 Human Performance & Limitations

2.1 Human Factors : Basic Concepts

a) Human Factors in aviation

- competence and limitations
- becoming a competent pilot – the traditional approach towards 'proficiency', the human factors approach towards 'professionalism'

b) Flight Safety concepts

2.2 Basic Aviation Physiology and Health Maintenance

a) Basics of flight physiology

- the atmosphere : composition, gas laws, oxygen requirements of tissues
- Respiratory and circulatory systems: pressurization, decompression, rapid decompression, entrapped gases, barotraumas, counter measures, hypoxia, symptoms, time of useful consciousness, hyperventilation, accelerations
- High altitude environment: ozone, radiation, humidity

b) Man and Environment the sensory system

- integration of sensory inputs : spatial disorientation, illusions, approach and landing problems

c) Health and Hygiene

- personal hygiene
- common minor ailments: cold, influenza, gastro-intestinal upset
- problem areas for pilots : hearing loss, flight related hazards to hearing, defective vision, hypotension, hypertension, coronary disease, obesity, nutrition hygiene, tropical climates – epidemic diseases
- intoxication: tobacco, alcohol, drugs and self-medication, various toxic materials
- incapacitation: symptoms and causes, recognition, operating coping procedures

2.3 Basic Aviation Psychology

a) Human information processing

- attention and vigilance: selectivity of attention, divided attention
- perception: perceptual illusions, subjectivity of perception
- Response selection: learning principles and techniques, drives, motivation and performance

Human error and reliability
- Reliability of human behaviour
- Theory and model of human error
- Error generation
  - Economics
  - Social environment (group, organization)

b) Decision making

- decision-making concepts: structure (phases), limits, risk assessment, practical application

c) Avoiding and managing errors: Cockpit Management

- safety awareness: risk area awareness, identification of error proneness (oneself), identification of error sources (others), situational awareness stress

- Co-ordination (multi-crew concepts)

- Co-operation: small group dynamics, leadership, management styles, duty and role

- Communication: communication model(s), verbal and non-verbal communication, communication barriers, conflict management

d) Personality

- Personality and attitudes : development, environmental influences
- individual differences in personality: self-concepts (e.g. , action vs. state-orientation)
- identification of hazardous attitudes (error proneness)

e) Human overload and under load

- arousal
- stress: definitions, anxiety and stress, effects of stress
- fatigue: types, causes, symptoms, effects of fatigue
- body rhythm and sleep: rhythm disturbances, symptoms, effects, management, circadian rhythm

- fatigue and stress management: coping strategies, management techniques, health and fitness programmes, relaxation techniques

f) Advanced cockpit automation

- advantages and disadvantages (criticalities)
- automation complacency

3. **Operational Procedures**

3.1 **Operational Procedures – Special and Emergency Procedures General:**

a) ICAO Annex 6, Parts I, II and III (as applicable)
- definitions
- applicability
- general framework and contents

b) CAR-OPS – Requirements
- General requirements about
  - quality system
  - additional crew members
  - methods of carriage of persons
  - admission to flight deck
  - unauthorized carriage
  - portable electronic devices
  - endangering safety
  - additional information and forms to be carried
  - information retained on ground
  - power to inspect
  - production of documentation and records
  - preservation of documentation
  - leasing

- Operator certification and supervision requirements
  - general rules for Air Operator Certification
  - issue

- variation and continued validity of an AOC
- administrative requirements

- Operational Procedures requirements
  - operational control and supervision
  - use of Air Traffic Services
  - instrument departure and approach procedures

  - carriage of person with reduced mobility
  - carriage of inadmissible passengers, deportees, or
  - persons in custody
  - stowage of baggage and cargo
  - passengers seating
  - security of passenger cabin and galley(s)
  - smoking on board
  - take-off conditions
  - application of take-off minima's
  - ETOPS
  - RVSM

- All-weather Operations requirements: Low Visibility
  - Aerodrome Operating Minima's – General
  - Low Visibility Operations – General operating rules
  - Low Visibility Operations – Aerodrome considerations
  - Low Visibility Operations – Training and qualifications
  - Low Visibility Operations – Operating procedures
  - Low Visibility Operations – Minimum equipment
  - VFR Operating Minima

- Instrument and safety equipment requirements
  - general introduction
  - circuit protection devices
  - windshield wipers
  - airborne weather radar equipment
  - flight crew interphone system
  - public address system
  - internal doors and curtains
  - first aid kits
  - emergency medical kit
  - first aid oxygen
  - supplemental oxygen – pressurized aeroplanes
  - supplemental oxygen – non-pressurized aeroplanes
  - crew protective breathing equipment
  - hand fire extinguishers
  - crash axes and crowbars

- marking of break-in points
- means for emergency evacuation
- megaphones
- emergency lightings
- automatic emergency locator transmitter
- life jackets

- life rafts and survival ELTs for extended over-water flights
- survival equipment

- Communication and navigation equipment requirements
  - radio equipment
  - audio selector panel
  - radio equipment VFR
  - communication and navigation IFR and VFR

- Flight crew
  - flight and duty time limitations and rest requirements
  - cabin crew

Knowledge of basic navigation equipment, operational and regulatory, requirements for long-range flights in MNPS, Trans-oceanic and polar airspace.

c) **Special Operational Procedures and Hazards (General Aspects)**

- Minimum equipment list
  - AFM

- 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

- Bird strike risk and avoidance

- Noise abatement
  - influence by the pilot (power setting, low drag, low power

- Fire/smoke
  - actions in case of overheated brakes after aborted take-off and landing

- Decompression of pressurized cabin
  - slow decompression
  - rapid or explosive decompression
  - dangers and action taken

- Windshear, microburst
  - definition and description
  - effects and recognition during departure and approach
  - actions to avoid and actions taken during encounter

- Wake turbulence
  - cause
  - influence of speed and mass, wind
  - actions taken when crossing traffic, during take-off and landing

- Security
  - unlawful events

- Emergency and precautionary landings operations in various terrain – water (i.e. slopes, mountains, jungle, offshore)
  - definition
  - cause
  - factors to be considered (wind terrain, preparation, flight tactics, landing in various terrain and water)
  - passenger information
  - evacuation
  - action after landing

- Fuel jettisoning
  - safety aspects

- Transport of dangerous goods
  - Annex 18
  - practical aspects

- Contaminated runways
  - kinds of contamination
  - braking action, brake co-efficient
  - performance correction and calculations

3.2 Communications

3.2.1 VFR Communications

a) Definitions

- Meaning and significance of associated terms
- Air Traffic Services abbreviations
- Q-code groups commonly used in RTF air-ground communications
- Categories of messages

b) General Operating Procedures

- Transmission of letters
- Transmission of numbers (including level information)
- Transmission of time
- Transmission technique
- Standard work and phrases (relevant RTF phraseology included)
- Radiotelephony call signs for aeronautical stations including use of abbreviated call signs
- Radiotelephone call signs for aircraft including use of abbreviated call signs
- Transfer of communication
- Test procedures including readability scale
- Read back and acknowledgement requirements
- Radar procedural phraseology

c) Relevant Weather information terms (VFR)

- Aerodrome weather
- Weather broadcast

d) Action required to be taken in case of communication failure

e) Distress and urgency procedures

- Distress (definition – frequencies – watch of distress frequencies – distress signal – distress message)
- Urgency (definition – frequencies – urgency signal – urgency message)

f) General Principles of VHF Propagation and Allocation of Frequencies

3.3 IFR Communications

a) Definitions

- Meaning and significance of associated terms

- Air Traffic Control abbreviations
- Q-code groups commonly used in RTF air-ground communications

b) General Operating Procedures

- Transmission of letters
- Transmission of numbers (including level information)
- Transmission of time
- Transmission of technique
- Standard words and phrases (relevant RTF phraseology included)
- Radiotelephony call signs for aeronautical stations including use of abbreviated call signs
- Radiotelephone call signs for aircraft including use of abbreviated call signs
- Transfer of communication
- Test procedures including readability scale; establishment of RTF communications
- Read back and acknowledgement requirements
- Radar procedural phraseology
- Level changes and reports categories of messages

c) Action required to be taken in case of communication failure

d) Distress and Urgency Procedures

- PAN medical
- Distress (definition – frequencies – watch of distress frequencies – distress signal – distress message)
- Urgency (definition – frequencies – urgency signal – urgency message)

e) Relevant Weather Information Terms (IFR)
- Aerodrome weather
- Weather broadcast

f) General Principles of VHF propagation and allocation of frequencies

g) Morse Code

APPENDIX 'D'

AIRCRAFT & ENGINE – TECHNICAL GENERAL

THE SYLLABUS OF AIRCRAFT & ENGINE – TECHNICAL GENERAL AS FOLLOWS :

1. **Aircraft and Engines**

1.1 Airframe and Systems

- Fuselage
  - types of construction
  - stress

- Wings
  - types of construction
  - structural components
  - stress

- Stabilizing surfaces
  - vertical, horizontal and V-tail surfaces
  - 'flutter'
  - compensation system
  - mach trim

- Landing Gear
  - types
  - locking devices and emergency extension systems
  - accidental retraction prevention devices
  - position, movement lights and indicators
  - nose wheel steering
  - wheels and tyres (limitations)
  - braking systems
    - parking brake
    - mode of operation of anti-skid system
    - mode of system of auto brake system
    - operation, indications and warning systems

- Flight Controls

  - Primary controls:
    - elevator, aileron and rudder
    - trim
    - mode of actuation (mechanical, hydraulic, electrical, fly-by-wire)
    - operation, indicators, warning devices and controls)
    - efforts to transmit

- Secondary controls:

  - leading and trailing edge lift augmentation devices
  - lift dumping and speed brakes
  - variable elevator
  - mode of actuation (mechanical, hydraulic, electrical, fly-by-wire)
  - operation, indicators, warning devices and controls)
  - danger situations and potential failures

- Hydraulics
  - Basic principles of hydromechanics
    - hydraulic fluids
    - schematic construction and functioning of hydraulic systems

  - Hydraulic system
    - main, standby and emergency system
    - operation, indicators, warning system
    - ancillary system

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

  - Air-conditioning systems
    - construction, functioning, operation, indicators and warning devices
    - heating and cooling
    - temperature regulation
    - automatic and manual
    - ram air ventilation
    - schematic construction

  - Anti-ice systems
    - aerofoil and control surfaces, power plant, air intakes, windshield
    - schematic construction, operating limitations and initiation, timing of de-icing system usage
    - ice warning system

- Pressurization
  - cabin altitude, maximum cabin altitude, differential pressure
  - pressurized zones in the aircraft
  - safety devices and warning systems
  - rapid decompression, cabin altitude warning
  - emergency procedures

- 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
    - rain repellent system

- Fuel system
  - Fuel tanks
    - structural components and types
    - location of tanks on single-and-multi-engine aircraft
    - sequence and types of re-fuelling
    - unusable fuel

  - Fuel feed
    - gravity and pressure feed
    - crossfeed

- Fuel system monitoring
  - operating, indicators, warning systems
  - fuel management (sequencing of fuel tank switching)
  - dip stick

1.2 Electrics

a) Director Current (DC); Direct /Alternating Current (DC/AC)
- 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) system, shock absorbers)

- Batteries
    - types, characteristics
    - capacity
    - uses
    - hazards
- Magnetism
    - permanent magnetism
    - electromagnetism:
        - relay, circuit breaker, solenoid valve (principle, function and applications)
        - electromagnetic power
        - electromagnetic induction
- Generators
    - alternator:
        - principle, function and applications
        - monitoring devices
        - regulation, control and protection
        - modes of excitation
    - starter generator
- Distribution
    - current distribution (buses)
    - monitoring of electrical flight instruments/systems:
        - ammeter, voltmeter
        - annunciators
    - electrical consumers
    - DC power distribution:
        - construction, operation and system monitoring
        - elementary switching circuits
- Inverter
- The aircraft structure as an electrical conductor

b) Alternating Current (AC)

- General
    - single and multi-phase AC
    - frequency
    - phase shift

- AC components

- Generators
  - 3-phase generator
  - brushless generator
  - generator drive:
    - constant speed drive
    - integrated drive

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

- Transformers
  - function
  - types and applications

- Transformer/rectifier units

d) Basic knowledge of computers

- Logic circuits
- Logical symbols
- Switching circuits and logical symbols

1.3 Power Plant

a) Piston engine

General
- design type
- Principle of the 4-stroke internal combustion engine
- Mechanical component

Lubrication system
- function
- schematic construction
- monitoring instruments and indicators
- lubricants

Air cooling
- system monitoring
- cylinder head temperature

- cowl flaps

Ignition
- schematic construction and function
- types of ignition
- magneto check

Engine fuel supply

- carburetor (construction and mode of operation, carburetor icing)
- fuel injection (construction and mode of operation)
- alternate air

Engine performance
- pressure / density altitude
- performance as a function of pressure and temperature

Power augmentation devices
- turbocharger, supercharger (construction and effect on engine performance)

Fuel
- types, grades
- detonation characteristics, octane rating
- colour coding
- additives
- water content, ice formation
- fuel density
- alternate fuels, differences in specifications, limitations

Mixture
- rich and lean mixture
- maximum power and fuel economy mixture setting

Propeller
- fixed pitch and constant speed propeller
- principles and operation of propellers on single and multi-engine aircraft
- propeller check
- propeller efficiency as a function of airspeed
- aircraft and engine protection (propeller operation: ground/ air, coarse/fine pitch limitations)

Engine handling and manipulation
- power setting, power range
- mixture setting

- operational limitations

Operational criteria
- maximum and minimum RPM
- (induced) engine vibration and critical RPM
- remedial action by abnormal engine start run-up and inflight

b) Turbine engine
- principles of operation
- types of construction
  - turboprop
  - turbojet
  - turbofan

c) Engine construction

- Air inlet
  - function

- Compressor
  - function
  - construction and mode of operation
  - effects of damage
  - compressor stall and surge (cause and avoidance)

- Diffuser
  - function

- Combustion chamber
  - function, types and working principles
  - mixing ratios
  - fuel injectors
  - thermal load

- Turbine
  - function, construction and working principles
  - thermal and mechanical stress
  - effects of damage
  - monitoring of exhaust gas temperature

- Jet pipe
  - function
  - different types
  - noise silencing devices

- Pressure, temperature and airflow in a turbine engine

- Reverse thrust
  - function, types and principles of operation
  - degree of efficiency
  - use and monitoring

- Performance and thrust augmentation
  - water injection, principles of operation
  - use and system monitoring

- Bleed air
  - effect of use of bleed air on thrust, exhaust temperature, RPM and pressure ratio

- Auxiliary gearbox
  - function

d) Engine systems

- Ignition
  - function, types, components, operation, safety aspects

- Starter
  - function, type, construction and mode of operation
  - control and monitoring
  - self sustaining and idle speeds

- Engine start malfunctions
  - cause and avoidance

- Fuel system
  - schematic diagrams, components
  - operation and monitoring
  - malfunctions

- Lubrication
  - components
  - operation and monitoring
  - malfunctions

- Fuel
  - effects of temperature
  - impurities
  - additives

- Thrust
  - thrust formula
  - flat rated engine
  - thrust as a function of airspeed, air density, pressure, temperature and RPM
  - power plant operation and monitoring

e) Auxiliary Power Unit (APU)

- General
  - function, types
  - location
  - operation and monitoring

- Ram air turbine
  - function

1.4 Emergency Equipment

a) Doors and emergency exits
- evacuation slides, general usage or as life rafts or flotation devices

b) Smoke detection
- location, indicators, function test

c) Fire detection
- location, warning mode, function test

d) Fire fighting equipment
- location, operation, contents, gauge, function test

e) Aircraft oxygen equipment
- drill, use of equipment in case of rapid decompression
- oxygen generators

f) Hydraulic systems
- components, fluids
- operation, indication, warning systems
- auxiliary systems

g) Emergency equipment
- portable, hand-held fire extinguisher
- smoke mask, smoke protection hood]
- portable oxygen system
- emergency locator beacon, transmitter

- life jacket, life raft
- pocket lamp, emergency lighting
- megaphone
- cash axe
- fireproof gloves
- emergency flotation system

2. Principles of Flight

2.1 Subsonic Aerodynamics

a) Basics Laws and Definitions

- Laws and definitions
  - units
  - laws of Newton
  - ideal gas equation
  - equation of impulse
  - equation of continuity
  - Bernoulli's theorem
  - static pressure
  - dynamic pressure
  - viscosity
  - density
  - IAS, CAS, EAS, TAS

- Basics about airflow
  - stationary airflow
  - not stationary airflow
  - streamline
  - stream tube
  - two-dimensional airflow
  - three-dimensional airflow

- Aerodynamic forces on surfaces
  - resulting air force
  - lift
  - drag
  - angle of attack
  - forces and equilibrium of forces during climb, level, descent and turn

- Shape of an aerofoil
  - thickness of chord ratio
  - chordline
  - camberline

- nose radius
- camber
- angle of attack
- angle of incidence

- The wing shape
  - aspect ratio
  - root chord
  - tip chord
  - tapered wings
  - shape of wing surface
  - mean aerodynamic chord (MAC)

b) The two-dimensional airflow about an aerofoil

- streamline pattern
- stagnation point
- pressure distribution
- centre of pressure
- lift and downwash
- drag and wake (loss of impulse)
- influence of angle of attack
- flow separation at high angles of attack
- the lift-graph

c) The coefficients

- The lift coefficient C
  - the lift formula
  - C_L – α graph
  - C_{Lmax} and α
  - normal values of C_{Lmax}, α_{crit}, stall, and the slope of the C_L / A.o.A curve

- The drag coefficient C_D
  - the drag formulas:
  - zero lift drag
  - lift induced drag
  - C_D – α graph
  - C_L – C_D graph, profile polar
  - C_L – C_D ratio
  - normal values of the C_L – C_D ratio

d) The three-dimensional airflow about an aeroplane

- Streamline pattern
  - span-wise flow and causes
  - tip vortices and local α
  - tip vortices and angle of attack
  - up-wash and down-wash due to tip vortices
  - span-wise lift distribution
  - wake turbulence behind an aircraft (causes, distribution, duration of the phenomenon)

- Induced drag
  - influence of tip vortices on the angle of attack
  - the induced local α
  - influence of induced angle of attack on the direction of the lift vector
  - induced drag and angle of attack
  - induced drag and speed
  - induced drag and wing aspect ratio
  - induced drag and wing planform
  - induced drag coefficient
  - induced drag coefficient and angle of attack
  - influence of the induced drag on the C_L – α graph
  - influence of the induced drag on the C_L – C_D graph, airplane lift drag ratio
  - influence of plan of section
  - winglets
  - wing span loading
  - influence of wing twist

e) The total drag

- influence of change of camber
  - the parasite drag
  - profile drag
  - interference drag
- friction drag
- The profile drag and speed
- the induced drag and speed
- the total drag
- the total drag and speed
- minimum drag
- the drag – speed graph

f) The ground effect

- effect on C_{Di}
- effect on α_{crit}
- effect on C_L

- Effect on take-off and landing characteristics of an aircraft

g) The relation between the lift coefficient and the speed for constant lift

- as a formula
- in a graph

h) The stall

- Flow separation at increasing angles of attack
  - the boundary layer:
    - laminar layer
    - turbulent layer
    - transition
  - separation point
  - influence of angle of attack
  - influence on:
    - pressure distribution
    - location of centre of pressure
    - C_L
    - C_D
    - pitch moments
    - down-wash at horizontal stabilizer
  - buffet
  - use of controls
- The stall speed
  - in the lift formula
  - 1g stall speed
  - influence of:
    - the centre of gravity
    - power setting
    - altitude / IAS
    - wing loading
  - load factor n:
    - definition

- turns
- forces

- The initial stall in span-wise direction
  - influence of plan form
  - aerodynamic twist (wash out)
  - geometric twist
  - use of ailerons
  - influence of fences, vortilons, saw teeth and vortex generators

- Special phenomena of stall
  - the power-on stall
  - climbing and descending turns
  - swept back wings
  - super- or deep-stall, stick pusher
  - canards
  - T-tailed aircraft
  - avoidance of spins:
    - spin development
    - spin recognition
    - spin recovery

  - ice (in stagnation point and on surface):
    - absence of stall warning
    - abnormal behaviour of the stall
    - stabilizer stall

  - Stall warning
    - importance of stall warning
    - speed margin
    - buffet
    - stall strip
    - flapper switch
    - AOA vane
    - AOA probe
    - stick shaker
    - recovery from stall

i) C_{Lmax} augmentation

- Trailing edge flaps and the reasons for use in take-off and landing
  - different types of flaps:
    - split flap
    - plain flap

- slotted flap
- fowler flap

- their influence on the C_L – α graph
- their influence on the C_L – C_D graph
- flap asymmetry
- influence on pitch movement

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

- different types:
  - Krueger flaps
  - variable camber flaps
  - slats

- their influence on the C_L – α graph
- their influence on the C_L – C_D graph
- slat asymmetry
- normal/automatic operation

- Vortex generators
  - aerodynamic principles
  - advantages
  - disadvantages

j) Means to decrease the C_L – C_D ratio, increasing drag

- Spoilers and the reasons for use in the different phases of flight
  - different functions:
    - flight spoilers (speedbrakes)
    - ground spoilers (lift dumpers)
    - roll spoilers
    - spoiler-mixer

  - their influence on the C_L - α graph
  - their influence on the C_L – C_D graph and ratio

- Speedbrakes as a means of increasing drag and the reasons for use in the different phases of flight
  - the influence on the C_L – C_D graph ratio

k) The boundary layer

- Different types

- laminar
- turbulent

- Their advantages and disadvantages on pressure drag and friction drag

l) Special circumstances

- Ice and other contamination
  - ice in stagnation point
  - ice on the surface (frost, snow, clear ice)
  - rain
  - contamination of the leading edge
  - effects on stall
  - effects on loss of controllability
  - effects on control surface movement
  - influence on high lift devices during take-off, landing and low speeds
  - affect on lift/drag ratio

- Deformation and modification of airframe, ageing aircraft

2.2 Transonic Aerodynamics

- The Mach number definition
  - speed of sound
  - influence of temperature and altitude
  - compressibility

- Normal shockwaves
  - M_{crit} and exceeding M_{crit}
  - Influence of:
    - mach number
    - control deflection
    - angle of attack
    - aerofoil thickness
    - angle of sweep
    - area ruling
    - $C_L - \alpha$ graph
    - C_{Lmax}
    - C_D
    - $C_L - C_D$

  - Aerodynamic heating
  - Shock stall / Mach buffet

- Influence on:
  - drag
  - pitch (Mach trim):
    - contribution of:
      - movement of the centre of pressure
      - angle of sweep
      - down-wash

- Buffet margin, aerodynamic ceiling

- Means to avoid the effects of exceeding M_{crit}
  - Vortex generators
  - Supercritical profile
    - shape
    - influence of aerofoil shape on shockwaves
    - advantages and disadvantages of supercritical aerofoil

2.3 **Stability**

a) Condition of equilibrium in stable horizontal flight

- precondition for static stability

- sum of moments
  - lift and weight
  - drag and thrust

- sum of forces
  - in horizontal plane
  - in vertical plane

b) Methods of achieving balance

- Wing and empennage (tail and canard)
- control surfaces
- Ballast or weight trim

c) Longitudinal stability

- Basics and definitions
- Static stability, positive, neutral and negative
- precondition for dynamic stability
- dynamic stability, positive, neutral and negative
- damping:

- phugoid
- short period

- effect of high altitude on dynamic stability
- static stability
- neutral point/location of neutral point
  - definition

- Contribution of:
  - aircraft geometry
  - down-wash
    - a.c. of the wing

  - Location of centre of gravity
    - aft limit, minimum stability margin
    - forward position
    - effects on static and dynamic stability

  - The $C_M - \alpha$ graph
  - Contribution of:
    - location of centre of gravity
    - control deflection

    - major aircraft parts (wings, fuselage, tail)
    - configuration:
    - flap deflection
    - gear extension

  - The elevator position – speed graph (IAS)
  - Contribution of;
    - location of centre of gravity
    - trim (trim tab)
    - trim (stabilizer trim)
    - Mach number/Mach trim
    - friction in the system
    - down spring
    - bob weight

  - The manoeuvring /stick force per g

  - Contribution of:
    - location of centre of gravity
    - trim
    - down spring
    - bob weight

- Stick force per g and the limit load factor
  - category of certification

- Special circumstances
  - ice:
    - effects of flap extension
    - effects of stabilizer ice

- rain
- deformation of airframe

d) Static directional stability
- Slip angle ß
- Yaw moment coefficient C_N
- C_N – ß graph
- Contribution of :
  - location of centre of gravity
  - angle of sweep of the wing
  - fuselage at high angles of attack
  - strakes
  - dorsal fin and angle of sweep of fin
  - major aircraft parts

e) Static lateral stability

- Bank angle ø
- The roll moment coefficient C_L
- Contribution of angle of slip ß
- The C_L – ß graph
- Contribution of:
  - angle of sweep of wing
  - ventral fin
  - location of the wing
  - dihedral / anhedral

- Effective lateral stability

f) Dynamic lateral stability

- effects of asymmetric propeller slipstream
- Tendency to spiral dive
- Dutch roll
  - causes
  - Mach
  - yaw damper

- Effects of altitude on dynamic stability

2.4 **Control**

a) General

- Basics, the Three Planes and Three Axis
- Camber change
- Angle of attack change

b) Pitch Control

- Elevator
- Down-wash effects
- Ice on tail
- Location of centre of gravity

c) Yaw Control
- Pedal/Rudder ratio changer
- Moments due to engine thrust
  - direct
  - induced

- Engine failure
  - rudder limitations at asymmetric thrust
  - meaning of V_{MCA}, V_{MCG}

d) Roll Control

- Ailerons
  - inboard ailerons
  - outboard ailerons
  - function in different phases of flight

- Spoilers
- Adverse yaw
- Means to avoid adverse yaw
  - frise ailerons
  - differential aileron deflection
  - coupling ailerons to rudder by spring
  - roll spoilers
  - effects of asymmetric propeller slip stream

e) Interaction in different planes (yaw/roll)
  - limitations of asymmetric power

f) Means to reduce control forces

- Aerodynamic balance
  - nose balance
  - horn balances
  - internal balances
  - balance tab, anti-balance tab
  - servo tab
  - spring tab

- Artificial
  - power assisted controls
  - fully powered controls
  - artificial feel:
    - inputs:
      - dynamic pressure q
      - stabilizer setting

g) Mass Balance
- reasons to balance
  - means

h) Trimming

- reasons to trim
- trim tabs
- stabilizer trim/trim rate versus IAS
  - position of centre of gravity influence on trim/stabilizer setting for take-off

2.4 Limitations

a) Operating limitations
- flutter
- aileron reversal
- gear/flap operating

- V_{MO}, V_{NO}, V_{NE}
- M_{MO}

b) Manoeuvring envelope

- Manoeuvring load diagram
  - load factor

- accelerated stall speed
- V_A, V_C, V_D
- manoeuvring limit load factor/certification category

- Contribution of:
  - mass
  - altitude
  - Mach number

c) Gust Envelope

- Gust load diagram
  - vertical gust speeds
  - accelerated stall speed
  - V_B, V_C, V_D
  - gust limit load factor
  - V_{RA}

- Contribution of:
  - mass
  - altitude
  - Mach number

2.5 Propellers

a) Conversion of engine torque to thrust
- meaning of pitch
- blade twist
- fixed pitch and variable pitch/constant speed
- propeller efficiency versus speed
- effects of ice on propeller

b) Engine failure or engine stop

- Windmilling drag
  - influence on yaw moment when asymmetric power

- Feathering
  - influence on glide performance
  - influence on yaw moment when asymmetric power

c) Design feature of power absorption

- aspect ratio of blade
- diameter of propeller
- number of blades

- propeller noise

d) Moments and couples due to propeller operation

- Torque reaction
- Gyroscopic precession
- Asymmetric slipstream effect
- Asymmetric blade effect

2.6 Flight Mechanics

a) Forces action on an airplane

- Straight horizontal steady flight
- Straight steady climb
- Straight steady descent
- Straight steady glide

- Steady coordinated turn
  - bank angle
  - load factor
  - turn radius

  - angular velocity
  - rate one turn

b) Asymmetric Thrust

- Moments about the vertical axis
- Influence of bank angle
  - overbanking
  - finstall

- Influence of aircraft weight
- Influence of use of ailerons
- Influence of special propeller effects on roll moments
  - propeller torque
  - propeller wash on flaps

- Influence of slipangle on roll moments
- V_{MCA}
- V_{MCL}
- V_{MCG}
- Influence of altitude

c) Emergency Descent

(MOA).

Dy Capt (Dr) Sanjay Srivastava

30 Jul 2025

- Influence of configuration
- Influence of chosen mach number and IAS
- Typical points on polar curve

d) Windshear

INDIRA GANDHI RASHTRIYA URAN AKADEMI

AGENDA POINTS FOR BOS MEETING- B. SC. AVIATION TO BE HELD ON 30.07.2025

The agenda points for BOS Meeting are as follows.

1. Finalization of panel of Examiners / paper setters/ Evaluators for conduct of Examination of B.Sc. Aviation Academic session 2025-26 and 2026-27.

2. Adoption of Ordinance for B. Sc. Aviation, having the following highlights: -

   a) Syllabus for B Sc. Aviation

   b) Change in Nomenclature of Subjects.

   c) Allotment of Grace marks

   d) Increase in seats per batch.

   e) Fee structure for students at IGRUA.

3. **Adoption of Ordinance for B. Sc. Aviation, :-** B. Sc. Aviation is proposed to be conducted at IGRUA as an affiliated college of RMLAU, as a subject under the science faculty. The current ordinance issued in the year 1999 needs certain changes to meet with the changing scenario of the aviation industry. Over the last 20 years certain issues have come up which necessitate suitable amendments to the existing Ordinance. Revision of Ordinance had been taken up with CSJMU, Kanpur as part of the BOS meeting in Jun 21. It had been principally approved by Academic Council CSJMU but could not be adopted since the affiliation of IGRUA was transferred to RMLAU, Ayodhya. The salient features of the Ordinance which are proposed to be revised are given below.

4. **Syllabus for B Sc. Aviation** :- DGCA vide **F. No CEO/Pilot Syllabus/2011 Dated 16 June 2011** has issued a syllabus for ground training, since DGCA is the authority for all Aviation related policies. It is proposed to incorporate the ground training syllabus as per the same.

5. **Change in Nomenclature of subjects.** As per the existing ordinance the subjects, simulator training and flying training in the first year and second year mention specific model of aircraft as TB20 and King Air C-90A aircraft respectively. In due course of time these aircraft have been withdrawn from service and different type of single engine and multi engine aircraft are being operated by IGRUA. It is therefore proposed that the type of aircraft may be replaced with single engine and multi engine in order to make it more generic. Apart from this few more minor changes are proposed as under:

   (i) Prefix of the subject numbers of the question papers to be replaced from **TBS** to **IGR and Basic to be added for all first-year theoretical subjects.**

   (ii) Nomenclature of **Air Navigation** be bifurcated and made into two subjects namely **Air Navigation** and **Avionics** This is necessitated since Air Navigation is a very vast subject. As such Avionics deals with Instruments and Radio Aids which are integral sub topics of Air Navigation.

   (iii) Nomenclature of **Airframe Engine Theory of Flight** to be changed to **Tech Gen as per DGCA Syllabus.**

   (iv) Tech Gen (Advanced) is to be added as one of the subjects for the second year.

Comparative table of the existing and proposed ordinance related to subjects as per part B Regulation is mentioned below:

Part-1 (Ist year)

SN	**Subjects as per 'Part B' Regulations Scheme of Examination Existing Ordinance for B. Sc. Aviation 1st year**	**Subject as per 'Part B' Regulations Scheme of Examination Proposed Ordinance for B. Sc. Aviation 1st year**
01	TBS-101(Air Navigation)	IGR- 101(Air Navigation – Basic)
02	TBS-102 (Aviation Meteorology)	IGR-102 (Avionics – Basic)
03	TBS -103 (Airframe engine Theory of flight)	IGR-103(Aviation Meteorology – Basic)
04	TBS -104(Air Regulations)	IGR -104 (Tech. General – Basic)
05	-	IGR -105 (Air Regulations – Basic)
06	Simulator Training – TB-20	Simulator Training – Single Engine
07	Flying Training – TB-20	Flying Training – Single Engine

Part-II (2nd year)

SN	**Subjects as per 'Part B' Regulations Scheme of Examination Existing Ordinance for B. Sc. Aviation 2nd year**	**Subjects as per 'Part B' Regulations Scheme of Examination Proposed Ordinance for B. Sc. Aviation 2nd year**
01	TBS-201(Air Navigation -Advanced)	IGR- 201(Air Navigation – Advanced)
02	TBS-202 (Radio Aids -Advanced)	IGR-202 (Avionics – Advanced)
03	TBS -203 (Meteorology - Advanced)	IGR-203(Aviation Meteorology –Advanced)
04	TBS -204(Air Regulations – Advanced)	IGR -204 (Tech. General – Advanced)
05	-	IGR -205 (Air Regulations – Advanced)
06	Simulator Training – King Air C-90A	Simulator Training – Multi Engine
07	Flying Training – King Air C-90A	Flying Training - Multiengine

6.	**Increase in seats per batch.** As per the existing ordinance two courses are to be inducted every year beginning January & July of 50 students each. It is proposed to induct one course every year with 100 students for the course, since 120 students are joining this institute every year. This will allow almost all students to take up B. Sc. Aviation except those who already come with graduation or other higher degrees. Presently most of the students are deprived of taking up B.Sc. Aviation because presently we are having limited seats. It is felt that it is not justifiable for IGRUA since we claim to offer B. Sc. Aviation to all our students. IGRUA has all necessary infrastructure in the form of adequate number of classrooms, qualified instructors, library facilities and well-equipped computer rooms to accommodate the students and successfully complete the training curriculum. Therefore,

the ordinance may be amended as follows:-

S. No	Existing Ordinance	Proposed Ordinance
1.	**Para -3** Two courses are planned for induction every year beginning January and July	**Para-3** One course is planned for induction every year beg nning July
2	**Para -4** Total number of students to the B. Sc. Aviation course shall be restricted to 50 per course at IGRUA	**Para 4.**Total number of students to the B. Sc. Aviation course shall be restricted to 100 per course at IGRUA

7.**Allotment of grace marks.** There is no provision of allotment of grace marks as per the existing ordinance whereas there is a need for the same. it is proposed that the following changes may be incorporated in the ord nance to include provision of allotting grace marks.

S. N	Existing Ordinance	Proposed Ordinance
1.	**Para 22 (b) Failed:** Failure in two or more subjects shall be considered as "failed". Student who has failed in one academic year may appear for the same examination along with the next batch while continuing in the next academic year.	**Para 22 (b) (i). Failed.** Failure in two or more subjects shall be considered as failed and the student has to repeat the academic year. Any student who has failed in one subject in an academic year may appear for the same examination along with the next batch while continuing in the next academic year. **Para 22 (b) (ii).** In case of a student having failed in one subject by few marks, grace marks up to 5 may be given at the discretion of the Vice Chancellor/Registrar, in order to obtain pass marks in the failed subject. **Para 22 (b) (iii)** In case of a student having passed in all subjects but fails to secure an aggregate of 60%, (420/700), then at the discretion of the Vice Chancellor/Registrar of the University, grace marks up to 5 may be added to the student's marks.

8. **Fee Structure** mentioned in the existing ordinance needs a routine change due to the revision of Fees and other allied charges by the Governing Council, over the past twenty years. It is proposed that Part C – Fee structure in the ordinance may be revised as follows:

S. No	Existing Ordinance	Proposed Ordinance
1	**Part C-FEE STRUCTURE** **B.Sc. AVIATION – FULL TIME** **NORMAL CATEGORY**	**Part C-FEE STRUCTURE** **B.Sc. AVIATION – FULL TIME** **NORMAL CATEGORY**
	TRAINING FEE: Total Rs. 10 lacs payable in Quarterly installments of Rs 2.5 lacs each . The same may be modified from time to time as per the instructions of ministry of Civil Aviation Govt. of India.	**TRAINING FEE:** Total Rs. 45 lacs payable in Quarterly installments of Rs 11.25 lacs each. The same may be modified from time to time as per the instructions of ministry of Civil Aviation Govt. of India.
	SECURITY DEPOSIT: Rs 5000/- at the time of joining which is refundable which may be modified from time to time as per the requirement.	**SECURITY DEPOSIT:** Rs 10000/- at the time of joining which is refundable which may be modified from time to time as per the requirement.
	HOSTEL RENT: Rs. 350 /- per month including electricity and water charges. Which may be modified from time to time as per the requirement.	**HOSTEL RENT:** As per prevailing rates at IGRUA revised from time to time.
	MESSING : As per Actual	**MESSING :**As per actual.
	UNIFORM& STATIONERY: As per Actual	**UNIFORM& STATIONERY:** As per Actual

GP CAPT (Dr.) SANJAY SRIVASTAV (Retd)
Secretary BOS Meeting