AEC- 401
Aircraft System & Instrumentation

UNIT I AIRCRAFT SYSTEMS

Hydraulic systems –Study of typical workable systems –components –Hydraulic systems controllers –Modes of operation –Pneumatic systems –Working principles–Typical Pneumatic Power system –Brake system –Components, Landing Gear Systems Classification –Shock absorbers –Retractive mechanism.

UNIT II AIRPLANE CONTROL SYSTEMS

Conventional Systems –Power assisted and fully powered flight controls –Power actuated systems –Engine control systems –Push pull rod system– operating principles –Modern control systems –Digital fly by wire systems –Auto pilot system, Active Control Technology.

UNIT III ENGINE SYSTEMS

Fuel systems –Piston and Jet Engines –Components -Multi-engine fuel systems, lubricating systems -Piston and jet engines –Starting and Ignition systems –Piston and Jet engines.

UNIT IV AIRCONDITIONING & PRESSURIZING SYSTEM

Basic Air Cycle systems –Vapour Cycle Systems, Boot-strap air cycle system –Evaporative vapour cycle systems –Evaporation air cycle systems –Oxygen systems –Fire protection systems, De-icing and anti-icing system.

UNIT V AIRCRAFT INSTRUMENTS

Flight Instruments and Navigation Instruments –Accelerometers, Air speed Indicators –Mach Meters –Altimeters -Gyroscopic Instruments–Principles and operation –Study of various types of engine instruments –Tachometers –Temperature gauges –Pressure gauge –Operation and principles.

TEXT BOOKS

1. Mekinley, J.L. and R.D. Bent, Aircraft Power Plants, McGraw Hill 1993.
2. Pallet, E.H.J. Aircraft Instruments & Principles, Pitman & Co 1993.

REFERENCES

1. Teager, S. Gas Turbine technology, McGraw Hill 1997.
2. Mckinley, J.L. and Bent R.D. Aircraft Maintenance & Repair, McGraw Hill, 1993.
3. Handbooks of Airframe and Power plant Mechanics, US Dept. of Transportation, Federal, Aviation Administration, The English Book Store, New Delhi, 1995.

LIST OF EXPERIMENT

1. Study on Mock up system used for aircraft steering.
2. Typical workable hydraulic system used in aircraft.
3. Study of Push pulls rod system.
4. Study of Flight Instruments and Navigation Instruments
5. Study of Vapor Cycle cooling Systems

AEC- 402
Aircraft Structure -I

UNIT I STATICALLY DETERMINATE STRUCTURES
Statically determinate frames –plane truss analysis –method of joints –method of sections 3D trusses –the landing gear tripod –beams of two materials.
UNIT II STATICALLY INDETERMINATE STRUCTURES
Propped cantilevers –fixed-fixed beams–Clapeyron's 3 moment equation moment Distribution method.
UNIT III ENERGY METHODS
Strain energy evaluation in structural members –energy theorems –dummy load & unit load methods –Maxwell's reciprocal theorem –energy methods applied to statically determinate and indeterminate beams, frames, rings & trusses.
UNIT IV COLUMNS
Euler's column curve –inelastic buckling –effect of initial curvature –the South well plot –columns with eccentricity –use of energy methods –theory of beam columns –beam columns different end conditions –stresses in beam columns.
UNIT V FAILURE THEORIES
Ductile and brittle materials –maximum principal stress theory -maximum principal strain Theory -maximum shear stress theory -distortion energy theory –octa hedral shear stress theory.
TEXT BOOKS
1. Timoshenko and Gere, `Mechanics of Materials", Tata McGraw Hill, 1993.
2. Bruhn E F, Analysis and Design of Flight Vehicle Structures, Tri-State Off-set Company, USA, 1985
REFERENCES
1. Donaldson, B.K., „Analysis of Aircraft Structures -An Introduction", McGraw Hill, 1993.
2. Megson T M G, `Aircraft Structures for engineering students" Edward Arnold Publishers.
3. Peery, D.J., and Azar, J.J., Aircraft Structures, 2nd edition, McGraw –Hill,N.Y., 1999.
LIST OF EXPERIMENTS
1. Study the construction of fuselage and identify the primary load carrying members
2. Study the construction of wings.
3. Measurement of deflection of Truss members.
4. Study of Composite structure.
5. Study the construction of landing gears

AEC- 403
Aircraft Propulsion -I

UNIT I FUNDAMENTALS OF GAS TURBINE ENGINES

Illustration of working of gas turbine engine–The thrust equation–Factors affecting thrust–Effect of pressure, velocity and temperature changes of air entering compressor–Methods of thrust augmentation – Characteristics of turboprop, turbofan and turbojet–Performance characteristics.

UNIT II SUBSONIC AND SUPERSONIC INLETS FOR JET ENGINES

Internal flow and Stall in subsonic inlets –Boundary layer separation–Major features of external flow near a subsonic inlet –Relation between minimum area ratio and eternal deceleration ratio –Diffuser performance –Supersonic inlets–Starting problem on supersonic inlets –Shock swallowing by area variation –External declaration –Models of inlet operation.

UNIT III COMBUSTION CHAMBERS

Classification of combustion chambers–Important factors affecting combustion chamber design –Combustion process–Combustion chamber performance–Effect of operating variables on performance–Flame tube cooling–Flame stabilization–Use of flame holders–Numerical problems.

UNIT IV NOZZLES

Theory of flow in isentropic nozzles–Convergent nozzles and nozzle choking–Nozzle throat conditions–Nozzle efficiency–Losses in nozzles–Over expanded and under–expanded nozzles–Ejector and variable area nozzles–Interaction of nozzle flow with adjacent surfaces–Thrust reversal.

UNIT V COMPRESSORS

Principle of operation of centrifugal compressor–Work done &pressure rise–Velocity diagrams –Diffuser vane design considerations–Concept of pre whirl–Rotation stall–Elementary theory of axial flow compressor–Velocity triangles–Degree of reaction–Three dimensional–Air angle distributions for free vortex and constant reaction designs–Compressor blade design–Centrifugal and Axial compressor performance characteristics.

TEXT BOOKS

1. Hill, P.G. & Peterson, C.R. “Mechanics & Thermodynamics of Propulsion” Addison–Wesley Longman INC, 1999.

REFERENCES

1. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. “Gas Turbine Theory”, Longman, 1989.
2. Oates, G.C., “Aero thermodynamics of Aircraft Engine Components”, AIAA Education Series, New York, 1985.
3. “Rolls Royce Jet Engine” –Third Edition –1983.
4. Mathur, M.L. and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers & Distributors, Delhi, 1999.

LIST OF EXPERIMENTS

1. Study of an aircraft piston engine - assembly of sub systems.
2. Study of an aircraft piston engine - various components, their functions and operating principles. 3. Study of an aircraft jet engine - assembly of sub systems.
4. Study of an aircraft jet engine - various components, their functions and operating principles.
5. Study of forced convective heat transfer

AEC- 404
Aerodynamics-I

UNIT I REVIEW OF BASIC FLUID MECHANICS
System and Control volume approach, substantial, local and convective derivative, Continuity, momentum and energy equations, inviscid flow, Euler equation, incompressible Bernoulli's Equation. Circulation and Vorticity, Green's Lemma and Stoke's Theorem, Barotropic Flow, Kelvin's theorem, Streamline, Stream Function, Irrotational flow, Potential Function, Equipotential Lines, Elementary Flows and their combinations.

UNIT II TWO DIMENSIONAL INVISCID IN COMPRESSIBLE FLOW
Ideal Flow over a circular cylinder, D'Alembert"s Paradox, Magnus effect, Kutta Joukowski's Theorem, Starting Vortex, Kutta condition, Real flow over smooth and rough cylinder.

UNIT III AIRFOIL THEORY
Cauchy- Riemann relations, Complex Potential, Methodology of Conformal Transformation, Kutta-Joukowski transformation and its applications, Karman Trefftz Profiles, Thin Airfoil theory and its applications.

UNIT IV SUBSONIC WING THEORY
Vortex Filament, Biot and Savart Law, Bound Vortex and trailing Vortex, Horse Shoe Vortex, Lifting Line Theory and its limitations.

UNIT V INTRODUCTION TO LAMINAR & TURBULENT FLOW
Boundary layer and boundary layer thickness, displacement thickness, momentum thickness, Energy thickness, Shape parameter, Boundary layer equations for a steady, two dimensional Incompressible flow, Boundary Layer growth over a Flat plate, Critical Reynolds Number, blasius solution, Basics of Turbulent flow, Prandtl's mixing length hypothesis, Free shear layers.

TEXT BOOKS
1. Houghton, E.L., and Caruthers, N.B., Aerodynamics for Engineering students, Edward Arnold Publishers Ltd., London, 1989.
2. Anderson, J.D., Fundamentals of Aerodynamics, McGraw Hill Book Co., 1999

REFERENCES
1. Milne Thomson, L.H., Theoretical Aerodynamics, Macmillan, 1985
2. John J Bertin., Aerodynamics for Engineers, Pearson Education Inc, 2002
3. Clancey, L J., Aerodynamics, Pitman, 1986

LIST OF EXPERIMENTS
1. Calibration of subsonic wind tunnel.
2. Pressure distribution over smooth and rough cylinder.
3. Pressure distribution over symmetric airfoil.
4. Pressure distribution over cambered airfoil& thin airfoils
5. Force measurement using wind tunnel balance

AEC- 405
Aircraft Performance

UNIT-I GENERAL CONCEPTS
International Standard atmosphere, IAS, EAS, TAS, Propeller theory-Froude momentum and blade element theories, Propeller co-efficient, Use of propeller charts, Performance of fixed and variable pitch propellers, High lift devices, Thrust augmentation

UNIT-II DRAG OF BODIES
Streamlined and bluff body, Types of drag, Effect of Reynolds number on skin friction and pressure drag, Drag reduction of airplanes, Drag polar, Effect of Mach number on drag polar

UNIT-III STEADY LEVEL FLIGHT
Steady level flight, Thrust required and Power required, Thrust available and Power available for propeller driven and jet powered aircraft, Effect of altitude, maximum level flight speed, conditions for minimum drag and minimum power required, Effect of drag divergence on maximum velocity, Range and Endurance of Propeller and Jet airplanes.

UNIT-IV GLIDING AND CLIMBING FLIGHT
Shallow and steep angles of climb, Rate of climb, Climb hodograph, Maximum Climb angle and Maximum Rate of climb-Effect of design parameters for propeller and jet aircrafts, Absolute and service ceiling, Cruise climb, gliding flight, Glide hodograph

UNIT-V ACCELERATD FLIGHT
Estimation of take-off and landing distances, Methods of reducing landing distance, level turn, minimum turn radius, bank angle and load factor, Constraints on load factor, Pull up and pull down maneuvers, maximum turn rate, V-n diagram.

TEXT BOOKS
1. Houghton, E.L. and Carruthers, N.B. Aerodynamics for engineering students, Edward Amold Publishers, 1988.
2. Anderson, Jr., J.D. Aircraft Performance and Design, McGraw-Hill International Edition, 1999.

REFERENCES
1. Kuethe, A.M. and Chow, C.Y., Foundations of Aerodynamics, John Wiley & Sons, 1982.
2. J.J.Bertin, Aerodynamics for Engineers, Prentice-Hall, 1988.
3. L.J. Clancey, Aerodynamics, Pitman, 1986
4. Anderson, Jr., J.D. Introduction to Flight, McGraw-Hill International Edition, 1999.

AEC- 406
Aircraft Materials & Composite

UNIT I INTRODUCTION
Introduction to Aerospace materials: Classification, composition, properties, heat treatment & application of plain carbon steels, alloy steels. Stainless steels. Classification, composition, properties, heat treatment & application of aluminum and its alloys. Titanium alloys, Special alloys for high temperature.

UNIT II COMPOSITE MATERIALS
Introduction to composite materials: Definition –Classification of Composite materials based on structure –based on matrix. Advantages of composites –application of composites –functional requirements of reinforcement and matrix. FIBERS: Preparation, properties and applications of glass fibers, carbon fibers, Kevlar fibers and metal fibers –properties and applications of whiskers, particle reinforcements.

UNIT III MANUFACTURING OF ADVANCED COMPOSITES
Polymer matrix composites: Preparation of Moulding compounds and prepregs –hand layup method –Autoclave method –Filament winding method –Compression moulding –Reaction injection moulding. Manufacturing of Metal Matrix Composites: Casting –Solid State diffusion technique, Cladding –Hot isostatic pressing.

UNIT IV CREEPAND FRACTURE
Factors influencing functional life of components at elevated temperatures, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress, temperature and strain rate.

DESIGN FOR CREEP RESISTANCE
Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monk man-Grant relationship. Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, ductile fracture due to micro void coalescence-diffusion controlled void growth; fracture maps for different alloys and oxides. Fatigue of aircraft materials.

UNIT –V SUPERALLOYS & OTHER MATERIALS
Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidification of single crystals, Intermetallic, high temperature ceramics.

TEXT BOOKS
1. Material Science and Technology –Vol 13 –Composites by Cahn –VCH, West Germany Composite Materials –K.K. Chawla.
2. Calcote, L R. "The Analysis of laminated Composite Structures", Von –Noastrand Reinhold Company, New York 1998.
3. Jones, R.M., "Mechanics of Composite Materials", McGraw-Hill, Kogakusha Ltd., Tokyo, 1985.

REFERENCE BOOKS
1. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites",John Wiley and sons. Inc., New York, 1995.
2. Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co., New York, 1989.

3. Raj. R., “Flow and Fracture at Elevated Temperatures”, American Society for Metals,USA, 1985.
4. Hertzberg R. W., “Deformation and Fracture Mechanics of Engineering materials”, 4th Edition, John Wiley, USA, 1996.
5. Courtney T.H, “Mechanical Behaviour of Materials”, McGraw-Hill, USA, 1990.

LIST OF EXPERIMENT

1. Determination of mechanical properties of plain carbon steel using heat treatment techniques.
2. Solution treatment and hardening of Al-Mg and Al-Cu base alloys.
3. Fatigue and creep behavior iron base alloys.
4. Convert the Load-Displacement data to Stress-Strain data and plot out the Stress versus Strain curve for each specimen.
5. From the Stress-Strain curves, determine the Elastic Modulus (E1) and Ultimate Strength (SU1) for each sample tested.