AE-601
AIRCRAFT STRUCTURE- II

UNIT-1 FUNDAMENTALS OF STRUCTURAL ANALYSIS
Basic Elasticity: stress, notation for forces and stresses , equation of equilibrium, plane stress, Boundary conditions, determination of stresses on inclined planes, principal stresses, strain, Compatibility equations, plane strain, determination of strains on inclined planes principal Strains, stress-strain relationship.

UNIT-2 BENDING OF THIN WALLED BEAMS
Bending of open and closed thin walled beams: Symmetrical bending, unsymmetrical bending, deflection due to bending, calculation of section properties, application of bending theory, temperature effects, numerical problems.

UNIT-3 TORSION OF THIN WALLED BEAMS
Torsion of beams: torsion of closed section beams, torsion of multi-cell section, shear centre, properties of shear center, numerical problems.

UNIT-4 SHEAR FLOW
Bredt-Batho formula, Shear flow in open section, Shear flow in closed section, shear flow in boom section, combination of open and close section.

UNIT-5 AIRWORTHINESS AND AIRFRAME LOADS
Airworthiness, factor of safety-flight envelope, load factor determination, loads on an aircraft, safe life and fail safe structure, fatigue, creep and relaxation, materials used in an aircraft.

TEXT BOOKS:-
1. Megson T.H.G., Aircraft Structure for engineering students, Edward Arnold.
2. Perry D.J. and Azar J.J., Aircraft Structures, McGraw hill.

REFERENCE BOOKS:-
1. Analysis of A/C Structure by Bruce K. Donaldson (Cambridge Aerospace Series).
2. 'Theory & Analysis of Flight Structure' by Rivello, R.M., McGraw Hill.

LIST OF EXPERIMENTS:-
1. Verification of Maxwell's Reciprocal theorem & principle of superposition.
2. Shear center location for open sections.
3. Deflection of beams with various end conditions for different load.
4. Shear center location for closed sections.

AE 602
AIRCRAFT SYSTEMS & INSTRUMENTS

UNIT I AIRPLANE CONTROL SYSTEMS
Conventional Systems - Power assisted and fully powered flight controls - Power actuated systems – Engine control systems - Push pull rod system, flexible push pull rod system - Components – Modern control systems - Digital fly by wire systems - Auto pilot system active control Technology, Communication and Navigation systems Instrument landing systems, VOR - CCV case studies.

UNIT II AIRCRAFT SYSTEMS
Hydraulic systems - Study of typical workable system - components - Hydraulic system controllers - Modes of operation - Pneumatic systems - Advantages - Working principles - Typical Air pressure system – Brake system - Typical Pneumatic power system - Components, Landing Gear systems - Classification – Shock absorbers – Retractive mechanism.

UNIT III ENGINE SYSTEMS
Fuel systems for Piston and jet engines, - Components of multi engines. lubricating systems for piston and jet engines - Starting and Ignition systems - Typical examples for piston and jet engines.

UNIT IV AUXILLIARY SYSTEM
Basic Air cycle systems - Vapour Cycle systems, Boost-Strap air cycle system – Evaporative vapour cycle systems - Evaporative air cycle systems - Oxygen systems - Fire protection systems, De-icing and anti icing systems.

UNIT V AIRCRAFT INSTRUMENTS
Flight Instruments and Navigation Instruments – Gyroscope - Accelerometers, Air speed Indicators – TAS, EAS- Mach Meters - Altimeters - Principles and operation - Study of various types of engine instruments - Tachometers - Temperature gauges - Pressure gauges - Operation and Principles.

TEXT BOOKS
1. Lalit Gupta & Sharma O.P. 'Fundamental of Flight (Aircraft Systems)' McGraw Hill Pvt.Ltd.
1. McKinley, J.L., and Bent, R.D., *"Aircraft Maintenance & Repair*", McGraw-Hill, 1993.
2. *"General Hand Books of Airframe and Powerplant Mechanics",* U.S. Dept. of Transportation, Federal Aviation Administation, The English Book Store, New Delhi1995.

REFERENCES
1. Mekinley, J.L. and Bent, R.D*., "Aircraft Power Plants*", McGraw-Hill, 1993.
2. Pallet, E.H.J., *"Aircraft Instruments & Principles",* Pitman & Co., 1993.
3 .Treager, S., "*Gas Turbine Technology*", McGraw-Hill, 1997.

LIST OF EXPERIMENTS

1. Aircraft “jacking up” procedure.
2. Aircraft “leveling” procedure
3. Control system “rigging” check procedure
4. Aircraft “symmetry check” procedure
5. Flow test “to assess of filter” element clogging
6. Pressure test to adjust “operating system” components
7. Brake torque load test on wheel brake units
8. Maintenance and rectification of snags in hydraulic and fuel systems.

AE 603

HEAT AND MASS TRANSFER

UNIT-I FUNDAMENTALS

Modes of heat transfer: Conduction –Convection - Radiation

UNIT-II HEAT CONDUCTION

Steady and unsteady state heat conduction in solids - Effect of variation of thermal conductivity on heat transfer in solids –conduction with heat generation –Heat transfer problems in infinite and semi-infinite solids–Critical radius of insulation-Extended surfaces-Application of numerical techniques.

UNIT-III FREE AND FORCED CONVECTION

Convection fundamentals: Basic equations, Boundary layer concept, Dimensional analysis **Free Convention:** Laminar boundary layer equation- Free convection in atmosphere free Convection on a vertical flat plate –Integral method - Empirical relation in free convection – External flow.

Forced convection: Forced convection - Laminar and turbulent convective heat transfer analysis in flows between parallel plates, over a flat plate and in a circular pipe. Empirical relations - numerical techniques in problem solving.

UNIT-IV RADIATIVE HEAT TRANSFER AND HEAT EXCHANGERS

Concept of black body-Intensity of radiation-Laws of Black body Radiation-Radiation from non-black surfaces- real surfaces –Radiation between surfaces-Radiation shape factors-Radiation shields.

HEAT EXCHANGERS: Types-overall heat transfer coefficient- LMTD- NTU method of heat exchanger Analysis.

UNIT-V HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING

Heat transfer problems in gas turbine combustion chambers - Rocket thrust chambers Aerodynamic heating - Ablative heat transfer.

TEXT BOOKS:

1 Sachdeva, S.C. Fundamentals of Engineering, Heat and Mass Transfer, Wiley Eastern Ltd., New Delhi, 1981.
2. Lienhard, J.H., "A Heat Transfer Text Book", Prentice Hall Inc., 1981.
3. Holman, J.P., "Heat Transfer", McGraw-Hill Book Co., Inc., New York, 6th Edn, 1991.

REFERENCES

1. Sachdeva, S.C., "Fundamentals of Engineering Heat and Mass Transfer", Wiley Eastern Ltd., New Delhi, 1981.
2. Sutton, G.P., "Rocket Propulsion, JohnElements"WileyandSons,5thEdn.1986.
Mathur, M. and Sharma, R.P., "Gas Turbine and Jet and Rocket Propulsion", Stand.

LIST OF EXPERIMENTS

1. Heat transfer through composite wall.
2. Critical heat flux apparatus.
3. Measurement of surface emissivity.
4. Heat transfer through forced convection.
5. Heat transfer through lagged pipe
6. Heat transfer through natural convection.
7. Parallel & counter flow heat exchanger.
8. Heat transfer through pin – fin.
9. Stefan boltzman's apparatus.
10. Thermal conductivity of concentric sphere.
11. Thermal conductivity of metal rod.
12. Transient heat conduction apparatus.
13. Heat pipe demonstration.

AE-604
SPACE DYNAMICS

UNIT-1 HISTORY OF SPACE FLIGHT

Introduction: History of space vehicles:- world history, Indian history, comparison, Initial works, first space flight, man in space, profile of flight from earth to a destination in space and back, space shuttle.

UNIT-2 ORBIT EQUATION

Introduction, differential equation, Lagrange's equation, Newton's law of gravitation, orbit equation, energy and angular momentum, Kepler's laws, orbit determination and satellite tracking.

UNIT-3 THE EARTH SATELLITE OPERATIONS

The Hohman transfer, inclination change maneuver, launc to rendezvous, decay life time, earth oblateness effect, low thrust orbit transfer,

UNIT-4 SATELLITE ATTITUDE DYNAMICS

Torque, free axisymmetric rigid body, the general torque free rigid body, semi rigid spacecraft, attitude control, spinning and non spinning spacecraft, the Yo-Yo mechanism, gravity gradient, satellite, the dual spin spacecraft.

UNIT-5 RE-ENTRY DYNAMICS

Introduction, ballistic re-entry, skip re-entry, double dip re-entry, aero braking, lifting reentry. space environment: introduction, atmosphere,light and spacecraft temperature, charged particle motion.

TEXT BOOK:-

1. Space Flight Dynamics, William E.Wiesel, Mcgraw Hill.

REFERENCE BOOK:-

1. Materials for missiles and spacecraft, Parker E.R.

AE-605
AIRCRAFT DESIGN

UNIT-1
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.

UNI-2
Airplane Weight Estimation: Weight estimation based on type of airplane, trends in wing loading, weight-estimation based on mission requirements, iterative approach. Basic Wing Design: Selection of airfoil selection, influencing factors. Span wise load Distribution and plan form shapes of airplane wing. Stalling take-off and landing Considerations. Wing drags 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.

UNIT-3
Landing Gears: Different kinds of landing gears, and associated arrangement for civil and military airplanes. Preliminary calculations for locating main and nose landing gears.

UNIT-4
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 center of gravity.

UNIT-5
Introduction of 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.

TEXT BOOK
1. Daniel P Raymer, Aircraft Design: A conceptual approach, AIAA Series, 1992.
2. John D Anderson (Jr.), Airplane Performance and Design, mcgraw Hill.

REFERENCE BOOKS:-
1. L M Nicholal, Fundamentals of airplane Design, Univ. Of Dayton DHIO.
2. Aircraft Design K.D.Wood, Johnson Publishing Company.

LIST OF EXPERIMENTS

To introduce and develop the basic concept of aircraft design. Each student is assigned with the design of an Airplane for given preliminary specifications. The following are the Assignments to be carried out:

1. Comparative configuration study of different types of airplanes.
2. Comparative study on specification and performance details of aircraft.
3. Preparation of comparative data sheets.
4. Work sheet layout procedures.
5. Comparative graphs preparation and selection of main parameters for the design.
6. Preliminary weight estimations, selection of main parameters.
7. Power plant selection, Aerofoil selection, Wing tail and control surfaces.
8. Preparation of layouts of balance diagram and three view drawings.
9. Estimation of various Drags.
10. Detailed performance calculations and stability estimates.

AE-606
BASIC TRAINING ELEMENTS (SIMULATOR)

LIST OF EXPERIMENTS

A. Trimming an airplane that has three-axis trim (elevator, rudder, and aileron).
B. Introduction to the four step scan.
C. Demonstrating the graveyard spiral and the importance of using the triangles of knowledge
D. Flying with hands-off the yoke.
1. Controlling the airplane with rudder.
2. Pitch trimming with power.
E. Straight and level flight.
1. Slow cruise
2. Normal cruise.
F. Elevator/throttle coordination.
1. When maintaining a constant airspeed.
2. When maintaining constant altitude or vertical speed.
G. Climbs and level-offs.
1. Normal cruise – best rate climb – normal cruise.
2. Normal cruise – cruise climb – normal cruise.
3. Slow cruise – best rate climb – slow cruise.
H. Descents and level-offs
1. Normal cruise – cruise descent – slow cruise
2. Normal cruise – slow cruise descent – slow cruise.
I. Descending and climbing turns with intermediate level-offs and roll-outs to specific headings.
J. Vertical S with and without the attitude indicator.
K. Vertical S-1 with and without the attitude indicator.
L. Oscar pattern with and without the attitude indicator.
M. Multiengine (if applicable)—using the rudder to initiate engine failure procedures.