

SINGHANIA UNIVERSITY

B.TECH – AERONAUTICAL ENGINEERING (Aero-Mechanical)

Syllabus

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DETAILED SYLLABUS

SEMESTER-I

Paper-I

Workshop Technology (BTAEN-101)

Safety Precautions-Aircraft and Workshop: Aspects of safe working practices including precautions to take when working with electricity, gasses especially oxygen, oils and chemicals. Also, instruction in the remedial action to be taken in the event of a fire or another accident with one or more of these hazards including knowledge on Extinguishing agents.

Workshop Practices: Care of tools, control of tools, use of workshop materials; Dimensions, allowances and tolerances, standards of workmanship; Calibration of tools and equipment, calibration standards.

Tools: Common hand tool types; Common power tool types; Operation and use of precision measuring tools; Lubrication equipment and methods; Operation, function and use of electrical general test equipment.

Avionic General Test Equipment: Operation, function and use of avionic general test equipment.

Fits and Clearances: Drill sizes for bolt holes, classes of fits; Common system of fits and clearances; Schedule of fits and clearances for aircraft and engines; Limits for bow, twist and wear; Standard methods for checking shafts, bearings and other parts.

Bearings: Purpose of bearings, loads, material, construction; Types of bearings and their application.

Springs: Types of springs, materials, characteristics and applications.

Transmissions: Gear types and their application; Gear ratios, reduction and multiplication gear systems, driven and driving gears, idler gears, mesh patterns; Belts and pulleys, chains and sprockets.

Material handling and Sheet Metal: Marking out and calculation for bend allowance; Sheet metal working, including bending and forming; Inspection of sheet metal work.

Welding, Brazing, Soldering and Bonding: Soldering methods, inspection of soldered joints. Welding and brazing methods, Inspection of welded joints and brazed joints. Bonding methods and inspection of bonded joints.

Paper-II
Aviation Legislation Part-I (BTAEN-102)

The A/C Act. 1934: Introduction: Detailed Discussion of section –1, 2, 3, 4, 5, 5A, 6, 7, 8, 8A, 8B, 8C, 9, 9A, 9C, 10, 11, 11A, 11B, 12, 14A.

The A/C Rules 1937: Rule 1 – Short title and extent. Rule 3 – Definition and interpretation.

The A/C Rules, 1937 & CAR Section – 2 AAC: Nationality and registration marking of aircraft Rule – 2, 5, 14, 30, 31, 32, 33, 35, 36, 37, 37S Series – F Part – I

The A/C Rules 1937 & CAR section-2 AAC: Approval of organizations. Rule – 133B, 133C, 154, 155, 155 A. Series-E Part – I to IX & CAR 21, CAR 145, 2 of 2001 – Accountable managers, 4 of 1998 Approval of foreign repair organization.

The A/C rules 1937: Rule 8 – carriage of arms, explosives & Dangerous goods, Rule 10 – Mails, Rule 11 – Aerodromes, Rule 12 – Prohibited Areas, Rule 13 – Photographs at aero plane and from a/c in flight, Rule 13 A – Carriage of photographic apparatus in a/c, Rule 18 – Invention of flights in contravention of the rules, Rule 20 – Set and rule not applicable to gliders & kites, Rule 26 – Dropping of articles & decent by parachute, Rule 29 B – Prohibition on use of portable electronic devices, Rule 38 A – Carriage of operating crew.

CAR Section – 2 & the A/c Rules 1937: RESPONSIBILITIES OF OWNER/OPERATOR AND AIR WORTHINESS DIRECTORATE: Series – A Part – I, II, III DOCUMENTS TO BE CARRIED ON BOARD A/C: Rule – 7, 7B, Series B Part- I, II, Series X Part VII.

The A/C Rules 1937 & CAR Section – 2 AAC: DEFECTS, RECORDING, REPORTING INVESTIGATION ANALYSIS AND RECTIFICATION: Rule –56, 59, 59A, Series – C Part - I to V 5 of 2001 – Engineering Statistics Report.

The A/C Rules 1937 CAR Section –2 AAC: APPROVED MAINTENCANCE PROGRAM Rule 60 Series – D Part – I to VI, Series – A Part – IV Oversight Program of 2000 – Airworthiness Surveillance, 2 of 1995 – Extension to the approved lives of component and inspection schedules.

The A/C Rules 1937 CAR Section –2 AAC: TYPE – CERTIFICATE Rule: 49, 49A, 49B 49C, 49D, 62, Series – F Part – II, XI, X, Series – X Part – IX, 7 of 1998 – Guidelines for procuring Parts manufactured by PMA Holders.

The A/C Rules 1937 & CAR Section -2: CERTIFICATION OF AIRWORTHINESS Rule: 15, 50,50A, 55, 62 (Sub rule D) Series F Part – III, V.

CAR Section – 2 AAC: CONTINUED AIRWORTHINESS & MANNER OF CERTIFICATION OF AIRCRAFT, Series – F Part – VII, VIII, IX, X, XI, XVII, 4 of 2000 – Maintenance of ageing A/C, The A/C Rules 1937 & CAR Section – 2: INSPECTION AND AIRWORTHINESS REQUIREMENTS OF WOODEN AIRCRAFT GLIDES, MICRO LIGHT AIRCRAFT AND HOT AIR

BALLOON: Series F Part – XII, XIII, XIV, XV

The A/C Rules 1937 & CAR Section – 2: FLIGHT MANUAL, Rule – 51, Series – F Part 5 XVI

CAR Section – 2: AGE OF A/C IMPORTED INTO INDIA AND PROCEDURE FOR IMPORT OF A/C SPARES, EQUIPMENTS ETC. Series F – XV & XXI

The A/C Rules 1937: GENERAL: Rule 156 – Inspection, Rule 157 – fraudulent of documents, Rule 158 – Foreign Military Aircraft, Rule 158 A – Aircraft Registered in or belonging to Foreign state, Rule 159 – Obstruction of Authorized person, Rule 160 – General power to exempt, Rule 161 – Penalties.

Paper-III

Engineering Drawing (BTAEN 103)

Engineering Drawings, Diagrams and Standards: Drawing types and diagrams, their symbols, dimensions, tolerances and projections; Identifying title block information; Microfilm, microfiche and computerized presentations; Specification 100 of the Air Transport Association (ATA) of America;

Aeronautical and other applicable standards including, ISO, An, MS, NAS and MIL; Wiring diagrams and schematic diagrams.

Paper-IV

Basic Aerodynamics (BTAEN 104)

Aerodynamics: Airflow around a body; Boundary layer, laminar and turbulent flow, free stream, flow, relative airflow, up wash and downwash, vortices, stagnation; The terms: camber, chord, mean aerodynamic chord, profile (parasite) drag, induced drag, centre of pressure, angle of attack, wash in and wash out, fineness ratio, wing shape and aspect ratio; Thrust, Weight, Aerodynamic Resultant; Generation of Lift and Drag: Angle of Attack, Lift coefficient, Drag coefficient, polar curve, stall; Aerofoil contamination including ice, snow, frost.

Theory of Flight: Relationship between lift, weight, thrust and drag; Glide ratio; Steady state flights, performance; Theory of the turn; Influence of load factor: stall, flight envelope and structural limitations; Lift augmentation.

Flight Stability and Dynamics: Longitudinal, lateral and directional stability (active and passive).

Theory of Flight:

1. Aero plane Aerodynamics and Flight Controls: Operation and effect of: roll control: ailerons and spoilers; pitch control: elevators, stipulators, Variable incidence stabilizers and canards; Yaw control, rudder limiters; Control using elevons, ruddervators; Height lift devices; slots, slats, flaps; Drag inducing devices: spoilers, lift dumpers, speed brakes; Operation and effect of trim tabs, servo tabs, control surface blas.

2. High Speed Flight: Speed of sound, subsonic flight, transonic flight, supersonic flight, Mach number, critical Mach number.

3. Rotary Wing Aerodynamics: Terminology; Operation and effect of cyclic, collective and anti-torque controls.

Structures — General Concepts:

1. Fundamentals of structural systems.
2. Zonal and station identification systems; Electrical bonding; Lightning strike protection provision.

Paper-V Human Factor (BTAEN 105)

General: The need to take human factors into account; Incidents attributable to human factors/human error. Murphy's Law.

Human Performance and Limitations: Vision; Hearing; Information Processing; Attention and perception; Memory; Claustrophobia and physical access.

Social Psychology: Responsibility: individual and group; Motivation and de-motivation; Peer pressure; 'Culture' issues; Team working; Management, supervision and leadership.

Factors Affecting Performance: Fitness/health; Stress: domestic and work related; Time pressure and deadlines; Workload: overload and underload; Sleep and fatigue, shiftwork; Alcohol, medication, drug abuse.

Physical Environment: Noise and fumes; Illumination; Climate and temperature; Motion and vibration; Working environment.

Tasks: Physical work; Repetitive tasks; Visual inspection; Complex systems.

Communication: Within and between teams; Work logging and recording; Keeping up to date, currency; Dissemination of information.

Human Error: Error models and theories; Types of error in maintenance tasks; Implications of errors (i.e. accidents); Avoiding and managing errors.

Hazards in the Workplace: Recognizing and avoiding hazards; Dealing with emergencies.

SEMESTER-II

Paper-I

Electrical Fundamentals (BTAEN-201)

Electron Theory

Structure and distribution of electrical charges within: atoms, molecules, ions, compounds; Molecular structure of conductors, semiconductors and insulators.

Static Electricity and Conduction

Static electricity and distribution of electrostatic charges; Electrostatic laws of attraction and repulsion; Units of charge, Coulomb's Law; Conduction of electricity in solids, liquids, gases and a vacuum.

Electrical Terminology

The following terms, their units and factors affecting them; potential difference, electromotive force, voltage, current, resistance, conductance, charge, conventional current flow, electron flow.

Generation of Electricity

Production of electricity by the following methods: light, heat, friction, pressure, chemical action, magnetism and motion.

DC Sources of Electricity

Construction and basic chemical action of: primary cells, secondary cells, lead acid cells, nickel cadmium cells, other alkaline cells; Cells connected in series and parallel; Internal resistance and its effect on a battery;

- Construction, materials and operation of thermocouples;
- Operation of photo-cells.

DC Circuits

Ohms Law, Kirchoff's Voltage and Current Laws;

Calculations using the above laws to find resistance, voltage and current;

Significance of the internal resistance of a supply.

Resistance/Resistor

a)

Resistance and affecting factors; Specific resistance; Resistor colour code, values and tolerances, preferred values, wattage ratings; Resistors in series and parallel; Calculation of total resistance using series, parallel and series parallel combinations; Operation and use of potentiometers and rheostats; Operation of Wheatstone Bridge.

b)

- Positive and negative temperature coefficient conductance;
- Fixed resistors, stability, tolerance and limitations, methods of construction;
- Variable resistors, thermistors, voltage dependent resistors;
- Construction of potentiometers and rheostats;
- Construction of Wheatstone Bridge.

Power

Power, work and energy (kinetic and potential); Dissipation of power by a resistor,; Power formula; Calculations involving power, work and energy.

Capacitance/Capacitor

Operation and function of a capacitor; Factors affecting capacitance area of plates, distance between plates, Number of plates, dielectric and dielectric constant, working voltage, voltage rating; Capacitor types, construction and function; Capacitor colour coding; Calculations of capacitance and voltage in series and parallel circuits; Exponential charge and discharge of a capacitor, time constants; Testing of capacitors.

DC Motor/Generator

Basic motor and generator theory; Construction and purpose of components in DC generator; Operation of, and factors affecting output and direction of current flow in DC generators; Operation of, and factors affecting output power, torque, speed and direction of rotation of DC motors; Series wound, shunt wound and compound motors; Starter Generator construction.

AC Theory

Sinusoidal waveform: phase, period, frequency, cycle; Instantaneous, average, root mean square, peak, peak to peak current values and calculations of these values, in relation to voltage, current and power; Triangular/Square waves; Single/3phase principles;

Resistive (R), Capacitive (C) and Inductive (L) Circuits

Phase relationship of voltage and current in L, C and R circuits, parallel, series and series parallel; Power dissipation in L, C and R circuits; Impedance, phase angle, power factor and current calculations; True power, apparent power and reactive power calculations.

Transformers

Transformer construction principles and operation; Transformer losses and methods for overcoming them; Transformer action under load and no-load conditions; Power transfer, efficiency, polarity markings; Primary and Secondary current, voltage, turns ratio, power, efficiency; Auto transformers.

Filters

Operation, application and uses of the following filters: low pass, high pass, band pass, band stop.

AC Generators

Rotation of loop in a magnetic field and waveform produced; Operation and construction of revolving armature and revolving field type AC generators; Single phase, two phase and three phase alternators; Three phase star and delta connections advantages and uses; Calculation of line and phase voltages and currents; Calculation of power in a three phase system; Permanent Magnet Generators.

AC Motors

Construction, principles of operation and characteristics of: AC synchronous and induction motors both single and polyphase; Methods of speed control and direction of rotation; Methods of producing a rotating field: capacitor, inductor, shaded or split pole.

Paper-II
Aviation Legislation Part-II (BTAEN-202)

The A/C Rules 1937 & CAR Section – 2 & AAC

The A/C Rules vol. I and II

Civil Aviation Requirement Vol. II (Series L to X)

The A/C Rules 1937 & CAR Section – 2 & AAC

CAR 21, CAR M, CAR 147, CAR 66

Paper-III
Aircraft Materials (BTAEN-203)

Aircraft Materials — Ferrous

- a) Characteristics, properties and identification of common alloy steels used in aircraft; Heat treatment and application of alloys steels;
- b) Testing of ferrous materials for hardness, tensile strength, fatigue strength and impact resistance.

Aircraft Materials — Non-Ferrous

- a) Characteristics, properties and identification of common non Ferrous materials used in aircraft heat treatment and application of non Ferrous materials .
- b) Testing of non ferrous materials for hardness, tensile strength, fatigue strength and impact resistance

Aircraft Materials — Composite and Non-Metallic

- a) Characteristics, properties and identification of common composite and non-metallic materials, other than wood, used in aircraft; Sealants and bonding agents.
- b) The detection of defects in composite material. Repair of composite and non-metallic material.

Corrosion

- a) Chemical fundamentals; Formation by, galvanic action process, microbiological, stress;
- b) Types of corrosion and their identification; Causes of corrosion; Material types, susceptibility to corrosion.

Composite and non-metallic

- Bonding practices;
- Environmental conditions
- Inspection methods

Paper-IV

Computer Fundamentals (BTAEN-204)

Basic Computer Structure

- a) Computer terminology (including bit, byte, software, hardware, CPU, IC and various memory devices such as RAM, ROM, PROM); Computer technology (as applied in aircraft systems).
- b) Computer related terminology; Operation, layout and interface of the major components in a micro computer including their associated bus systems; Information contained in single and multi address instruction words; Memory associated terms; Operation, advantages and disadvantages of the various data storage systems.

Microprocessors

Functions performed and overall operation of a microprocessor; Basic operation of each of the following microprocessor elements: control and processing unit, clock, register, arithmetic logic unit.

Software Management Control

Awareness of restrictions, airworthiness requirements and possible catastrophic effects of unapproved changes to software programs.

Paper-V

Aircraft & Components (BTAEN-205)

Airframe Structures — General Concepts

- Airworthiness requirements for structural strength;
- Structural classification, primary, secondary and tertiary;
- Fail safe, safe life, damage tolerance concepts;
- Zonal and station identification systems;
- Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue;
- Drains and ventilation provisions;
- System installation provisions;

- Lightning strike protection provision.
- Aircraft bonding

Flight Controls (ATA 27)

- Primary controls: aileron, elevator, rudder;
- Trim tabs;
- High lift devices;
- System operation: manual;
- Gust locks;
- Balancing and rigging;
- Stall warning system.

SEMESTER-III

Paper-I

Propulsion (BTAEN-301)

Turbine Engines

- a) Constructional arrangement and Operation of Turbojet, Turbo fan, Turbo shaft and Turbo Propeller Engines.
- b) Electronic Engine Control and Fuel Metering systems (FADEC).

Engine Indicating Systems

Exhaust Gas Temperature \ Inter stage Turbine temperature systems, Engine Speed, Engine thrust Indication, Engine pressure Ratio, Engine Turbine Discharge Pressure or Jet Pipe Pressure Systems, Oil Pressure and Temperature, Fuel Pressure, Temperature and flow, Manifold Pressure, Engine Torque, Propeller speed.

Paper-II

Basic Aircraft Instruments (BTAEN-302)

Electronic Instrument Systems

Typical systems arrangements and cockpit layout of electronic instrument systems.

Servomechanisms

- a) Understanding of the following Terms:- Open and Close Loop systems, feedback, follow up, Analogue Transducers, Principle of Operation and Use of following Synchro System components \ Features:- Resolvers, Differential, control and torque, transformers, Inductances and Capacitance Transmitters.
- b) Understanding of the following Terms:- Servo mechanism, Null, Damping, Dead band, Construction operation and use of the following Synchro system components : Resolvers, Differential, control and torque, E & I Transformer, Inductance Transmitters, Capacitance Transmitters, Synchronous Transmitters, Servo Mechanism Defects, Reversal of Synchro leads, Hunting.

Paper-III

Electronics Fundamentals & Digital Technique (BTAEN-303)

Transistors

- a) Transistor symbols; Component description and orientation; Transistor characteristics and properties.
- b) Construction and operation of PNP and NPN transistors; Base, collector and emitter configuration; Testing of transistors. Basic appreciation of other transistor types and their uses. Application of transistors: classes of amplifier (A, B, C); Simple circuits including: bias, decoupling, feedback and stabilization; Multistage circuit principles: cascades, push-pull, oscillators, multivibrators, flip-flop circuits.

Integrated Circuits

- a) Description and operation of logic circuits and linear circuits/operational amplifiers.
- b) Description and operation of logic circuits and linear circuits; Introduction to operation and function of an operational amplifier used as: integrator, differentiator, differentiator, voltage follower, comparator; Operation and amplifier stages connecting methods: resistive capacitive, inductive (transformer), inductive resistive (IR), direct; Advantages and disadvantages of positive and negative feedback.

Printed Circuit Boards

Description and use of printed circuit boards.

Numbering Systems

Numbering systems: binary, octal and hexadecimal; Demonstration of conversation between the decimal and binary, octal and hexadecimal systems and vice versa.

Data Conversion

Analogue Data, Digital Data; Operation and application of analogue to digital, and digital to analog converters, inputs and outputs, limitations of various types.

Data Buses

Operation of data buses in aircraft systems, including knowledge of ARINC and other specifications

Logic Circuits

- a) Identification of common logic gate symbols, tables and equivalent circuits;
Applications used for aircraft systems, schematic diagrams.
- b) Interpretation of logic diagrams

Integrated Circuits

Operation and use of encoders and decoders;
Function of encoder types;
Uses of medium, large and very large scale integration

Multiplexing

Operation, application and identification in logic diagrams of multiplexers and demultiplexers

Fiber Optics

Advantages and disadvantages of fiber optic data transmission over electrical wire propagation;
Fiber optic data bus;
Fiber optic related terms;
Terminations;
Couplers, control terminals, remote terminals;
Application of fiber optics in aircraft systems

Electronic Displays

Principles of operation of common types of displays used in modern aircraft, including cathode ray tubes, light emitting diodes and Liquid Crystal Display.

Electrostatic Sensitive Devices

Special handling of components sensitive to electrostatic discharges;
Awareness of risks and possible damage, component and personnel anti-static protection devices

Electromagnetic Environment

Influence of the following phenomena on maintenance practices for electronic systems;

EMC – Electromagnetic Compatibility

EMI – Electromagnetic Interference

HIRF – High Intensity Radiated Field

Lightning/lightning protection

Typical Electronic/Digital Aircraft Systems:

ACARS – ARINC Communication and Addressing and Reporting System

ECAM – Electronic Centralized Aircraft Monitoring

EFIS – Electronic Flight Instrument System

EICAS – Engine Indication and Crew Alerting System

FBW – Fly by Wire

FMS – Flight Management System

GPS – Global Positioning System

IRS – Inertial Reference System

TCAS – Traffic Alert Collision Avoidance System

Note: Different manufacturers may use different terminology for similar systems.

Paper-IV

Aircraft Hardware (BTAEN-304)

Fasteners & Screw threads

Screw nomenclature; Thread forms, dimensions and tolerances for standard threads used in aircraft; Measuring screw threads.

Bolts, studs and screws

Bolt types: specification, identification and marking of aircraft bolts, international standards; Nut: self locking, anchor, standard types;

Machine screws: aircraft specifications; Studs: types and uses, insertion and removal; Self tapping screws, dowels.

locking devices

Tab and spring washers, locking plates, split pins, pal-nuts, wire locking. Quick release fasteners, keys, circlips, cotter pins

Aircraft rivets

Types of solid and blind rivets: specifications and identification, heat treatment.

Pipes and Unions

- a) Identification of, and types of rigid and flexible pipes and their connectors used in aircraft.
- b) Standard unions for aircraft hydraulic, fuel, oil, pneumatic and air system pipes.

Control Cables

Types of cables;
End fittings, turnbuckles and compensation devices;
Pulleys and cable system components;
Bowden cables;
Aircraft flexible control systems.

Electrical Cables and Connectors & Electrical Cables and Connectors

Cable types, construction and characteristics; High tension and co-axial cables; Crimping; Connector types, pins, plugs, sockets, insulators, current and voltage rating, coupling, identification codes. Continuity, insulation and bonding techniques and testing; Use of crimp tools: hand and hydraulic operated; Testing of crimp joints; Connector pin removal and insertion; Co-axial cables: testing and installation precautions; Wiring protection techniques: Cable looming and loom support, cable clamps, protective sleeving techniques including heat shrink wrapping, shielding.

Riveting

- Riveted joints, rivet spacing and pitch;
- Tools used for riveting and dimpling;
- Inspection of riveted joints.

Pipes and Hoses

- Bending and beaming/flaring aircraft pipes;
- Inspection and testing of aircraft pipes and hoses;
- Installation and clamping of pipes.

SEMESTER-IV

Paper-I

Gas Turbine Engine, Piston Engine & Propeller-I (Jet Engine & Piston Engine) (BTAEN-404)

Fundamentals

- Mechanical, thermal and volumetric efficiencies;
- Operating principles — 2 stroke, 4 stroke, Otto and Diesel;
- Piston displacement and compression ratio;
- Engine configuration and firing order.

Engine Performance

- Power calculation and measurement;
- Factors affecting engine power;
- Mixtures/leaning, pre-ignition.

Engine Construction

- Crank case, crank shaft, cam shafts, sumps;
- Accessory gearbox;
- Cylinder and piston assemblies;
- Connecting rods, inlet and exhaust manifolds;
- Valve mechanisms;
- Propeller reduction gearboxes.

Engine Fuel Systems, *Carburettors*

Types, construction and principles of operation; Icing and heating.

Fuel injection systems

Types, construction and principles of operation.

Electronic engine control

Operation of engine control and fuel metering systems including electronic engine control (FADEC); Systems lay-out and components.

Starting and Ignition Systems

Starting systems, pre-heat systems; Magneto types, construction and principles of operation; Ignition harnesses, spark plugs; Low and high tension systems.

Induction, Exhaust and Cooling Systems

Construction and operation of: induction systems including alternate air systems; Exhaust systems, engine cooling systems — air and liquid.

Supercharging/Turbo charging

Principles and purpose of supercharging and its effects on engine parameters; Construction and operation of supercharging/turbo charging systems; System terminology; Control systems; System protection.

Lubricants and Fuels

Properties and specifications; Fuel additives; Safety precautions.

Lubrication Systems

System operation/lay-out and components.

Engine Indication Systems

- Engine speed;
- Cylinder head temperature;
- Coolant temperature;
- Oil pressure and temperature;
- Exhaust Gas Temperature;
- Fuel pressure and flow;
- Manifold pressure.

Power plant Installation

- Configuration of firewalls, cowlings, acoustic panels,
- engine mounts, anti-vibration mounts, hoses, pipes,
- feeders, connectors, wiring looms, control cables and rods,
- Lifting points and drains.

Engine Monitoring and Ground Operation

- Procedures for starting and ground run-up;
- Interpretation of engine power output and parameters;
- Inspection of engine and components: criteria, tolerances,
- And data specified by engine manufacturer.

Engine Storage and Preservation

- Preservation and depreservation for the engine and accessories/ systems.

PROPELLER

Fundamentals

- Blade element theory;
- High / low blade angle, reverse angle, angle of attack, rotational speed;
- Propeller slip;
- Aerodynamic, centrifugal, and thrust forces;
- Torque;
- Relative airflow on blade angle of attack;
- Vibration and resonance.

Propeller Construction

- Construction methods and materials used in wooden, composite and metal propellers;
- Blade station, blade face, blade shank, blade back and hub assembly;
- Fixed pitch, controllable pitch, constant speed propeller;
- Propeller/spinner installation.

Propeller Pitch Control

- Speed control and pitch change methods, mechanical and electrical/electronic;
- Feathering and reverse pitch;
- Over speed protection.

Propeller Synchronizing

- Synchronizing and synchrophasing equipment.

Propeller Ice Protection

- Fluid and electrical de-icing equipment.

Propeller Maintenance

- Static and dynamic balancing;
- Blade tracking;
- Assessment of blade damage, erosion, corrosion, Impact damage, delamination;
- Propeller treatment/repair schemes;
- Propeller engine running.

Propeller Storage and Preservation

Propeller preservation and depreservation

Paper-II
Turbine Aeroplane Aerodynamics, Structures & Systems-I (Heavy Aeroplane)
(BTAEN-405)

Physics of the Atmosphere

- International Standard Atmosphere (ISA), application to aerodynamics.

Aerodynamics

- Airflow around a body;
- Boundary layer, laminar and turbulent flow, free stream flow, relative airflow, upwash and downwash, vortices, stagnation;
- The terms: camber, chord, mean aerodynamic chord, profile (parasite) drag, induced drag, centre of pressure,
- angle of attack, wash in and wash out, fineness ratio, wing shape and aspect ratio;
- Thrust, Weight, Aerodynamic Resultant;
- Generation of Lift and Drag: Angle of Attack, Lift coefficient, Drag coefficient, polar curve, stall;
- Aerofoil contamination including ice, snow, frost.

Theory of Flight

- Relationship between lift, weight, thrust and drag; Glide ratio;
- Steady state flights, performance;
- Theory of the turn;
- Influence of load factor: stall, flight envelope and structural limitations;
- Lift augmentation.

Flight Stability and Dynamics

- Longitudinal, lateral and directional stability (active and passive).

Aeroplane Aerodynamics and Flight Controls Operation and effect of:

- roll control: ailerons and spoilers;
- pitch control: elevators, stabilators, variable incidence stabilizers and canards;
- yaw control, rudder limiters;

Control using elevons, ruddervators; High lift devices, slots, slats, flaps, flapersons; Drag inducing devices, spoilers, lift dumpers, speed brakes; Effects of wing fences, saw tooth leading edges; Boundary layer control using, vortex generators, stall wedges or leading edge devices;

Operation and effect of trim tabs, balance and antibalance (leading) tabs, servo tabs, spring tabs, mass balance, control surface bias, aerodynamic balance panels;

High Speed Flight

Speed of sound, subsonic flight, transonic flight, supersonic flight, Mach number, critical Mach number, compressibility buffet, shock wave, aerodynamic heating, area rule; Factors affecting airflow in engine intakes of high speed aircraft; Effects of sweepback on critical Mach number.

Airframe Structures — General Concepts

a) Airworthiness requirements for structural strength; Structural classification, primary, secondary and tertiary; Fail safe, safe life, damage tolerance concepts; Zonal and station identification systems; Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue; Drains and ventilation provisions; Lightning strike protection provision.

b) Construction methods of: stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement, methods of skinning, anti-corrosive protection, wing, empennage and engine attachments; Structure assembly techniques: riveting, bolting, bonding; Methods of surface protection, such as chromating, anodizing, painting; Surface cleaning; Airframe symmetry: methods of alignment and symmetry checks

Fuselage

Construction and pressurization sealing; Wing, stabilizer, pylon and undercarriage attachments; Seat installation and cargo loading system; Doors: construction, mechanisms, operation and safety devices; Windows and windscreen construction and mechanisms

Wings

Construction; Fuel storage Landing gear, pylon control surface and high lift/drag attachments

Stabilizers

Construction; Control surface attachment

Flight Control Surfaces

Construction and attachment; Balancing – mass and aerodynamic

Nacelles/Pylons

Construction; Firewalls; Engine mounts

Flight Controls (ATA 27)

- Primary controls: aileron, elevator, rudder, spoiler;
- Trim control;
- Active load control;
- High lift devices;
- Lift dump, speed brakes;
- System operation: manual, hydraulic, pneumatic, electrical, fly-by-wire;
- Artificial feel, Yaw damper, Mach trim, rudder limiter, gust locks systems;
- Balancing and rigging;
- Stall protection/warning system.

SEMESTER-V

Paper-I

Gas Turbine Engine, Piston Engine & Propeller-II (Jet Engine & Piston engine) (BTAEN-504)

Fundamentals

- Potential energy, kinetic energy, Newton's laws of motion, Brayton cycle;
- The relationship between force, work, power, energy, velocity, acceleration;
- Constructional arrangement and operation of turbojet, turbofan, turbo shaft, turboprop.

Engine Performance

- Gross thrust, net thrust, choked nozzle thrust, thrust distribution,
- resultant thrust, thrust horsepower, equivalent shaft horsepower, specific fuel consumption;
- Engine efficiencies;
- By-pass ratio and engine pressure ratio;
- Pressure, temperature and velocity of the gas flow;
- Engine ratings, static thrust, influence of speed, altitude and hot climate, flat rating, limitations.

Inlet

- Compressor inlet ducts
- Effects of various inlet configurations;
- ice protection.

Compressors

Axial and centrifugal types; Constructional feature and operating principles and applications; Fan balancing Operation; Causes and effect of compressor stall and surge; Methods of air flow control: bleed valves, variable inlet guide vanes, variable stator vanes, rotating stator blades; Compressor ration

Combustion Section

Constructional features and principles of operation.

Turbine Section

Operation and characteristics of different turbine blade types; Blade to disk attachment; Nozzle guide vanes; Causes and effect of turbine blade stress and creep.

Exhaust

Constructional features and principles of operation; Convergent, divergent and variable area nozzles; Engine noise reduction; Thrust reversers.

Bearings and Seals

- Constructional features and principles of operation.

Lubricants and Fuels

- Properties and specifications;
- Fuel additives;
- Safety precautions.

Lubrication Systems

System operation/lay-out and components.

Fuel Systems

Operation of engine control and fuel metering systems including electronic engine control (FADEC);
System lay-out and components

Air Systems

Operation of engine air distribution and anti-ice control systems, including internal cooling, sealing and external air services.

Starting and Ignition Systems

Operation of engine air distribution and anti-ice control systems, including internal cooling, sealing and external air services.

Engine Indication Systems

- Exhaust Gas Temperature/Interstage Turbine

Temperature; Engine Thrust Indication: Engine Pressure Ratio, engine turbine discharge pressure or jet pipe pressure systems; Oil pressure and temperature; Fuel pressure and flow; Engine speed; Vibration measurement and indication; Torque; Power.

Power Augmentation Systems

- Operation and applications;
- Water injection, water methanol;
- Afterburner systems.

Turbo-prop Engines

- Gas coupled/free turbine and gear coupled turbines;
- Reduction gears;
- Integrated engine and propeller controls;
- Overspeed safety devices.

Turbo-shaft engines

- Arrangements, drive systems, reduction gearing, couplings, control systems.

Auxiliary Power Units (APUs)

- Purpose, operation, protective systems

Powerplant Installation

- Configuration of firewalls, cowlings, acoustic panels, and engine mounts, anti-vibration mounts, hoses, pipes, feeders, connectors, wiring looms, control cables and rods, lifting points and drains.

Fire Protection Systems

- Operation of detection and extinguishing systems.

Engine Monitoring and Ground Operation

Procedures for starting and ground run-up;

Interpretation of engine power output and parameters;

Trend (including oil analysis, vibration and boroscope) monitoring;

Engine Storage and Preservation - 2

Preservation and depreservation for the engine and accessories/systems.

Paper-II

Turbine Aeroplane Aerodynamics, Structures & Systems-II (Heavy Aeroplane) (BTAEN-505)

Air Conditioning and Cabin Pressurization and Air supply

- Pressurization and air conditioning systems;
- Cabin pressure controllers, protection and warning devices.

Sources of air supply including engine bleed, APU and ground cart;

Air Conditioning

Air conditioning systems; Air cycle and vapour cycle machines; Distribution systems; Flow, temperature and humidity control system

Pressurization

Pressurization systems; Control and indication including control and safety valves; Cabin pressure controllers

Safety and warning devices

Protection and warning devices

Instruments/Avionic Systems and Instrument Systems

Pitot static: altimeter, air speed indicator, vertical speed indicator; Gyroscopic: artificial horizon, attitude director, direction indicator, horizontal situation indicator, turn and slip indicator, turn co-ordinator

Compasses: direct reading, remote reading; Angle of attack indication, stall warning systems; Other aircraft system indication.

Avionic Systems

Fundamentals of system lay-outs and operation of; Auto Flight (ATA 22); Communications (ATA 23) Navigation Systems (ATA 34).

Electrical Power (ATA 24)

Batteries Installation and Operation; DC power generation; AC power generation; Emergency power generation; Voltage regulation; Power distribution; Inverters,

transformers, rectifiers; Circuit protection; External/Ground power Equipment and Furnishings (ATA 25)

a) Emergency equipment requirements; Seats, harnesses and belts.

b) Cabin lay-out; Equipment lay-out; Cabin Furnishing Installation; Cabin entertainment equipment; Galley installation; Cargo handling and retention equipment; Airstairs.

Fire Protection (ATA 26)

Fire and smoke detection and warning systems. Fire extinguishing systems; System tests Fuel Systems (ATA 28)

System lay-out; Fuel tanks; Supply systems; Dumping, venting and draining; Cross-feed and transfer; Indications and warnings; Refueling and defueling; Longitudinal balance fuel systems

Hydraulic Power (ATA 29)

System lay-out; Hydraulic fluids; Hydraulic reservoirs and accumulators; Pressure generation: electric, mechanical, pneumatic; Emergency pressure generation; Pressure Control; Power distribution; Indication and warning systems; Interface with other systems

Ice and Rain Protection (ATA 30)

Ice formation, classification and detection; Anti-icing systems: electrical, hot air and chemical; De-icing systems: electrical, pneumatic and chemical; Rain repellent and removal; Probe and drain heating

Landing Gear (ATA 32)

Construction, shock absorbing; Extension and retraction systems: normal and emergency; Indications and warning; Wheels, brakes, antiskid and auto braking; Tyres; Steering

Lights (ATA 33)

External: navigation, landing, taxiing, ice; Internal: cabin, cockpit, cargo; Emergency.

Oxygen (ATA 35)

System lay-out: cockpit, cabin; Sources, storage, charging and distribution; Supply regulation; Indications and warnings

Pneumatic/Vacuum (ATA 36)

System lay-out; Sources: engine/APU, compressors, reservoirs, ground supply; Pressure Control; Distribution; Indications and warnings; Interfaces with other systems

Water/Waste (ATA 38)

Water system lay-out, supply, distribution, servicing and draining; Toilet system lay-out, flushing and servicing; Corrosion aspects

On Board Maintenance Systems (ATA 45)

Central maintenance computers; Data loading system; Electronic library system; Printing; Structure monitoring (damage tolerance monitoring).

Lights (ATA 33)

External: navigation, landing, taxiing, ice; Internal: cabin, cockpit, cargo; Emergency.

Oxygen (ATA 35)

System lay-out: cockpit, cabin; Sources, storage, charging and distribution; Supply regulation; Indications and warnings

Pneumatic/Vacuum (ATA 36)

System lay-out; Sources: engine/APU, compressors, reservoirs, ground supply; Pressure Control; Distribution; Indications and warnings; Interfaces with other systems

Water/Waste (ATA 38)

Water system lay-out, supply, distribution, servicing and draining; Toilet system lay-out, flushing and servicing; Corrosion aspects

On Board Maintenance Systems (ATA 45)

Central maintenance computers; Data loading system; Electronic library system; Printing; Structure monitoring (damage tolerance monitoring).

SEMESTER-VI

Paper-I

Principle of Management (BTAEN-601)

- Management Concepts
- Management Thoughts
- Planning, Decision Making
- Organization, Delegation of Authority
- Nature and Purpose of Staffing
- Staffing-Selection Process & Techniques
- Directing/Direction

Reference:

Principles of Management by K. Anbuvelan

Paper-II

Applied Mathematics (BTAEN-602)

Module 1 Determinants

Module 1.1 Properties of the Determinant

Module 1.2 Determinants of Matrices of Higher Order

Module 1.3 Applications of Determinants and Matrices

Module 2 Differential Equations

Module 2.1 Basic Concepts

Module 2.2 Order of a differential equation

Module 2.3 Degree of a differential equation

Module 2.4 Linear Differential Equations

Module 2.5 Separable Differential Equations

Module 2.6 Linear Second Order Equations

Module 2.7 *Real, Distinct Roots*

Module 2.8 Complex Roots

Module 2.9 Systems of Differential Equations

Module 3 INTEGRALS

Module 3.1 Basic Integration

Module 3.2 Solving Indefinite Integration

Module 3.3 Integrals are Summations

Module 3.4 Area Under The Curve

Module 3.5 Integration as an Inverse Process of Differentiation

Module 3.6 Definite Integrals

Module 3.7 Properties of Indefinite Integration

Module 3.8 Examples of Indefinite Integration

Module 3.9 The Fundamental Theorem of Calculus

Module 3.10 Table of Indefinite Integrals
Module 3.11 The Total Change Theorem
Module 3.12 The Substitution Rule
Module 3.13 Integrals of Symmetric Functions
Module 3.14 Integration By Parts
Module 3.15 Trigonometric Integrals
Module 3.16 Trigonometric Substitution
Module 3.17 Integration of Rational Functions By Partial Fractions
Module 3.18 Comparison between Differentiation and integration

Module 4 Permutation & Combination
Module 4.1 Permutation
Module 4.2 Circular Permutations
Module 4.3 Permutations when all the objects are distinct
Module 4.4 Circular permutations
Module 4.5 Restricted – Permutations

Module 5 Trigonometry
Module 5.1 Angles
Module 5.2 Radian measure
Module 5.3 Relation between radian and real numbers
Module 5.4 Relation between degree and radian
Module 5.5 Notational Convention
Module 5.6 Trigonometric Functions
Module 5.7 The Six Trigonometric Functions
Module 5.8 Trigonometric equations

Paper-III **Physics (BTAEN-603)**

Module 1 Bonding in solids

Module 1A Introduction
Module 1B Cohesive energy
Module 1C Calculation of cohesive energy of ionic solids
Module 1d Cohesive energy of Sodium Chloride (NaCl) crystal

Solved problems

Information for quiz

Module 2 Principles of Quantum Mechanics

Module 2A Derivation of de Broglie Equation for matter wave
Module 2C Davisson and Germer's Experiment
Module 2D G.P Thomson's Experiment
Module 2E Schrodinger Wave Equation (Time Independent)
Module 2F Physical Significance of Wave Function
Module 2G Particle in a Potential box

Solved problems

Information for quiz

Module 3 Magnetic Properties

Module 3A	Introduction
Module 3B	Origin of magnetic moment
Module 3C	Magnetic moment due to electro spin & Bohr magnetron
Module 3D	Classification of magnetic materials
Module 3E	Dia-magnetism
Module 3F	Para-magnetism
Module 3G	Magnetic domains
Module 3H	Ferro-magnetism
Module 3I	Domain theory of Ferro – magnetism
Module 3J	Hysteresis curve
Module 3K	Ferri – magnetism – Ferrites & their applications
Module 3L	Anti ferro – magnetism
Module 3M	Requirement of magnetic materials for different purposes

Solved problems

Information for quiz

Module 4 Semiconductors

Module 4A	Introduction
Module 4B	Intrinsic Semiconductors
Module 4C	Extrinsic Semiconductors
Module 4D	Minority carrier life time
Module 4E	Drift and Diffusion
Module 4F	Einstein relation
Module 4G	Equation of continuity
Module 4H	Hall effect
Module 4I	P-N junction
Module 4J	Width of depletion layer of the P-N junction
Module 4K	Volt-ampere characteristics
Module 4L	Zener diode
Module 4M	Varactor (varicap) diode
Module 4N	Light Emitting Diode (LED)
Module 4O	Solar cells

Solved problems

Information for quiz

Module 5 Lasers

Module 5A	Introduction
Module 5B	Einstein coefficients
Module 5C	Pumping and population inversion
Module 5D	Ruby laser
Module 5E	He-Ne laser

Module 5F Semiconductor laser

Module 5G Applications of laser

Solved problems

Information for quiz

Module 6 Fibre optics

Module 6A Introduction

Module 6B Principle of optical fibre

Module 6C Numerical aperture

Module 6D Step-index fibre-transmission of signal

Module 6E Graded index fibre – transmission of signal

Module 6F Optical fibres in communication and sensing application

Solved problems

Information for quiz

Paper-IV Chemistry (BTAEN-604)

MODULE 1 ATOMIC STRUCTURE

Module 1A Atomic Structure –Introduction

Module 1B Sub-Atomic Particles

Module 1C Discovery of Electron

Module 1D Discovery of Protons and Neutrons

Module 1E Atomic Models

Module 1F Wave Nature of Electromagnetic Radiation

Module 1G Electronic Energy Levels: Atomic Spectra

Module 1H Chemical Bonding

MODULE 2 ACIDS AND BASES: FUNDAMENTALS

Module 2A Arrhenius Theory

Module 2B Bronstedt-Lowry Theory

Module 2C Lewis Acids and Bases

Module 2D Reactions of Acids and Bases with Water

Module 2E Equilibrium Equations

Module 2F Strengths of Acids and Bases (The pH and pOH Scales)

Module 2G pH Concept

Module 2H Weak acids and Weak Bases

MODULE 3 CHEMICAL KINETICS

Module 3A	Laws of Thermodynamics
Module 3B	Rates of Reaction and the Rate Law for a Reaction
Module 3C	Different Ways of Expressing the Rate of Reaction
Module 3D	Order of Molecularity
Module 3E	Reaction Rates
Module 3F	Rate Laws
Module 3G	Integrated forms of Rate Laws
Module 3H	Simple Second Order Rate Equations
Module 3I	Reaction Mechanisms
Module 3J	Chain Reactions

MODULE 4 FUNDAMENTALS OF ORGANIC CHEMISTRY

Module 4A	Introduction
Module 4B	Empirical and Molecular Formulas
Module 4C	Structural Isomerism
Module 4D	Naming of Alkanes
Module 4E	The Importance of Functional Groups

MODULE 5 ELECTROCHEMISTRY

Module 5A	Faradays Laws
Module 5B	Redox Reactions
Module 5C	Electrochemical Cells
Module 5D	Industrial Electrochemistry:

MODULE 6 GASEOUS STATE

Module 6A	Boyle's Law
Module 6B	Charles' Law
Module 6C	Graham's Law of Gaseous Diffusion

MODULE 7 ENVIRONMENTAL CHEMISTRY

Module 7A	The Atmosphere
Module 7B	The Hydrosphere
Module 7C	The Geosphere
Module 7D	The Biosphere
Module 7E	The Flora and Fauna
Module 7F	Natural Resources Consumption

Module 7G	Atmospheric Chemistry
Module 7H	Air Pollution
Module 7I	Aquatic Chemistry and Water pollution
Module 7J	Soil Chemistry

Paper-V
English (BTAEN-605)

MODULE 1 Communication

Module 1A	Importance of Communication
Module 1B	Communication Basic Forms
Module 1C	The Process of Communication
Module 1D	Barriers to Communication:
Module 1E	Dealing with Communication Barriers

MODULE 2 Nonverbal Communication

Module 2A	Characteristics of Nonverbal Communication
Module 2B	Components of Nonverbal Communication

MODULE 3 Listening

Module 3A	Importance of Listening
Module 3B	Barriers to Effective Listening
Module 3C	Approaches to Listening
Module 3D	Better Listener
Module 3E	What Speakers Can Do to Ensure Better Listening

MODULE 4 Interviewing

Module 4A	Planning the Interview
Module 4B	Conducting the Interview
Module 4C	Ethics of Interviewing

MODULE 5 Letter Writing

Module 5A	Understanding the Audience
Module 5B	Organizing Your Message
Module 5C	Business Letters

MODULE 6 Oral Presentation

Module 6A	Introduction
Module 6B	Preparing to Give an Oral Presentation
Module 6C	Making the Presentation
Module 6D	Summary

Paper-VI Social Ethics (BTAEN-606)

UNDER CONSTRUCTION

SEMESTER-VII Paper-I Production Planning & Control (BTAEN-701)

Scope of Production Management : Elements of production-the production cycleNecessity for planning and control-analysis of production planning and control functions.
Production planning control as the nerve system of the production unit.

Factors affecting planning, forecasting information necessary for pre-planning. Sources of information. Methods of forecasting, aircraft components requiring overhaul, repair, modifications, premature, failures, Project planning. Estimates of plant, machinery, buildings, manpower, materials, spare parts, time and cost estimates.

Materials, Machines and Processes : Production engineering knowledge necessary for planning, machine tools and processes. Materials including aircraft materials and their processing, Spare parts required for overhaul and maintenance. Ground handling equipment. Testing of components and aircraft after overhaul. Standards for acceptance after overhaul.

Equipment and Tools : Pre-planning required for provision of special tools, jigs, fixtures and test equipment required for overhaul and maintenance. Types and description of major test equipment.

Production Planning : Production planning function of routing estimating and scheduling-LOB-CPM and PERT. Queing theory, sequencing in jobs, shop scheduling. Assembly line balancing. Charts and graphs.

Production Control : Production control functions of dispatching, progressing and evaluation. Activities of progressing. Shop procedures. Maintenance of critical data statistics of evaluation control charts.

Design of PPC Systems : PPC as a management information. System design parameters. Charting information for systems charts.

ORGANISING FOR PPC : Centralized and decentralized systems. Organizing PPC around information flow-concepts and practices in Indian Airlines and Air India, practices in other countries.

Text Books and Reference Books :

1. Frankling S Moore, Production Control, McGraw Hill.
2. E H MacNiec, Production Forecasting Planning and Control John Wiley.
3. Landy Thomas, Production Planning and Control M, McGraw Hill.
4. Carson Gordon, Production Hand Book B Ronald Press Company.
5. Mages John F., Production Planning and Inventory Control, McGraw Hill.
6. Churchman, Operations Research, Ackoff and Arnoff.
7. Hoffman and Wadsworth, Production Management and Manufacturing Systems.
8. K C Batra, Production Management

Paper-II

Management of System (BTAEN-702)

Systems Approach to Management : Systems concept; Types and characteristics of manufacturing and service systems; overall conceptualization of business systems, model building; Planning, analysis and control of engineering systems; Communication for planning and control.

Organisational Concepts : Management hierarchy for different types of industry: Organisation principles, structures, tools for coordination and planning

Human Resource Development : Management function for human resource planning people, profit and productivity. Staffing, recruitment policy, training and development programmes, motivation, incentive and promotion policies, collective decision-making, trade unions and collective bargaining.

Projectology : Project formulation and implementation strategies. Monitoring and control of projects. Project evaluation - benefit - cost analysis.

Management Information System: Significance of information as a corporate resource. Identification, collection, storage and retrieval of information. Frequency of reporting and updating. Introduction to Decision Support Systems.

Planning and Control of Production Systems : Product design and development, product life cycle; Demand analysis and forecasting - Time series analysis, simple exponential smoothing models, input - output analysis. Resource requirement planning. Basic models for shop loading, sequencing and scheduling. Materials requirement planning. Management functions for planning maintenance, maintenance strategies.

Managerial Economics : Concepts of managerial economics; Production and cost analysis; Managerial uses of production and demand functions. Determinants of price - pricing under different objectives. Role, objective and goals of financial management.

TextBooks:

1. E S Buffa, Modern Production/Operation management, ES., Wiley Eastern, New Delhi
2. Gupta A K, Management of Systems, Macmillan Book CO., New Delhi
3. Chary S N, Production and Operations Management, Tata McGraw Hill Book Co., New Delhi

Reference Books:

1. S C Keshu & KK Ganapathy, Aircraft Production Technology and Management, Interline Publications
2. Palmer, Maintenance, Planning and Scheduling Manual, McGraw Hill
3. Wright, Management of Organisation, McGraw Hill

Paper-III **Control Theory & Practice (BTAEN-703)**

Introduction to Laplace transform, Fourier transforms, Definition of feedback terms, symbols to represent feedback control variables, characteristics of basic feedback loop. Introduction to dynamics of stable and unstable vehicles. Definition of Aerodynamic coefficients, force and moment equations, definition of relaxed static stability , CCV concept in modern flight control system.

Models of Components and Systems : Its variables and equations, modeling of passive electrical components and systems, static and dynamic variables, modeling of DC motors

and servo systems, transducer, sensors and actuators, transport delay.

Frequency response analysis :

- a) Open loop and closed loop poles and zeros
- b) Nyquist diagram
- c) Nyquist stability criterion
- d) Stability margins, illustration of phase margin and gain margins

The BODE magnitude plot: Studies on BODE phase plot, stability margins on the BODE plot, Time delay effects.

The root locus method : the locus equations, properties and sketching rules, loci for systems.

Time Response : Steady state error, transient response to a input, performance measures.

System design : (a) Signal conversion and processing: Digital signals and coding, data conversions and quantization sample and hold devices, digital to analog conversion, analog to digital conversion, the sampling theorem, reconstruction of sampled signals. (b) Compensation networks, system effects of offset and noise. (c) Servo components: Synchros, Sensors, actuators, computers (d) Electronic design aspects: rating, time delays, reasonable values, etc. proportional controller, proportional integral controller, proportional integral differential controller (PID)

The Z-Transform : (a) Definition of Z Transform (b) Evaluation of Z Transform (c) Mapping between s-plane and the z-plane (d) the inverse Z transform (e) Theorems of Z transform.

The State Variable Technique : (a) State equations and state transition equations of continuous data system (b) State transition equations of digital systems (c) Relation between state equation and transfer function (d) Characteristic equation, eigen values and eigen vectors (e) Diagonalisation of A matrix (f) Methods of computing the state transition of A matrix.

Stability of digital control system, time domain analysis, frequency domain analysis.

TextBooks:

1. Katsuhiko Ogata, Modern Control Engineering, Prentice Hall of India
2. Robert C Nelson, Flight Stability and Automatic Control, McGrawHill, New York
3. B Etkin, Dynamics of Aircraft, McGraw Hill, New York

Reference Books:

1. Douglas B Miron, Design of Feed Back Systems, Harcourt Brace Jovanovic Publications, NY
2. Benjamin C Kuo, Digital Control Systems
3. Mc Ruer, Ashkenaus and Graham, Aircraft Dynamics and Controls, Princeton Univ. Press, NJ

Paper-IV

Fluid Mechanics (BTAEN-705)

Introduction: Fluids : Definition of fluids, the science of fluid mechanics, fluid properties, capillarity, surface tension, compressibility, units and dimensions.

Normal and Shear stresses in fluid flows, measurement of fluid velocity.

Regimes of fluid flows : Continuum and free molecular flow, inviscid and viscous flows, incompressible and compressible flows, Newtonian and Non-Newtonian flow, Aerodynamic force and moments, Dimensional analysis, Non-dimensional parameters, M , Re , Fr etc.

Fluid Statics : Pascal's law, types of forces on a fluid system, measurement of pressure, use of manometers and gauges, numerical problems. Hydraulic devices, forces on partially and fully submerged bodies, including that on curved surfaces, numerical problems, buoyancy, stability of floating bodies, centre of gravity and meta centric heights.

Description of Fluid Motion : Lagrangian and Eulerian methods, description of properties in a moving fluid, local and material rate of change, equation of conservation of mass for control volume.

Streamlines, path lines, streak lines, vorticity and circulation, laws of vortex motion, translation, rotation and rate of deformation of fluid particle.

Equations of Fluid Motion : Euler's and Navier Stokes equation, derivation of Bernoulli's equation for inviscid and viscous flow fields momentum equation and angular momentum equation in Integral form.

Inviscid - Incompressible Flow : Condition on velocity for incompressible flow, Laplace's equation, potential function, stream function. Basic elementary flows: uniform flows, source flows, doublet flow and vortex flow. Super-imposition of elementary flows, non lifting and lifting flow over a circular cylinder. Pressure distribution over circular cylinder in real flow. Kutta - Joukowski Theorem, Generation of lift. Lift on air foils.

Introduction to Viscous Flows : Qualitative aspects of viscous flows, viscosity and thermal conductivity, phenomenon of separation, Navier Stokes's equations in vector form, viscous flow energy equation, some exact solutions of Navier Stokes's equations: Plane Poiseuille flow, Couette flow, Hagen - Poiseuille flow, Hele - Shaw flow, flow through corotating cylinders. Transition from laminar to turbulent flow. Turbulent flow in circular pipe.

Introduction to Incompressible Boundary layer (BL) : BL Concept, BL Properties, derivation of Prandtl's BL Equation, Blasius solution, Karman's Integral equation, Turbulent BL over a flat plate, skin friction drag, BL Control.

Dimensional Analysis and Similitude : Buckingham's theorem, non-dimensional

groups, Geometric, Kinematic and Dynamic similarity, Applications.

Elements of Compressible Flows : Compressible flow properties, total Enthalpy, total temperature, temperature and pressure ratio as function of mach number. Mass flow parameter (MFP), Isentropic area ratio A/A^* , velocity - area variation, 2-D small amplitude wave propagation, Adiabatic Steady Flow Ellipse. Description of flow regimes, Introduction to Normal and Oblique shock waves, working out solutions through Gas Tables/Charts

Text Books:

1. John D Anderson Jr., Fundamentals of Aerodynamics, McGraw Hill, 2nd Ed.
2. S W Yuan, Foundations of Fluid Mechanics, Prentice Hall
3. Gupta Vijay and Gupta S K, Fluid Mechanics and its Applications, Wiley-Eastern, 1982

Reference Books :

1. Jack D Mattingly, Principles of Gas Turbine Propulsion, 1st Ed., McGrawHill, 1997
2. H. Schlichting and K. Gersten, Boundary Layer Theory, 8th Ed., McGrawHill, 2000
3. Frank M White, Fluid Mechanics, 2nd Ed., McGrawHill, 1986
4. E. Rathakrishnan, Gas Dynamics, Prentice Hall India

SEMESTER-VIII

Paper-I

Engineering Thermodynamics (BTAEN-803)

Fundamental Concepts and Definitions : Scope and limitations of thermodynamics. Thermodynamic system, state, property, change of state, thermodynamic equilibrium, path process, cycle density, pressure and their molecular interpretation - dimension and units - Zeroth law of thermodynamics and concept of temperature, temperature scales, work and heat definition and units of work and heat, work of frictionless process, PV diagram, indicator diagram.

First law of Thermodynamics : Statement of the first law. Energy. Internal energy and its microscopic interpretation, enthalpy, applications of first law.

Steady Flow Energy Equation (SFEE). The steady - state, steady -flow process. The JouleThomson coefficient and the throttling process. Uniform state, Uniform flow process, SFEE and its applications.

Second Law of Thermodynamics : Limitations of the first law, heat engines, reversed heat engines and their performance, Kelvin-Planck's and Clausius statements of the second law reversibility-reversible and irreversible processes: Carnot cycle thermodynamic temperature scale: Clausius-Clapeyron equation.

Entropy : The property, entropy, principle of increase of entropy, calculation of entropy changes, T-S and h-s diagrams. Microscopic interpretation of entropy-Helmholtz (A) and Gibbs (G) functions.

Physical properties : Pure substance definition-internal energy and enthalpy of a pure substance, specific heats, equilibrium of phases, phase diagrams, phase changes, critical state, PVT surface, tabulated properties and process calculations. Maxwell relations. Ideal and Real Gases : Definition-internal energy and enthalpy, specific heats and their calculation from simple kinetic theory, gas tables, Van der Waal's equation of state, principle of corresponding states, compressibility factor.

Vapour Power Cycles : Carnot cycle using steam, Rankine cycle, reheat cycle, binary vapour cycles.

Air Standard Power Cycles : Carnot cycle, Otto cycle, Diesel cycle, dual cycle, gas turbine cycles, inter cooling, reheating and regeneration, gas turbine jet propulsion, deviation from ideal cycles.

TextBooks :

1. C O Van Wylen; Classical Thermodynamics Wiley 2001
2. J B Jones and C A Hawkins, Engineering Thermodynamics, John Wiley and Sons Inc., New York
3. P K Nag, Engineering Thermodynamics, Tata McGrawHill Book Co. 1981

Reference Books :

1. R A Sonntag and C O Van Wylen, Fundamentals of Thermodynamics, Wiley, New York
2. D B Spalding and E H Cole, Engineering Thermodynamics, 2nd Ed., Arnold, London. 1973
3. John F Les and Francis W Sears, Thermodynamics: An Introductory Text for Engineering Students, Addison, Wesley Reading

Paper-II

Aircraft Design (BTAEN-805)

Preliminaries : Aircraft Design Requirements, specifications, role of users, Aerodynamic and Structural Consideration, Importance of weight. Airworthiness requirements and standards. Classifications of airplanes. Special features of modern airplane.

Air Loads in Flight : Symmetrical measuring loads in flight, Basic flight loading conditions, Load factor, Velocity - Load factor diagram, gust load and its estimation, Structural limits.

Airplane Weight Estimation : Weight estimation based on type of airplane, trends in wing loading, weight-estimation based on mission requirements, iterative approach

Basics of Wing Design : Selection of airfoil selection, influencing factors. Span wise load distribution and planform shapes of airplane wing. Stalling, take off and landing

considerations. Wing drag estimation. High lift devices

Structural Design : Cockpit and aircraft passenger cabin layout for different categories, types of associated structure, features of light airplanes using advanced composite materials.

Structural aspects of design of airplane, Bending moment and shear force diagram. Design principles of all metal stressed skin wing for civil and military applications

Landing Gears : Different kinds of landing gears, and associated arrangement for civil and military airplanes. Preliminary calculations for locating main and nose landing gears. Integration of Structure and Power Plant : Estimation of Horizontal and Vertical tail volume ratios. Choice of power plant and various options of locations, considerations of appropriate air-intakes. Integration of wing, fuselage, empennage and power plant. Estimation of centre of gravity.

Introduction to advanced concepts : Supercritical Wings, relaxed static Stability, controlled configured vehicles, V/STOL aircraft and, rotary wing vehicles. Design and layout of flying controls and engine controls

TextBooks:

1. Daniel P Raymer, Aircraft Design: A conceptual approach, AIAA Series, 1992
2. D Stinton, The Design of Airplane, GRANADA, UK 1983
3. John D Anderson (Jr.), Airplane Performance and Design, McGraw Hill 1999

Reference Books:

1. E Torenbeek, Synthesis of Airplane Design
2. L M Nicholai, Fundamentals of airplane Design, Univ. of Dayton DHIO, 1975

Paper-III

Composite Materials (BTAEN-806)

Introduction to Composite Materials; Classification of composites, particulate composites, fibrous composites. Use of fiber reinforced composites; Fibers, matrices and manufacture of composites; properties of various type of fibers like glass, Kevlar, Carbon and Graphite, methods of manufacture, surface treatment of fibers, various forms of fibers, matrix materials, polymers: Thermosetting and thermoplastic polymers, properties of polymers like epoxies, phenolics, polyester peek etc.

Manufacture of composites : hand lay up technique, pressure bag and vacuum bag molding techniques, puftrusion, resin-transfer moulding, injection moulding, Bulk moulding compound, sheet moulding compound.

Behavior of unidirectional composites : volume traction, weight traction,

density of composites, Micromechanics approach, longitudinal strength and stiffness, factors affecting longitudinal strength and stiffness, transverse strength and stiffness, shear modulus and strength, Poisson's ratio, effect of fiber dimension and distribution on strength and stiffness, Halpin-Tsai equations.

Analysis and strength of an orthotropic lamina : strain relations and engineering constants, relation between engineering constants and stiffness coefficients, strength of an orthotropic lamina, failure theories, Analysis of laminated composites, laminate orientation code, stress and strain variation in a laminate, properties of symmetric, cross ply angle-ply and quasi isotropic analysis of laminate after initial failure, hygrothermal behaviour of laminates. Thermal and moisture expansion coefficients, transport properties, mass diffusion.

Short fiber composites: approximate analysis of stress transfer, average fiber stress, modulus and strength of short fiber composites.

Experimental characterization of composites : uniaxial tension and compression test, inplane shear test, flexural test, determination of intralaminar shear strength and fracture toughness.

Non destructive evaluation techniques : ultrasonic techniques, Acoustic emission techniques, X - ray radiography.

TextBooksand Reference Books:

1. R.M. Jones, Mechanics of Composite Materials, Technomic Publication.
2. B.D. Agarwal and L.J. Broutman, Analysis and Performance of Fibre Composites, John Wiley & Sons.
3. R.F. Gibson, Principles of Composite MaterialMechanics, Mc Graw Hill International Edition.
4. Latit Gupta, Advanced Composite Materials, Himalyans Books, New Delhi 1998.

Paper-IV

Airplane Performance, Stability & Control (BTAEN-807)

Atmosphere : ISA, Geopotential and Geometric altitude, Troposphere and Stratosphere, stability of atmosphere.

Aerodynamic characteristics : Drag Aerodynamics, Drag polar, estimation of drag. Forces and moments from dimensional analysis, pressure distribution over airfoils, variation with angle of attack, aerodynamic centre, centre of pressure - related problems. Estimation of CL, CD and CM from pressure distribution , variation of aerodynamic coefficients with Reynolds number and Mach number. Effect of span, aspect ratio, planform, sweep, taper and twist on aerodynamic characteristics. High lift devices.

V/STOL configurations.

Airplane Performance in Steady and Level Flight : Equations of motion of aircraft, variation of drag with flight, power required and power available, minimum drag and minimum power conditions, climbing and gliding performance.

Airplane Performance in Accelerated Flight : Take off and landing distances, Jet Assisted Take off, Range and Endurance. Turning flight performance.

Static longitudinal stability : Stick fixed static longitudinal stability, neutral point, power effects, stick free static longitudinal stability. Hinge moments, Aerodynamic Balancing, Static Margin. In flight measurement of stick fixed and stick free neutral points.

Maneuvering flight : Elevator angle per g and stick force per g maneuver margin.
Lateral and Directional Stability and Control: Assymmetric flight, weather cock stability, Rudder fixed and Rudder free static directional stability - Rudder lock, dihedral effect. Control in Roll, Aileron control power. Cross coupling of lateral and directional effects. Numerical problems.

Dynamic Stability : Equations of motion of airplane, stability derivatives, split-up of equations in symmetrical and non-symmetric groups of motion.

Analysis of short period and phugoid mode

Analysis of roll and spiral modes, Dutch Roll.

TextBooks:

1. John D Anderson Jr., Introduction to Flight, McGraw Hill
2. R C Nelson, Flight Stability & Automation Control, McGraw Hill

Reference Books:

1. B Etkins, Dynamics of Flight, John Wiley
2. E L Houghton and N B Caruthers, Aerodynamics for Engineers, Edward Arnold, UK