VARDHAMAN COLLEGE OF ENGINEERING

(AUTONOMOUS)

Affiliated to JNTUH, Approved by AICTE, Accredited by NAAC and ISO 9001:2008 Certified
Shamshabad - 501 218, Hyderabad, Telangana State, India.
www.vardhaman.org

BACHELOR OF TECHNOLOGY
AERONAUTICAL ENGINEERING

SYLLABI (III Year and IV Year)

B. Tech. - Regular Four Year Degree Program
(For batches admitted from the Academic Year 2013 - 2014)
&
B. Tech. - Lateral Entry Scheme
(For batches admitted from the Academic Year 2014 - 2015)

SYLLABI FOR V SEMESTER

B. Tech. AE V SEMESTER

AIR TRANSPORTATION SYSTEMS

Course Code: **A1710**

L	T	P	C
4	-	-	4

UNIT - I

AVIATION INDUSTRY: Introduction, history of aviation evolution, development, growth, challenges. Aerospace industry, air transportation industry, economic impact- types and causes. Airline Industry structure and economic characteristics. Airlines as oligopolists, other unique economic characteristics. Significance of airline passenger load factors.

UNIT - II

NATURAL ENVIRONMENT: The earth as a habitat, The Earth: physical issues affecting demand: surface, core, continents. Shape of demand. Demand forecasting based on historical data, comparative analysis, theoretical demand models. Reliability of forecasts, Atmosphere of earth- gaseous properties, distance and speed, weather- weather effects on navigation.

REGULATORY ENVIRONMENT: The breadth of regulation- ICAO, IATA, national authorities (DGCA, FAA). Service properties, service volumes, international air service agreements, deregulation, privatization. Safety regulations, risk assessment, human factors and safety, security regulations, environmental regulations.

UNIT - III

OPERATIONAL ENVIRONMENT: Introduction. Evolution, communication, navigation and surveillance systems (CNSS). Radio communications: VHF, HF, ACARS, SSR, ADS. Navigation- NDB, VOR, DME, area-navigation systems(R-Nav), ILS, MLS, GPS, INS, laser-INS. Surveillance- SSR, ADS . Airborne elements- AFCS, PMS, electronic control and monitoring /engine instrumentation and central automated systems, EFIS, FMS, GPWS, TCAS- future trends.

AIRCRAFT: Costs- project cash-flow, aircraft price. Compatibility with the operational infrastructure. Direct and indirect operating costs. Balancing efficiency and effectiveness, payload-range, fuel efficiency, technical contribution to performance, operating speed and altitude, aircraft field length performance. Typical operating costs. Effectiveness, wake-vortices, cabin dimensions, flight deck.

UNIT - IV

AIRLINES: Setting up an airline, modern airline objectives. Route selection and development, airline fleet planning, annual utilization and aircraft size, seating arrangements. Indirect operating costs. Aircraft buy or lease. Revenue generation, Computerized reservation systems, yield management. Integrating service quality into the revenue generation process. Marketing the seats. Airline scheduling. Evaluating success financial viability, regulatory compliance, efficient use of resources, effective service.

AIRPORTS: Setting up an airport- airport demand, airport setting, runway characteristics: length, declared distances, aerodrome areas, obstacle safeguarding. Runway capacity, evaluating runway capacity, sustainable runway capacity. Runway pavement length, Manoeuvring area airfield lighting, aprons, Passenger terminals-terminal sizing and configuration. Airport demand, capacity and delay.

UNIT - V

AIRSPACE: Categories of airspace, separation minima, airspace sectors, capacity, demand and delay. Evolution of air traffic control system procedural ATC system, procedural ATC with radar assistance, first generation 'automated' ATC system, current generation radar and computer-based ATC systems. Aerodrome air traffic control equipment and operation - ICAO future air-navigation systems (FANS). Air-navigation service providers as businesses.

TEXT BOOKS:

1. Mike Hirst (2008), *The Air Transport System*, Cambridge Woodhead Publishing Ltd, USA.

REFERENCE BOOKS:

1. John G Wensveen (2008), *Air Transportation: a Management Perspective*, 6th edition, Ashgate, New Delhi.
2. Peter Belobaba, Amedeo R. Odoni and Cynthia Barnhart (2009), *Global Airline Industry*, Wiley, USA.
3. Massoud Bazargan(2010), *Airline Operations and Scheduling*, 2nd edition , Ashgate, New Delhi.
4. Michael S Nolan (2011), *Fundamentals of Air Traffic Control*, 5th edition, Delmar Cengage Learning, New York.
5. Seth B. Young, Alexander Wells(2011), *Airport Planning and Management*, 6th edition, McGraw-Hill, New Delhi.

B. Tech. AE V SEMESTER

AEROSPACE PROPULSION - I

Course Code: **A1711**

L	T	P	C
4	-	-	4

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 compressors. Method of thrust augmentation. Characteristics of turboprop, turbojet, Performance characteristics.

UNIT - II

SUBSONIC INLETS: 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: Supersonic inlets, starting problem in supersonic inlets, Shock swallowing by area variation, External deceleration. Modes of inlet operation.

UNIT - III

COMBUSTION CHAMBERS AND PERFORMANCE: Classification of combustion chambers, important factors affecting combustion chamber design, Combustion process, Combustion chamber performance.

PERFORMANCE SENSITIVITY: 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

CENTRIFUGAL COMPRESSORS: Principle of operation of centrifugal compressors. Work done and pressure rise - Velocity diagrams, Diffuser vane design considerations. Concept of Prewhirl, Rotating stall.

AXIAL FLOW COMPRESSORS: Elementary theory of axial flow compressor, Velocity triangles, Degree of reaction, three dimensional flow. Air angle distribution for free vortex and constant reaction designs, Compressor blade design. Centrifugal and Axial compressor performance characteristics.

TEXT BOOKS:

1. Ronald D. Flack (2010), *Fundamentals of Jet Propulsion with Application*, Cambridge University Press, USA.
2. H. I. H. Saravanamuttoo, Cohen H. Rogers (2009), *Gas Turbine Theory*, 6th edition, Pearson Education, New Delhi, India.
3. V. Ganesan (2010), *Gas Turbines*, Tata McGraw-Hill, New Delhi, India.

REFERENCE BOOKS:

1. Oates G. C (1986), *AeroThermodyanamics of Aircraft Engine Components*, AIAA Education Series, USA.
2. Rolls- Royce (2005), *Jet Engine*, 6th edition, Rolls - Royce Ltd, USA.
3. A. S. Burack (2011), *Gas Turbines and Jet and Rocket Propulsion*, Goldberg Press, New York.
4. Saeed Farokhi (2009), *Aircraft Propulsion*, 2nd edition, John Wiley, USA.

B. Tech. AE V SEMESTER

AERODYNAMICS - II

Course Code: **A1712**

L	T	P	C
3	1	-	4

UNIT - I

ONE DIMENSIONAL FLOWS: Isentropic process for closed system/flow processes. Velocity of sound. Mach number, flow regimes. Governing equations of inviscid compressible flow. Continuity, Momentum and Energy equations in Integral and Differential form. Stagnation conditions.

UNIT - II

FLOW THROUGH NOZZLES: Isentropic flow through Convergent – Divergent nozzles. Chocked flow conditions. Normal shock. Under and over expansion conditions. Flow through diffusers, wave reflections from a free boundary. Description of supersonic wind tunnels and rocket engine.

UNIT - III

OBLIQUE SHOCKS AND EXPANSION WAVES: Oblique shock relations. Super sonic , M relations strong and weak shock solutions / Shockflow over a wedge polar. Regular reflection from a solid boundary. Intersections of shock wave. Expansion waves. Prandtl – Meyer Expansion.

SUBSONIC COMPRESSIBLE FLOW OVER AIRFOIL: Introduction, Velocity potential equation, Transonic small perturbation equation, Prandtl-Glauert compressibility corrections, Critical Mach number, Drag divergence Mach number, Area rule, Supercritical airfoil.

UNIT - IV

SUPERSONIC FLOW: Linearized supersonic flow, Linearized supersonic flow over airfoil and wings. Shock Expansion theory. Detached shock. Axi-symmetrical flows, flow past slender bodies of revolution, conical flows, Numerical integration procedure.

HYPERSONIC FLOWS: Qualitative aspects of hypersonic flow. Newtonian theory. Flat plate at an angle of attack. Hypersonic shock wave relations. Lift and drag of wings at hypersonic speeds. Recent advances in hypersonic flows and testing techniques.

UNIT - V

FLOW MEASUREMENTS AND MODEL TESTING: Non dimensional parameters and II numbers Similarity of flows. Model testing in wind tunnels. Pressure, Velocity measurements, Hotwire and Laser, Doppler anemometer, Turbulence measurements. Measurement errors. Test section speed, horizontal buoyancy, flow angularities.

FORCE MEASUREMENTS WIND TUNNEL BALANCES: Force measurements, Wind tunnel balances. Scale effects and corrections, wall interferences, induced drag and other computations/corrections.

TEXT BOOKS:

1. Anderson J .D. (2011), *Fundamental of Aerodynamics*, 5th edition, McGraw-Hill, New Delhi.
2. Rathakrishnan E.E. (2010), *Gas Dynamics*, 3rd Edition, Prentice Hall of India, New Delhi.

RFFERENCE BOOKS:

1. Anderson J .D (2004), *Modern Compressible Fluid Flow*, 3rd Edition, McGraw-Hill International Edition, New York
2. Hodge B. K, Koenig K (1995), *Compressible Fluid Dynamics with Computer Application*, 1st edition, Prentice Hall, New York.
3. Clancy L. J. (2006), *Aerodynamics*, Sterling Publishers, New Delhi.

B. Tech. AE V SEMESTER

FLIGHT MECHANICS - II

Course Code: **A1713**

L	T	P	C
3	1	-	4

UNIT - I

INTRODUCTION: Degree of freedom of a system, Static and dynamic stability. Need for stability in an airplanes. Purpose of controls, inherently and marginally stable airplanes.

EQUATIONS OF MOTION: Equations of motion of a rigid body. Inertial forces and moments. Equations of motion of flight vehicles. Aerodynamic forces and moments. Decoupling of longitudinal and lateral-directional equations. Linearization of equations.

UNIT - II

AERODYNAMIC STABILITY DERIVATIVES: Aerodynamic stability and control derivatives. Relation to geometry, flight configuration. Effects of power, compressibility and flexibility.

UNIT - III

STATIC LONGITUDINAL STABILITY - CONTROL FREE: Effects of releasing the elevator. Hinge moment coefficients, Control forces to trim. Control free neutral point - Trim tabs. Aerodynamic balancing of control surfaces. Means of augmentation of control.

MANEUVER STABILITY: Contribution of pitch damping to pitching moment of flight vehicle, Effect on trim and stability. Control deflections and control forces for trim in symmetric maneuvers and coordinated turns. Control deflection and force gradients. Control fixed and control free maneuver stability. Maneuver points. Maneuver margins.

UNIT - I V

STATIC LONGITUDINAL STABILITY AND CONTROL - CONTROL FIXED: *Stick Fixed*: Basic equilibrium equation, Stability criterion, Contribution of wing and tail and elevator to pitching moments. Effect of fuselage and nacelles, Effects of center of gravity location, Power effects Stabilizer setting and center of gravity location, Elevator power, Elevator to trim . Trim gradients. Control fixed static stability, Control fixed neutral point. Stability margins.

UNIT - V

STATIC LATERAL AND DIRECTIONAL STABILITY AND CONTROL: Dihedral effect, Coupling between rolling and yawing moment, Adverse yaw, Aileron power, Aileron reversal. Weather cocking effects, Rudder power. Lateral and directional stability- definition. Control surface deflections in steady sideslips, rolls and turns one engine inoperative conditions, Rudder lock.

DYNAMIC STABILITY AND RESPONSE TO CONTROL: Solutions to the stability quadratic of the linearised equations of motion. The principal modes. Phugoid , Short Period Dutch Roll and Spiral modes, Further approximations. Restricted degrees of motion. Solutions. Response to controls. Auto rotation and spin.

TEXT BOOKS:

1. Houghton E. L, Carruthers N. B. (2010), *Aerodynamics for Engineering Students*, 5th edition, Elsevier, USA.
2. Mc. Cormic B. W. (2010), *Aerodynamics, Aeronautics and Flight Mechanics*, Wiley India Pvt. Ltd, USA.

REFERENCE BOOKS:

1. Perkins C. D, Robert Hage E (2003), *Airplane Performance, Stability and Control*, Wiley Toppan, USA.
2. Nelson R. C (2007), *Flight Stability and Automatic Control*, SIE edition, McGraw Hill, New York.
3. T. R. Yechout, S. L. Morns (2003), *Introduction to Aircraft Flight Mechanics*, AIAA Publishers, USA.

B. Tech. AE V SEMESTER

AEROSPACE VEHICLE STRUCTURES - II

Course Code: **A1714**

L	T	P	C
3	1	-	4

UNIT - I

LOAD DIFFISION IN STIFFNED PANELS: Wagner's theory of beams. Shear carrying capabilities of panels and introduction to Tension field webs. Semi tension and complete tension field beams. Minocqua and semi Minocqua structures.

SHEET STRINGER COMBINATIONS: Axial Load flow diagrams for boom in stiffened panels. Simple illustrative examples of A/C sheet stringer elements through free body diagrams. Load diffusion in thin walled panels with oblique stiffeners.

UNIT - II

STRESS ANALYSIS OF WING AND FUSELAGE: Procedure - Shear and bending moment distribution for semi cantilever and other types of wings and fuselages - Thin webbed beam with parallel and non parallel flanges, Shear resistant web beams.

UNIT - III

STABILITY OF PANELS: Stability of stiffened panels. Effective width concept. Simple estimations of load carrying capability of stressed skins of Aircraft wing shells.

SHEAR FLOW IN OPEN SECTIONS SUBJECTED TO PURE BENDINGS: Thin walled beams, Shear centre and Elastic axis Concept of shear flow beams with one axis of symmetry, Unsymmetrical box beam with effective and ineffective skins.

UNIT - IV

TORSION BENDING OF OPEND TUBES: Torsion bending phenomena. Torsion bending constant and specific torsion bending strength Simple derivation of torsion bending equation. The phenomena of warping. Stresses in cantilever, I-beam by solution of general differential equation for torsion beam.

UNIT - V

INHIBITION OF AXIL CONSTRAINT STRESS: Torsion of thin walled beams with open sections effect of axial constraints. Primary and Secondary warping phenomena. Computation of torsion bending constant for open tubes with cross sections such as Channel, T and Angle.

AIRCRAFT SKIN STIFFNERS: Methods of improving torsion bending strength by lipping, as an effective means of improving torsion bending constant. Computation of improvement of specific torsion bending strength in lipped Channel, T, I, L, sections over the unclipped counter parts

TEXT BOOKS:

1. Megson T. H. G (2012), *Aircraft Structures for Engineering Students*, 5th edition, Elsevier, USA.
2. David J. Perry (2011), *Aircraft Structures*, 2nd Edition, McGraw- Hill, New Delhi.

REFRENCE BOOKS:

1. Irving Herman Shames, Clive L. Dym(2003), *Energy and finite element methods structural analysis,* McGraw-Hill, New Delhi.
2. B. C. Punmia (2011), *Theory of Structures*, 13th edition, Laxmi Publication, Hyderabad.
3. Donaldson B. K.(2008), *Analysis of Aircraft Structures An introduction to Aeronautical Structures Analysis*, 2nd Edition, Cambridge University Press, USA.

B. Tech. AE V SEMESTER

INTRODUCTION TO SPACE TECHNOLOGY

Course Code: **A1715**

L	T	P	C
4	-	-	4

UNIT - I

INTRODUCTION: Space Mission, Types, Space Environment, Launch Vehicle Selection.

UNIT - II

FUNDAMENTALS OF ROCKET PROPULSION: Introduction to rocket propulsion, fundamentals of solid propellant rockets, Fundamentals of liquid propellant rockets. Rocket equation.

UNIT - III

ASCENT FLIGHT MECHANICS OF ROCKETS AND MISSILES: Two-dimensional trajectories of rockets and missiles. Multi-stage rockets, Vehicle sizing. Two stage Multi-stage Rockets, Trade-off Ratios-Single Stage to Orbit, Sounding Rocket-Aerospace Plane, Gravity Turn Trajectories-Impact point calculation, Injection conditions, Flight dispersions.

ATMOSPHERIC REENTRY: Introduction, Steep Ballistic Reentry, Ballistic Orbital Reentry, Skip Reentry, "Double- Dip" Reentry, Aero-braking, Lifting Body Reentry.

UNIT - IV

FUNDAMENTALS OF ORBITAL MECHANICS: Two-body motion-Circular, elliptic, hyperbolic, and parabolic orbits. Basic Orbital Elements, Ground Trace.

ORBITAL MANEUVERS: In-Plane Orbit changes, Hohmann Transfer, Bielliptical Transfer, Plane Changes, Combined Maneuvers, Propulsion for Maneuvers.

UNIT - V

SATELLITE ATTITUDE DYNAMICS: Torque free Axi-symmetric rigid body, Attitude Control for Spinning Spacecraft. Attitude Control for Non-spinning Spacecraft. The Yo-Yo Mechanism, Gravity, Gradient Satellite. Dual Spin Spacecraft, Attitude Determination.

SPACECRAFT POWER AND COMMUNICATION SYSTEMS: Spacecraft Power, Telecommunications.

TEXT BOOKS:

1. W. E. Wiesel (2010), *Spaceflight Dynamics*, 3rd edition, McGraw-Hill, New Delhi.

REFERENCE BOOKS:

1. J. Sellers (2005), *Understanding Space: An Introduction to Astronautics*, 3rd edition, McGraw- Hill, New Delhi.
2. Francis J. Hale (1994), *Introduction to Space Flight*, 1st edition, Prentice-Hall, New York.
3. D. Brown Charles (1998), *Spacecraft Mission Design*, 2nd edition, AIAA Education Series, USA.
4. Meyer Rudolph X (1999), *Elements of Space Technology for Aerospace Engineers*, Academic Press, New York.

B. Tech. AE V SEMESTER

AIRCRAFT PRODUCTION TECHNOLOGY LAB

Course Code: **A1716**

L	T	P	C
-	-	3	2

Basic Exercises in Lathe, Shaper, Milling, Slotting, EDM, CNC and Grinding machines welding equipment and metallurgy equipment comprising Microscopes polishing disc grinders as under.

PRODUCTION LAB:

1. Plain Turning, Taper turning, Facing, Knurling, Thread Cutting.
2. Drilling, boring, counter boring, counter sinking
3. Shaping and planning of square blocks, V-ways and Dovetail ways
4. Plain Milling
5. Gear Milling
6. Cylindrical Grinding / Surface Grinding
7. Simple exercises in EDM
8. Sheet metal joining by rivets Soldering and brazing.
9. Simple exercises on CNC machines and Programme generation.
1. 10.Simple exercises in Solid State Welding, Gas Welding and Arc Welding.
10. Metal joining Techniques (Brazing and Soldering).

MATERIALS LAB:

1. Aircraft wood gluing practice
2. Study of properties of sandwich structures
3. Study of Micro Structures of Non ferrous alloys
4. Experiment on Autoclave for different geometrical structures

REFERENCE BOOKS:

1. Keshu S. C, Ganapathy K. K (2011), *Air craft production techniques*, E-book, Interline Publishing House, New York, USA.
2. Kalpakajian Serope (2011), *Manufacturing Engineering and Technology*, 5th edition, Pearson Education, London.

B. Tech AE V SEMESTER

AEROSPACE VECHILE STRUCTURES LAB

Course Code: **A1717**

L	T	P	C
-	-	3	2

LIST OF EXPERIMENTS:

1. Tensile testing using universal Testing Machine - Mechanical and optical Extensometers, Stress - strain curves and strength tests for various engineering materials.
2. Bending tests: Stress and deflection of beams for various end conditions. Verification of Maxwell's and Castiglianos theorems, Influence coefficients.
3. Compression tests on long and short columns, Critical buckling loads, South well plot.
4. Test on riveted and bolted joints.
5. Test using NDT inspection method.
   Strain gauge techniques, Measurement of strain in beams, thin and thick walled cylinders subjected to internal pressure, Shaft subjected to combined loading.
6. Shear centre in open and closed sections beams, Test on semi-tension field beams.
7. Elastic constants for composite materials, Flexural test on composites.
8. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
9. Study and use of a Seismic pickup for the measurement of vibration amplitude.
10. Critical Fracture toughness of Aerospace material

TEXT BOOKS:

1. Megson T. H. G (2012), *Aircraft Structures for Engineering Students*, 5th edition, Elsevier, USA.
2. David J. Perry (2011), *Aircraft Structures*, 2nd Edition, McGraw- Hill, New Delhi.

REFRENCE BOOKS:

1. Irving Herman Shames, Clive L. Dym (2003), *Energy and finite element methods structural analysis,* McGraw Hill, New Delhi.
2. B. C. Punmia (2011), *Theory of Structures*, 13th edition, Laxmi Publications, New Delhi.
3. Donaldson B. K (2008), *Analysis of Aircraft Structures An introduction to Aeronautical Structures Analysis*, 2nd edition, Cambridge University Press, London.

EQUIPMENT NEEDED:

1. UTM – 20 / 40 Tons with. Jigs and Fixtures and precision Extensometers
2. Deflection test rig (Fabricated hardware + precession dial gauge)
3. Shear center Test rig
4. NDT Equipment
   a. Ultrasonic apparatus
   b. Magnetic Particle test rig
   c. Dye penetration test
5. Strain Measuring equipment
   a. Wheat stone Bridge
   b. Multi channel strain measuring equipment
   c. Various gauges / rosettes
6. Various Hardware rigs desired in the lab for specific test.

SYLLABI FOR VI SEMESTER

B. Tech AE VI SEMESTER

CONTROL SYSTEMS

Course Code: **A1212**

L	T	P	C
3	1	-	4

UNIT - I

BASICS IN CONTROL SYSTEM AND TRANSFER FUNCTION: Introduction of Control Systems , Various types of systems (Open Loop and closed loop) and their differences- Classification and Feed-Back Characteristics of control system- Effects of feedback. Mathematical models – Differential equations, Translational and Rotational mechanical systems. Transfer Function of DC Servo motor - AC Servo motor- Synchro transmitter and Receiver.

UNIT - II

REPRESENTATION OF TRANSFER FUNCTION AND CONTROL DESIGN TECHNIQUES: Block diagram representation of systems considering electrical systems as examples. Block diagram algebra – Representation by Signal flow graph - Reduction using Mason's gain formula. Compensation techniques – Lag, Lead, Lead-Lag Controllers design, PID Controllers.

UNIT - III

TIME RESPONSE ANALYSIS: Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants – Effects of proportional derivative, proportional integral systems.

STABILITY ANALYSIS: The concept of stability – Routh's stability criterion – qualitative stability and conditional stability – limitations of Routh's stability. The root locus concept - construction of root loci-effects of adding poles and zeros to G(s)H(s) on the root loci.

UNIT - IV

FREQUENCY RESPONSE ANALYSIS: Introduction, Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain margin-Stability Analysis from Bode Plots.

STABILITY ANALYSIS IN FREQUENCY DOMAIN: Polar Plots-Nyquist Plots-Stability Analysis

UNIT - V

STATE SPACE ANALYSIS: Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and it's Properties - Concepts of Controllability and Observability

TEXT BOOKS:

1. I. J. Nagrath, M .Gopal (2011), *Control Systems Engineering*, 5th edition, New Age International (P) Limited, New Delhi, India.
2. Benjamin. C. Kuo (2003), *Automatic Control Systems*, 8th edition, John Wiley and Son's, USA.

REFERENCE BOOKS:

1. K. Ogata (2008), *Modern Control Engineering*, 4th edition, Prentice Hall of India Pvt. Ltd, New Delhi.
2. N. K. Sinha (2008), *Control Systems*, 3rd edition, New Age International Limited Publishers, New Delhi.

B. Tech. AE VI SEMESTER

OPERATIONS RESEARCH
(Common to AE & CE)

Course Code: **A1330**

L	T	P	C
4	-	-	4

UNIT - I

INTRODUCTION TO OPERATIONS RESEARCH: Basics definition, scope, objectives, phases, models and limitations of Operations Research. Linear Programming Problem, Formulation and Graphical solution of Linear Programming Problem. Simplex Method, Artificial variables Techniques, big -M method, two -phase simplex method, degeneracy and unbound solutions.

UNIT - II

TRANSPORTATION PROBLEM: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions, North-West corner rule, least cost method and Vogel's approximation method. Optimality test - MODI method.

ASSIGNMENT MODEL: Formulation, Hungarian method for optimal solution, solving unbalanced problem, Traveling salesman problem as assignment problem.

UNIT - III

SEQUENCING MODELS: Solution of Sequencing Problem, Processing n Jobs through two machines, Processing n Jobs through three machines, Processing two Jobs through m machines, Processing n Jobs through m Machines.

QUEUING THEORY: Introduction, Single Channel, Poisson arrivals, exponential service times with infinite population and finite population models.

UNIT - IV

REPLACEMENT MODELS: Replacement of Items that Deteriorate whose maintenance costs increase with time without change in the money value, Replacement of items that fail suddenly, individual replacement policy, group replacement policy.

INVENTORY MODELS: Inventory costs, Models with deterministic demand model: (a) Demand rate uniform and production rate infinite, (b) Demand rate non-uniform and production rate infinite, (c) Demand rate uniform and production rate finite.

UNIT - V

GAME THEORY: Competitive game, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle, Rectangular games without saddle point, mixed strategy for 2 X 2 games.

DYNAMIC PROGRAMMING: Characteristics of dynamic programming, Dynamic programming approach for priority management employment smoothening, Capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.

TEXT BOOKS:

1. A. M. Natarajan, P. Balasubramani, A. Tamilarasi (2006), *Operations Research*, Pearson Education, India.
2. S. D. Shama (2009), *Operation Research,* Tata McGraw Hill, New Delhi.

REFERENCE BOOKS:

1. J. K. Sharma (2007), *Operations Research – Theory and Applications,* 3rd edition, Macmillan India Ltd, India.
2. R. Panneerselvam (2008), *Operations Research*, 2nd edition, Prentice Hall of India, India.
3. F. S. Hillier, G. J. Lieberman (2007), *Introduction to Operations Research,* 8th edition, Tata McGraw Hill, New Delhi, India.

B. Tech. AE VI SEMESTER

AEROSPACE PROPULSION - II

Course Code: **A1718**

L	T	P	C
4	-	-	4

UNIT - I

GAS TURBINE THEORIES: Impulse and reaction balding of gas turbines, Velocity triangles and power output, Elementary theory, Vortex theory. Choice of blade profile, pitch and chord, Estimation of stage performance.

DESIGN CONSILRETIONS: Limiting factors in gas turbine design, Overall turbine performance. Methods of blade cooling, matching of turbine and compressor, Numerical problems.

UNIT - II

THRUST CONTROL: Thrust Augmentation through after burning, thrust vector control methods.

RAMJET PROPULSION: Operating principle Subcritical, critical and supercritical operation. Combustion in ramjet engine, Ramjet performance, Sample ramjet design calculations. Introduction to SCRAMJET, Preliminary concepts in supersonic combustion, Integral ram, Rocket, Numerical problems.

UNIT - III

CHEMICAL ROCKETS: *Solid Propellant:* Solid propellant rockets, Selection criteria of solid propellants, important hardware components of solid rockets, Propellant grain design considerations.

LIQUID PROPELLANT: Liquid propellant rockets, cooling in liquid rockets. Limitations of hybrid rockets, Relative advantages of liquid rockets over solid rockets.

UNIT - IV

FUNDAMENTALS OF ROCKET PROPULSION: Operating principle, Specific impulse of a rocket, internal ballistics, Rocket nozzle classifications. Rocket performance considerations, Numerical problems.

UNIT - V

ADVANCED PROPULSION TECHNIQUES: Electric rocket propulsion, Ion propulsion techniques, nuclear rocket - Types, Solar sail, Preliminary concepts in nozzle less propulsion.

TEXT BOOKS:

1. Sutton G. P. (2010), *Rocket Propulsion Elements*, 8th edition, John Wiley & Sons Inc, USA.
2. Philipa Hill, Carl Peterson (2010), *Mechanics and Thermodynamics of Propulsion*, 2nd edition, Addison Wesley Longman Inc, USA.

REFERENCE BOOKS:

1. Oates G. C (1986), *Aero Thermodyanamics of Aircraft Engine Components*, AIAA Educational Series, USA.
2. Rolls- Royce (2005), *Jet Engine*, 6th edition, Rolls - Royce Ltd, USA.
3. Ganesan V (2010), *Gas Turbines*, Tata McGraw- Hill, New Delhi.
4. S. M. Yahya(2010), *Fundamentals of Compressible Flow with Aircraft and Rocket propulsion*, 4th Edition, New Age International Publications, New Delhi.

B. Tech. AE VI SEMESTER

FLIGHT VEHICLE DESIGN

Course Code: **A1719**

L	T	P	C
3	1	-	4

UNIT - I

OVERVIEW OF THE DESIGN PROCESS, SIZING FROM A CONCEPTUAL SKETCH: Phases of aircraft design. Aircraft conceptual design process, project brief / request for proposal, problem definition, information retrieval, aircraft requirements, configuration options. Integrated product development and aircraft design. The initial conceptual sketches, L / D estimation. Initial takeoff weight build-up, empty weight estimation, historical trends, fuel fraction estimation, mission profiles, mission segment weight fractions.

UNIT - II

AIRFOIL AND GEOMETRY SELECTION, THRUST TO WEIGHT RATIO, WING LOADING: Airfoil selection, airfoil design, design lift coefficient, stall, airfoil thickness ratio and other airfoil considerations. Wing geometry and wing vertical location, wing tip shapes. Tail geometry and arrangements. Thrust to weight ratio, statistical estimation, thrust matching. Wing loading performance constraints. Selection of thrust-to-weight ratio and wing loading.

INITIAL SIZING AND CONFIGURATION LAYOUT, CREW STATION, PASSENGERS AND PAYLOAD: Sizing with fixed engine and with rubber engine. Geometry sizing of fuselage, wing, tail, control surfaces. Development of configuration lay out from conceptual sketch. The inboard profile drawing, wetted area, volume distribution and fuel volume plots. Lofting- definition, significance and methods, flat wrap lofting. Special consideration in configuration lay out. Isobar tailoring, Sears-Haack volume distribution, structural load paths. Radar, IR, visual detectability, aural signature. Considerations of vulnerability, crashworthiness, producibility, maintainability. Fuselage design, crew station, passenger compartment, cargo provisions, weapons carriage, gun installation.

UNIT - III

PROPULSION AND FUEL SYSTEM INTEGRATION, LANDING GEAR AND SUBSYSTEMS: Propulsion selection, jet engine integration, engine dimensions, inlet geometry, inlet location, capture area calculation, boundary layer diverters, nozzle integration, engine cooling provisions, engine size estimation. Fuel system design and integration. Landing gear arrangements, guidelines for lay out. Shock absorbers–types, sizing, stroke determination, gear load factors. Gear retraction geometry. Aircraft subsystems, significance to configuration lay out. The baseline design layout and report of initial specifications.

BASELINE DESIGN ANALYSIS- AERODYNAMICS & PROPULSION, STRUCTURES & WEIGHT AND BALANCE: Estimation of lift curve slope, maximum lift coefficient, complete drag build up. Installed performance of an engine, installed thrust methodology, net propulsive force, part power operation. Aircraft loads, categories: maneuver, gust, inertial, power plant, landing gear loads. Limit loads, the V, n diagram. Air load distribution on lifting surfaces. Review of methods of structural analysis. Material selection. Weights and moments statistical group estimation method, centre of gravity excursion control.

UNIT - IV

BASELINE DESIGN - STABILITY AND CONTROL, PERFORMANCE AND CONSTRAINT ANALYSIS: Estimation of static pitch stability, velocity stability and trim. Estimation of stability and control derivatives. Static lateral, directional stability and trim. Estimation of aircraft dynamical characteristics, handling qualities. Cooper – Harper scale, relation to aircraft dynamic characteristics. Performance analysis and constraint analysis– steady level flight, minimum thrust required for level flight, range and loiter endurance. Steady climbing and descending flight, best angle and rate of climb, time to climb and fuel to climb. Level turning flight, instantaneous turn rate, sustained turn rate. Energy maneuverability methods of optimal climb trajectories and turns. The aircraft operating envelope. Take off analysis, Balanced field length. Landing analysis. Fighter performance measures of merit. Effects of wind on aircraft performance. Initial technical report of baseline design analysis and evaluation. Refined baseline design and report of specifications.

COST ESTIMATION, PARAMETRIC ANALYSIS, OPTIMISATION, REFINED SIZING AND TRADE STUDIES: Elements of life cycle cost, cost estimating method, RDT&E and production costs, operation and maintenance costs, fuel and oil costs, crew salaries, maintenance expenses, depreciation. Cost measures of merit. Aircraft and airline economics, DOC and IOC, airline revenue, breakeven analysis, investment cost analysis. Parametric analysis and optimisation. Refined conceptual sizing methods. Sizing matrix plot and carpet plot. Trade studies, design trades, requirement trades, growth sensitivities. Multivariable design optimization methods. Measures of merit. Determination of final baseline design configuration, preparation of type specification report.

UNIT - V

CASE STUDIES AND DESIGN OF UNIQUE AIRCRAFT CONCEPTS: Design of the DC – 1, DC – 2, DC- 3 aircraft, Boeing B-47 and 707, General Dynamics F-16, SR-71 Blackbird, Northrop-Grumman B-2 Stealth Bomber. A survey of the Indian aircraft design effort. Design of VTOL aircraft, helicopters, hypersonic vehicles, delta and double delta wings, forward swept wings, uninhabited air vehicles.

TEXT BOOKS:

1. Raymer, Daniel P. (2006), *Aircraft Design: A Conceptual Approach*, 4th edition, AIAA Educational Series, USA.
2. J. F. Marchman, L. R. Jenkinson (2003), *Aircraft Design Projects for Engineering students*, AIAA Publishers, USA.
3. Ajoy Kumar Kunda (2010), *Aircraft Design,* Cambridge University Press, UK.

REFERENCE BOOKS:

1. Torenbeek E. (1986), *Synthesis of Subsonic Airplane Design*, Delft University Press, New York.
2. Bruhn. E. H (1973), *Analysis and Design of Flight Vehicles Structures*, New Edition, Jacobs Publishing House, USA.
3. Scheler E. E, Dunn L.G (1963), *Airplane Structural Analysis and Design*, John Wiley & Sons, USA.
4. D. Howe (2005), *Aircraft conceptual Design Synthesis,* John Wiley & Sons Publishers, USA.

B. Tech. AE VI Semester

FINITE ELEMENT MODELING AND ANALYSIS

Course Code: **A1720**

L	T	P	C
3	1	-	4

UNIT - I

MODELS: Macro and Micro mechanical models and Basis of the Finite Element-formulations for developing and specification structural models. Equilibrium and energy bases for designing such as stiffness, flexibility, Inertia, damping and stability characteristics. Degrees of freedom and their relevance's to approximate methods of analysis

GENERELIZED COORDINATES: Introduction to generalized coordinates and their classification based frames of reference (local/global), nature and utility. Field specific nature of such coordinates in time and space for representing both continuua and discontinua. Non dimensional coordinates, Area and Volume coordinates, utility of generalized coordinates in respresenting continuum and discrete systems.

UNIT - II

DISCRETIZATION: Role of interpolation (Hermitian and Langragian) functions in discretization, concepts of nodes and elements in discretizing 1-D and 2-D Solid fluid continuua. Examples of discretization of heat conduction shear axial, Torsional and Bending deformations of constant and stepped 1-D structures. Discretization of plane stress Plain strain and 3-D space frame problems

UNIT - III

PROPERTIES AND DERIVATION: Derivation of element property matrices from first principles, energy basis for deriving stiffness, mass element properties, Assembly Technique, Concept of work done and derivation of kinematically consistent load vectors Direct deduction of matrix equation of equilibria using assembly technique for property derivation for 1-D structures and frames.

APPROXIMATIONS AND ERROR CONTROL: Nodal parametric representation of discrete domains and fields. Isoparametric, Subparametric and Superparametric representation. Injection of singularity in field distortions and their utility in fracture mechanics.

UNIT - IV

MATHEMATICAL TOOLS AND FEM TOOLS: Importance of designing codes in discretizing. Illustration of 1-D and 2-D field problems. Basics of Numerical integration and Gauss quadrature. Techniques of data storage and solution of storage of large scale matrices. Concept of bandwidth and Front widths and their minimization. In core, and out of core solution of based on matrices. Frontal techniques.

UNIT - V

CONCEPTS OF SYMMETRY: Symmetries in 1-D, 2-D Structures including Axisymmetry. Symmetry Operations and Symmetry boundary conditions for fractional models in Analysis

MESH GENERATION TECHNIQUES: Using Commercial software's such as ANSYS, NISA, NASTRAN, ASKA, CAEFEM etc.

TEXT BOOKS:

1. S. S. Rao (2012), *The Finite Element Methods in Engineering*, Elsevier, USA.

REFERENCES BOOKS:

1. Segarlind L. J (2011), *Applied Finite Element Analysis*, Wiley India Limited, New York.
2. Desai C. S, Abel J. F(2001) , *An introduction to the Finite Element Method*, CRC Press, New Delhi.
3. Bathe K. J, Wilson E. L (1985), *Numerical Methods in Finite Element Analysis*, Prentice Hall of India, New Delhi.
4. Daryl Logan (2007), *A first course in the Finite Element Method*, Nelson Engineering Publishers, New Delhi.

B. Tech. AE VI SEMESTER

AIR POLLLUTION AND CONTROL METHODS

Interdepartmental Elective - I
(Common to AE, EEE & ME)

Course Code: **A1148**

L	T	P	C
4	-	-	4

UNIT - I

AIR POLLUTION: Definitions, scope, significance and episodes, air pollutants – classifications - natural and artificial - primary and secondary, point and non- point, line and areal sources of air pollution- stationary and mobile sources. Effects of air pollutants on man, material and vegetation: global effects of air pollution - green house effect, heat islands, acid rains, ozone holes etc.

UNIT - II

THERMODYNAMICS AND KINETICS OF AIR - POLLUTION: Applications in the removal of gases like SOx, NOx, CO, HC etc., air-fuel ratio. Computation and Control of products of combustion. Meteorology and plume Dispersion,

UNIT - III

PROPERTIES OF ATMOSPHERE: Heat, Pressure, Wind forces, Moisture and relative Humidity, Influence of Meteorological phenomena on Air Quality-wind rose diagrams.

LAPSE RATES: Pressure Systems, Winds and moisture plume behavior and plume Rise Models; Gaussian Model for Plume Dispersion.

UNIT - IV

CONTROL OF PARTICULATES: Control at Sources, Process Changes, Equipment modifications, Design and operation of control. Equipment's – Settling Chambers, Centrifugal separators, filters Dry and Wet scrubbers, Electrostatic precipitators. General Methods of Control of NOx and Sox emissions – In-plant Control Measures, process changes, dry and wet methods of removal and recycling.

UNIT - V

AIR QUALITY MANAGEMENT: Monitoring of SPM, SO; NO and CO Emission Standards.

TEXT BOOKS:

1. M. N. Rao, H. V. N. Rao (1988), *Air pollution*, Tata McGraw Hill Education, New Delhi, India.
2. C. S. Rao (2006), *Environmental Pollution control Engineering*, New age international, New Delhi, India.

REFERENCE BOOKS:

1. R. K. Trivedy, P. K. Goel (2003), *Introduction to Air pollution*, ABD Publications, New Delhi, India.
2. Wark, Warner (1998), *Air pollution its origin and control,* Addison-Wesley, New York.

B .Tech. AE VI SEMESTER

SATELLITE AND RADAR COMMUNICATIONS

(Interdepartmental Elective - I)

Course Code: **A1441**

L	T	P	C
4	-	-	4

UNIT - I

ORIGIN OF SATELLITE COMMUNICATIONS: Historical Background, Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications, Future Trends of Satellite Communications.

SATELLITE SUBSYSTEMS: Attitude and orbit control system, telemetry, tracking, Command and monitoring, power systems, communication subsystems, Satellite antenna Equipment reliability and Space qualification.

UNIT - II

SATELLITE LINK DESIGN: Basic transmission theory, system noise temperature and G/T ratio, Design of down links, up link design, Design of satellite links for specified C/N, System design example.

MULTIPLE ACCESSES: Frequency division multiple access (FDMA) Inter modulation, Calculation of C/N. Time division Multiple Access (TDMA) Frame structure, Examples. Code Division Multiple access (CDMA).

UNIT - III

EARTH STATION TECHNOLOGY: Introduction, Transmitters, Receivers, Antennas, Tracking systems, Terrestrial interface, Primary power test methods.

INTRODUCTION TO RADAR: The Nature of Radar, Maximum unambiguous range, Radar waveforms, Simple form of Radar equation, Radar block diagram & Operation, Radar frequencies and applications, Related Problems.

UNIT - IV

RADAR EQUATION: Prediction of Range performance, Minimum detectable signal, Receiver Noise & SNR, Integration of Radar pulses, PRF & Range Ambiguities, System losses, Related Problems.

CW AND FREQUENCY MODULATED RADAR: Doppler Effect, CW Radar, Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, FM-CW Radar-Range and Doppler Measurement, FM-CW altimeter.

UNIT - V

MTI AND PULSE DOPPLER RADAR: Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter. Delay Line Cancellers, Filter Characteristics, Blind Speeds, Double Cancellation, MTI Radar Parameters, Limitations to MTI Performance. Non-coherent MTI, MTI versus Pulse Doppler Radar.

TRACKING RADAR: Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar - Amplitude Comparison Monopulse (one- and two- coordinates), Phase Comparison Monopulse.

TEXT BOOKS:

1. Timothy Pratt (2003), *Satellite Communications,* 2nd edition, Wiley Publications, India.
2. Merill I. Skolnik (2007), *Introduction to Radar Systems*, 2nd edition, Tata McGraw-Hill, India.

REFERENCE BOOKS:

1. M. Richharia (2003), *Satellite Communications: Design Principles*, 2nd edition, BS publications, India.
2. Dennis Roddy (2006), *Satellite Communications*, 2nd edition, Tata McGraw-Hill, India.
3. Merill I. Skolnik (2001), *Introduction to Radar Systems*, 3rd edition, Tata McGraw-Hill, India.

B. Tech. AE VI SEMESTER

DIGITAL ELECTRONICS AND MICROPROCESSORS

Interdepartmental Elective - I

(Common to AE, ME & CE)

Course Code: **A1453**

L	T	P	C
4	-	-	4

UNIT - I

BINARY SYSTEMS: Digital Computers and Digital Systems, Binary Numbers, Number base conversions, Octal and Hexadecimal Numbers, complements, Signed binary numbers, Binary codes, Binary Storage and Registers, Binary Logic.

BOOLEAN ALGEBRA AND LOGIC GATES: Basic Definitions, Axiomatic definition of Boolean Algebra, Basic theorems and properties of Boolean algebra, Boolean functions canonical and standard forms, other logic operations, Digital logic gates.

UNIT - II

SIMPLIFICATION OF BOOLEAN FUNCTIONS: The map method, Two, three, four and five variable maps, product of sums simplification, NAND and NOR implementation, other Two-level implementations, Don't-care conditions, Tabulation method, determination and selection of prime implicants.

COMBINATIONAL LOGIC: Introduction, design procedure, Adders, Subtractors, magnitude comparator, Decoders, Encoders, Multiplexers, Demultiplexers, Code converters and Parity Generators.

UNIT - III

SEQUENTIAL LOGIC: Introduction, latches, Flip-Flops, truth tables and excitation tables, triggering OF flip-flops, Registers, shift Registers, Ripple counters, shift register counters (Ring, Johnson and LFSR Counters).

UNIT - IV

8085 MICROPROCESSOR: Introduction to microprocessors, Architecture of 8085, Pin Diagram of 8085, Timing Diagram, Addressing Modes, Instruction Set, Interrupt structure of 8085.

UNIT - V

MICROPROCESSOR PERIPHERAL INTERFACING: Methods of Interfacing I/O Ports: I/O Mapped I/O, Memory Mapped I/O, Programmable Peripheral interface 8255 – Various Modes of Operation and Interfacing to 8085, Need for DMA, DMA data transfer Method, Interfacing with DMA Controller 8257.

TEXT BOOKS:

1. M. Morris Mano (2012), *Digital Design,* 4th edition, Pearson Education/Prentice Hall of India, New Delhi, India.
2. Ramesh S. Goankar(2011), *Microprocessor Architecture, Programming and Applications with the 8085,* Prentice Hall of India, India.

REFERENCE BOOKS:

1. C. V. S. Rao (2010), *Switching Theory and Logic Design*, Pearson Education, India.
2. K. Uday Kumar, B. S. Uma Shankar (2008), *The 8085 Microprocessor Architecture, Programming and Interfacing*, Pearson Publications, India.

B. Tech. AE VI SEMESTER

CAD / CAM
(Interdepartmental Elective - I)

Course Code: **A1331**

L	T	P	C
4	-	-	4

UNIT - I

Computers in Industrial Manufacturing, Product cycle, CAD / CAM Hardware, Basic structure, CPU, Memory types, input devices, display devices, hard copy devices, storage devices.

COMPUTER GRAPHICS: Raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, 3D transformations, mathematics of projections, clipping, hidden surface removal.

UNIT - II

GEOMETRIC MODELING: Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired.

DRAFTING AND MODELING SYSTEMS: Basic geometric commands, layers, display control commands, editing, dimensioning, solid modeling.

UNIT - III

NUMERICAL CONTROL: NC, NC modes, NC elements, NC machine tools, structure of CNC machine tools, features of Machining center, turning center, CNC Part Programming: fundamentals, manual part programming methods, Computer Aided Part Programming.

GROUP TECH: Part family, coding and classification, production flow analysis, advantages and limitations, Computer Aided Processes Planning, Retrieval type and Generative type.

UNIT - IV

COMPUTER AIDED QUALITY CONTROL: Terminology in quality control, the computer in QC, contact inspection methods, non contact inspection methods-optical, non contact inspection methods-non optical, computer aided testing, integration of CAQC with CAD/CAM.

UNIT - V

COMPUTER INTEGRATED MANUFACTURING SYSTEMS: Types of Manufacturing systems, Machine tools and related equipment, material handling systems, computer control systems, human labor in the manufacturing systems, CIMS benefits.

TEXT BOOKS:

1. A. Zimmers, P. Groover (2010), *CAD / CAM*, 3 rd edition, Prentice Hall of India, New Delhi.
2. Ibrahim Zeid(2011), *CAD / CAM Theory and Practice*, 4th edition, Tata McGraw Hill education (P) Ltd, New Delhi, India.

REFERENCE BOOKS:

1. P. Groover(2011), *Automation, Production systems and Computer integrated Manufacturing*, 3rd edition, Pearson Publications, India.
2. Radhakrishnan, Subramanian (2009), *CAD / CAM / CIM*, New Age Inetrnational Pvt. Ltd, New Delhi, India.
3. Alavala, C. R (2012), *CAD/CAM: Concepts and Applications*, 1st edition, Prentice Hall of India, New Delhi, India.

B. Tech. AE VI SEMESTER

ROBOTICS

Interdepartmental Elective – I

(Common to AE & EEE)

Course Code: **A1337**

L	T	P	C
4	-	-	4

UNIT - I

INTRODUCTION: Automation and Robotics, CAD/CAM and Robotics, an over view of Robotics, present and future applications – classification by coordinate system and control system.

COMPONENTS OF THE INDUSTRIAL ROBOTICS: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

UNIT - II

MOTION ANALYSIS: Homogeneous transformations as applicable to rotation and translation, problems.

MANIPULATOR KINEMATICS: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics, problems.

UNIT - III

MANIPULATOR DYNAMICS - I: Differential transformation and manipulators, Jacobians, problems. Dynamics: Lagrange, Euler and Newton, Euler formations, Problems.

MANIPULATOR DYNAMICS - II: Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion, straight line motion, Robot programming, languages and software packages.

UNIT - IV

ROBOT ACTUATORS AND FEEDBACK COMPONENTS: Actuators: Pneumatic, Hydraulic actuators, electric and stepper motors. Feedback components: position sensors, potentiometers, resolvers, encoders, Velocity sensors.

UNIT - V

ROBOT APPLICATION IN MANUFACTURING: Material Transfer, Material handling, loading and unloading, Processing spot and continuous arc welding & spray painting, Assembly and Inspection.

TEXT BOOKS:

1. M. P. Groover (2010), *Industrial Robotics*, 3rd edition, Pearson Education, New Delhi.
2. K. S. Fu (2010), *Robotics*, 1st edition, Tata Mc Graw Hill Publishing Company Ltd., New Delhi.

REFERENCE BOOKS:

1. R.K. Mittal, I. J. Nagrath (2012), *Robotics and Control*, 1st edition, Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
2. P. Coiffet, M. Chaironze (2010), *An Introduction to Robot Technology*, 3rd edition, Kogam Page Ltd., London.
3. Richard D. Klafter(2010), *Robotic Engineering*, 2nd edition, Prentice Hall of India, New Delhi.

B. Tech. AE VI SEMESTER

COMPOSITE MATERIALS

(Interdepartmental Elective - I)

Course Code: **A1338**

L	T	P	C
4	-	-	4

UNIT - I

INTRODUCTION: Definition, Classification of Composite materials based on structure based on matrix. Advantages of composites, application of composites, functional requirements of reinforcement and matrix.

UNIT - II

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.

UNIT - IV

MANUFACTURING OF METAL MATRIX COMPOSITES: Casting, Solid State diffusion technique, Cladding - Hot isostatic pressing. *Manufacturing of Ceramic Matrix Composites:* Liquid Metal Infiltration, Liquid phase sintering. *Manufacturing of Carbon – Carbon composites*: Knitting, Braiding, Weaving.

UNIT - V

RESPONSE OF COMPOSITES TO STRESS: (a) Iso Strain condition (b) Iso Stress condition (c) Load friction shared by the fibers.

TEXT BOOKS:

1. V. C. H. Cahn (2007), *Materia*l *Science and Technology*, Vol. 13, 3rd edition, Wiley WCH, West Germany.
2. K. K. Chawla (2010), *Composite Materials,* 2nd edition*,* Springer*,* USA.

REFERENCE BOOKS:

1. E. D. Lubin (2003), *Hand Book of Composite Materials*, 3rd edition, Tata McGraw-Hill, New Delhi, India.
2. Muhammad M. Rafique (2009), *Composite Materials: Processing and Technology,* 2nd edition, Academy Press, Lap Lambert.
3. P. K. Sinha (2006), *Composite Materials and structure*, IIT Kharagpur, India.

B. Tech. AE VI SEMESTER

FLIGHT VEHICLE DESIGN AND SIMULATION LAB

Course Code: **A1721**

L	T	P	C
-	-	3	2

FLIGHT VEHICLE DESIGN LAB

1. Objectives Requirements of the vehicle
2. Conceptual Sketch and first estimate of weight
4. Initial Sizing
5. Fuselage and control surfaces
6. Configuration layout.
7. Performance and stability Estimate
8. Load estimates

SIMULATION LAB

1. Falling sphere with viscous drag – Investigate velocity versus time plot and simulate the fall.
2. Frequency response for a spring-mass system; simulation of the oscillations.
3. Digital simulation of Analog Computations.
4. Simulate a bomb drop from an aircraft on a moving tank for pure –pursuit motion.
5. Simulate an Air Speed Indicator to read air speeds for the pressures read from a Pitot-static tube, with compressibility corrections.
6. Simulate a runaway.
7. Simulate a point take-off from a runaway.

B. Tech. AE VI SEMESTER

AERODYNAMICS AND PROPULSION LAB

Course Code: **A1722**

L	T	P	C
-	-	3	2

AERODYNAMICS LAB

1. Fluid flow studies using blower
2. Calibration of low speed wind tunnel
3. Drag of different bodies
4. Pressure distribution studies on two-dimensional models
5. Pressure distribution over an airfoil at different angles of attack
6. Aero dynamic Characterization on NACA - 0012 Air Foil
7. Axial Flow Compressor
8. Centrifugal Flow Compressor
9. Flow Visualization Techniques.

PROPULSION LAB

1. Study of piston engine (Valve Timing and Port Timing Diagram)
2. Stripping of a piston engine, visual inspection and reasoning for common troubles and trouble shooting
3. Performance of piston engine
4. Heat Balance Test on piston engine
5. Engine Balancing
6. Characterization of Aviation fuels

EQUIPMENT NEEDED

1. Low Speed Wind-tunnel Test Rig with a test section of 1 meter X 1 meter with necessary accessories.
2. Test Rig for Axial flow Compressor
3. Test rig for centrifugal flow compressor.
4. Heat Engine Test Rig.
5. Balancing test Rig
6. Calorimeter apparatus
7. Piston Engine

SYLLABI FOR VII SEMESTER

B. Tech. AE VII SEMESTER

HEAT TRANSFER

Course Code: **A1326**

L	T	P	C
4	-	-	4

UNIT - I

INTRODUCTION: Modes and mechanisms of heat transfer, Basic laws of heat transfer, Applications of heat transfer. General three dimensional heat conduction equations in Cartesian, Cylindrical and Spherical coordinates. Different forms of general equation, Steady state and Transient heat transfer, Initial and boundary conditions.

UNIT - II

CONDUCTION HEAT TRANSFER: One dimensional steady state heat conduction through Homogeneous slabs, hollow cylinders and spheres, Overall heat transfer coefficient, Electrical analogy, Critical radius of insulation. Systems with variable thermal conductivity and Systems with internal heat generation. Extended surfaces (Fins), Long, Short and insulated tips.

ONE DIMENSIONAL TRANSIENT HEAT CONDUCTION: Systems with negligible internal resistance, Significance of Biot and Fourier Numbers, Chart solutions of transient conduction systems.

UNIT - III

CONVECTIVE HEAT TRANSFER: Concepts of Continuity, Momentum and Energy Equations. Dimensional analysis-Buckingham's Pi Theorem - Application for developing non-dimensional correlation for convective heat transfer.

FORCED CONVECTION: External Flows**,** Concepts of hydrodynamic and thermal boundary layer and use of empirical correlations for Flat plates and Cylinders. Internal Flows**,** Concepts about Hydrodynamic and Thermal Entry Lengths, use of empirical correlations for Horizontal Pipe Flow and annulus flow.

FREE CONVECTION: Development of Hydrodynamic and thermal boundary layer along a vertical plate , Use of empirical relations for Vertical plates and pipes.

UNIT - IV

BOILING AND CONDENSATION: Regimes of Pool boiling and Flow boiling, Critical heat flux, Calculations on Nucleate Boiling. Film wise and drop wise condensation, Nusselt's theory of condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

HEAT EXCHANGERS: Classification of heat exchangers, overall heat transfer Coefficient and fouling factor, Concepts of LMTD and NTU methods, Problems using LMTD and NTU methods.

UNIT - V

RADIATION HEAT TRANSFER: Emission characteristics , Laws of black-body radiation, Irradiation ,Total and monochromatic quantities , Laws of Planck, Wien, Kirchhoff, Lambert, Stefan and Boltzmann , Heat exchange between two black bodies , concepts of shape factor , Emissivity ,heat exchange between grey bodies , radiation shields ,electrical analogy for radiation networks.

TEXT BOOKS:

1. Yunus A. Cengel (2012), *Heat Transfer a Practical Approach*, 4th edition, Tata McGraw hill education (P) Ltd, New Delhi, India.
2. R. C. Sachdeva (2012), *Fundamentals of Engineering, Heat and Man Transfer*, 3rd edition, New Age, New Delhi, India.

REFERENCE BOOKS:

1. Holman (2012), *Heat Transfer (SI Units)*, 10th edition, Tata McGraw hill education (P) Ltd, New Delhi, India.
2. P. S. Ghoshdastidar (2012), *Heat Transfer*, 2nd edition, Oxford University Press, New Delhi, India.
3. Incropera, Dewitt (2012), *Fundamentals of Heat Transfer*, 6th edition, John Wiley, UK.

B. Tech. AE VII SEMESTER

COMPUTATIONAL FLUID DYNAMICS

Course Code: **A1723**

L	T	P	C
4	-	-	4

UNIT - I

BASICS: Introduction to computational fluid dynamics, Research tool, Design Tool, Finite control volume, infinitesimal fluid element, substantial derivatives, divergence of Velocity.

GOVERNING EQUATIONS OF FLUID DYNAMICS: The continuity equation, the momentum equation, the energy equation, physical boundary conditions.

UNIT - II

SHOCK FITTING AND SHOCK CAPTURING: Form of Governing equation suited for CFD. Conservation form, shock fitting and shock capturing.

IMPACT OF PARTIAL DIFFERENTIAL EQAUTIONS ON CFD: Introduction, Classification of Quasi-Linear Partial differential equation, The Eigen value method, General behavior of different classes of Partial differential equation, elliptic, parabolic and hyperbolic.

UNIT - III

DISCRETIZATION: Introduction, Finite differences, difference equations, Explicit and implicit approaches, Errors and an analysis of stability.

TRANSFORMATIONS: Introduction, transformation of the governing partial differential equations, Matrices and the Jacobian of transformation.

UNIT - IV

GRID GENERATIONS - I: Grid Generation techniques, Elliptic Grid Generator, Simply connected domain, doubly connected domain.

UNIT - V

GRID GENERATIONS - II: Coordinate system control, Grid Point clustering, Introduction to Hyperbolic Grid Generation techniques and parabolic grid generator.

TEXT BOOKS:

1. T. J. Chung (2010), *Computational Fluid Dynamics*, 2nd edition, Cambridge University Press, Cambridge, UK.
2. John D. Anderson (2010), *Computational Fluid Dynamics*, McGraw Hill, New Delhi.
3. John C. Tannehill, Richard H. Pletcher (1997), *Computational Fluid Mechanics and Heat transfer*, 2nd edition, Taylor & Francis Group, New York.

REFERENCE BOOKS:

1. Ronnie Anderson (2012), *Computational Fluid Dynamics for Engineers*, Cambridge University Press, Cambridge, UK.
2. Jean-Jacques Chattot (2010), *Computational aerodynamics and fluid dynamics an introduction*, Springer, Germany.

B. Tech. AE VII SEMESTER

VIBRATIONS AND STRUCTURAL DYNAMICS

Course Code: **A1724**

L	T	P	C
3	1	-	4

UNIT - I

INTRODUCTION: Simple harmonic motion, terminology, Newton's Law, D'Alembert's Prinicple, Resonance, Introduction to mechanism of damping. Damped and Undamped oscillations. Degrees of freedom. Various mechanisms of damping. Equivalent viscous damping.

SINGLE DEGREE OF FREEDOM SYSTEMS: Free vibrations, free damped vibrations, forced vibrations with and without damping. Support excitation and vibration measuring instruments. Amplitude and Phase response diagrams. Generalized single degree of freedom systems for continuous structures and computation of K, M and C.

UNIT - II

MULTI DEGREE OF FREEDOM SYSTEMS: Two / Three degree of freedom systems, static and dynamic coupling, vibration absorbers, Principal coordinates, Principal modes, Othogonality conditions Hamilton's Principle, Lagrange's equation and application. Longitudinal vibration, lateral vibration, torsional vibration of shafts, dynamical equations of equilibrium of elastic bodies, natural frequencies and modeshapes determination.

UNIT - III

METHODS: determining natural frequencies and mode shape. Natural Vibrations of solid continua. Determination of Eigen Values and Eigen modes.

SHAFTS: Natural frequency of rotating shafts Whirling of shafts. Dynamic balancing of rotating shafts. Dynamic dampers.

UNIT - IV

APPROXIMATE METHODS FOR FREQUENCY: Introduction to approximate methods for frequency analysis Rayleigh Ritz method for vibration analysis. Diagonalization of stiffness, mass and damping matrices using orthogonality conditions.

UNIT - V

MATRICES FOR DYNAMIC ANALYSIS: Introduction to Matrices for dynamic analysis, Kinematically consistent Load systems and determination of [K], [M], [C] and [L] matrices. Normalization and formulation of modal equations. Steady state response, using fourier analysis for decomposing complex periodie load functions, of modal equations using S-plane representation. Transient response analysis of modal equations using Duhamel's integrals.

TEXT BOOKS:

1. R. W. Clough and Penzien (2010), *Dynamics of Structures*, 2nd edition, McGraw Hill, New Delhi.
2. S. S. Rao (2011), *Mechanical Vibrations*, 5th edition, Prentice Hall of India, New Delhi.
3. J. S. Rao, Gupta K. (2002), *Theory and practice of Mechanical vibrations*, Wiley Eastern Ltd, USA.

REFERENCE BOOKS:

1. Fug Y. C. (2008), *An Introduction to Theory of Aeroelasticity*, Dover Publications, US
2. Timoshenko S (2011), *Vibration Problems in Engineering*, 2nd edition, Oxford city press, USA.
3. Cyril M. Harris (2010), *Harris' shock and vibration handbook,* 6th edition, McGraw- Hill, New Delhi.

B. Tech. AE VII SEMESTER

AVIONICS
(Common to AE & ECE)

Course Code: **A1725**

L	T	P	C
4	-	-	4

UNIT - I

BASICS: Basic principles of Avionics, Typical avionics sub system in civil/ military aircraft and space vehicles.

FLIGHT DECK AND DISPLAY SYSTEMS: Flight deck display technologies, CRT, LED, LCD, Touch screen, Head up display, Electronic instrumentation systems.

UNIT - II

AUDIO AND COMMUNICATION SYSTEMS: Aircraft audio systems, basic audio transmitter and receiver principles, VHF communication system, UHF communication systems.

UNIT - III

RANGING AND LANDING SYSTEMS: VHF Omnirange, VOR receiver principles, distance maturity equipment, principles of operation, Instrument landing system, localizer and glideslope.

POSITIONG SYSTEM: Global positioning system principles, triangulation, position accuracy, applications in aviation.

UNIT - IV

INERTIAL NAVIGATION SYSTEM: Principle of Operation of INS, navigation over earth, components of inertial Navigation systems, accelerometers, gyros and stabilized platform.

SURVELLIENCE SYSTEM: ATC surveillance systems principles and operation interrogation and replay standards, Collision avoidance system, ground proximity warning system.

UNIT - V

AUTO FLIGHT SYSTEM: Automatic flight control systems fly by wire and fly by light technologies, flight director systems, flight management systems. Integrated Data transfer methodology by use of MILS - STD - 1553/ ARINC - 429.

TEXT BOOKS:

1. N. S. Nagaraja(1996), *Elements of electronic navigation*, 2nd edition, Tata McGraw Hill, New Delhi.
2. Janes W. Wasson, Jeppesen Sandersen(1994), *Avionic systems Operation and maintenance*, Sterling Book House, Mumbai.

REFERENCE BOOKS:

1. Albert Hel Frick (2010), *Principle of Avionics*, 6th edition, Avionics Communications Inc, India.
2. E. H. J. Pallet (2010), *Aircraft Instrumentation and Integrated systems*, Pearson Education, New Delhi.
3. J. Powell (1998), *Aircraft Radio Systems*, Pitman publishers, London.

B. Tech. AE VII SEMESTER

HUMAN VALUES AND ETHICS

Interdepartmental Elective - II

(Common to AE, EEE, ME & CE)

Course Code: **A1016**

L	T	P	C
4	-	-	4

UNIT - I

HUMANVALUES: Morals, values and ethics, integrity, work ethic, service learning, civic virtue, respect for others, living peacefully, caring, sharing, honesty, courage, valuing time, co-operation, commitment, empathy, self-confidence, character and spirituality.

UNIT - II

ENGINEERING ETHICS: Senses of 'Engineering Ethics', variety of moral issued, types of inquiry, moral dilemmas, moral autonomy, Kohlberg's theory, Gilligan's theory, consensus and controversy, models of professional roles, theories about right action, self-interest, customs and religion, uses of ethical theories.

UNIT - III

ENGINEERING AS SOCIAL EXPERIMENTATION: Engineering as experimentation, engineers as responsible experimenters, codes of ethics, a balanced outlook on law, the challenger case study.

UNIT - IV

SAFETY, RESPONSIBILITIES AND RIGHTS: Safety and risk, assessment of safety and risk, risk benefit analysis and reducing risk, the Three Mile Island and Chernobyl case studies. Collegiality and loyalty, respect for authority, collective bargaining, confidentiality, conflicts of interest, occupational crime, professional rights, employee rights, Intellectual Property Rights (IPR), discrimination.

UNIT - V

GLOBAL ISSUES: Multinational corporations, environmental ethics, computer ethics, weapons development, engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of ethics like ASME, ASCE, IEEE, institution of engineers (India), Indian institute of materials management, institution of electronics and telecommunication engineers (IETE),India, etc.

TEXT BOOKS:

1. Mike Martin, Roland Schinzinger(1996), *Ethics in Engineering*, McGraw-Hill, New York.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S (2004), *Engineering Ethics*, Prentice Hall of India, New Delhi, India.

REFERENCE BOOKS:

1. Charles D. Fleddermann(2004), *Engineering Ethics*, Pearson Education / Prentice Hall, New Jersey.
2. Charles E Harris, Michael S. Protchard, Michael J Rabins(2000), *Engineering Ethics - Concepts and Cases*, Wadsworth Thompson Learning, United States.
3. John R Boatright(2003), *Ethics and the Conduct of Business*, Pearson Education, New Delhi.
4. Edmund G Seebauer and Robert L Barry, (2001), *Fundamentals of Ethics for Scientists and Engineers,* Oxford University Press, New York.

B. Tech. AE VII SEMESTER

HUMAN RESOURCE MANAGEMENT

Interdepartmental Elective - II

(Common to AE, EEE, ME & CE)

Course Code: **A1017**

L	T	P	C
4	-	-	4

UNIT - I

INTRODUCTION HUMAN RESOURCE MANAGEMENT: Introduction and significance of HRM, Scope, functions of HRM, changing environment of HRM and Challenges. Human Resource Planning, Objectives, Factors influencing Human Resource planning, HR Planning Process.

UNIT - II

JOB ANALYSIS AND RECRUITMENT: Process and Sources of Recruitment; Selection, process of selection and techniques, Retention of Employees.

UNIT - III

HUMAN RESOURCES DEVELOPMENT: Training Vs Development, Need, Process of training, Methods of training, Training Evaluation, Career planning, Performance Management System, Methods of Appraisal, Common Errors.

UNIT - IV

COMPENSATION MANAGEMENT: Concepts and components of wages, Factors influencing wage fixation, Job evaluation, Methods of payment, Incentives and Fringe benefits.

UNIT - V

MANAGING INDUSTRIAL RELATIONS: Components of Industrial Relation, Trade Unions, functions of Trade Union, Employee Participation, Importance and Schemes, Collective Bargaining, Grievance Redressal, Industrial Dispute Settlement machinery.

TEXT BOOKS:

1. Biswajeet Pattnayak (2009), *Human Resource Management*, Prentice hall of India, New Delhi, India.
2. R. Wayne Mondy and Robert M. Noe (2009), *Human Resource Management*, Pearson, India.

REFERENCE BOOKS:

1. Aswathappa. K. (2007), *Human Resources and Personnel Management*, Tata MC Graw Hill, New Delhi, India.
2. Monappa. A, Saiyadain. M. (1979), *Personnel Management*, Tata Mc Graw Hill, New Delhi, India.
3. C. B. Mamoria (2003), *Personnel Management*, Himalaya Publishing House, India.

B. Tech. AE VII SEMESTER

ENTERPRENEURSHIP

Interdepartmental Elective - II

(Common to AE, EEE, ME & CE)

Course Code: **A1018**

L	T	P	C
4	-	-	4

UNIT - I

ENTREPRENEURSHIP: Importance and role of entrepreneurship, Characteristics of entrepreneurship, Qualities of an entrepreneur, Functions of entrepreneur; Theories of entrepreneurship, Stimulants of entrepreneurship and Barriers to entrepreneurship, Ethics and Social Responsibility, Role of entrepreneur in economic development.

UNIT - II

INSTITUTIONAL SUPPORT: Role of Government; Role of IDBI, SIDBI, SIDO, NIESBUD, SISI, DIC, Entrepreneurship Development Institute, MSMEs.

UNIT - III

WOMEN ENTREPRENEURSHIP: Role & Importance, Functions of women entrepreneur, Profile of Indian Women Entrepreneur, Problems of Women Entrepreneurs, Women Entrepreneurship Development in India and in Foreign Countries.

UNIT - IV

PROJECT MANAGEMENT: Concept of project and classification of project identification, project formulation - project report - project design, Project appraisal - profitability appraisal - project planning - social cost benefit analysis - financial analysis and project financing.

UNIT - V

TRAINING: Designing appropriate training programmes to inculcate Entrepreneurial Spirit, significance of entrepreneurial training, Training for New and Existing Entrepreneurs, Feedback and Performance of Trainees.

TEXT BOOKS:

1. Robert Hisrich, Michael P. Peter, Dean A. Shepherd (2010), E*ntrepreneurship*, Tata Mc Graw Hill, New Delhi.

REFERENCE BOOKS:

1. Bholanath Datta (2009), *Entrepreneurship*, Excel publications, India.
2. David H Holt (2010), *Entrepreneurship*, Prentice hall of India, New Delhi, India.

B. Tech. AE VII SEMESTER

BUSINESS COMMUNICATION

Interdepartmental Elective - II

(Common to AE, EEE, ME & CE)

Course Code: **A1019**

L	T	P	C
4	-	-	4

UNIT - I

INTRODUCTION TO MANAGERIAL COMMUNICATION: Meaning, Importance and objectives, Principles of Communication, Forms of communication, Communication Process, Barriers To effective communication, Gateways to effective communication.

UNIT - II

NONVERBAL COMMUNICATION: Body Language, Gestures, Postures, Facial Expressions, Dress Code. Listening and Speaking Skills, Probing questions, Observation, Business and Social etiquette.

UNIT - III

MANAGERIAL SPEECHES: Principles of Effective Speech & Presentations. Technical and Non-technical presentations. Speech of introduction, speech of thanks, occasional speech, theme speech, Use of audio visual aids.

UNIT - IV

INTERVIEW TECHNIQUES: Mastering the art of conducting and giving interviews, Placement interviews, discipline/technical interviews, appraisal interviews, exit Interviews. *Group communication*: Importance, Meetings, group discussions, Video conferencing.

UNIT - V

INTRODUCTION TO BUSINESS CORRESPONDENCE: *Business letters*: Enquiries, Circulars, Quotations, Orders, Acknowledgments, Executions, Complaints, Persuading letters, Sales letters, Job application letters, Bio-data, Covering Letter, Interview Letters, Letter of Reference, Memos, minutes, Circulars and Notices. *Reports:* Types of Business Reports - Format, Choice of vocabulary, Coherence, paragraph writing, organization reports by individual, Report by committee.

TEXT BOOKS:

1. Lesikar R. V, Flatley M. E (2005), *For Empowering the Internet Generation*, Tata McGraw Hill Publishing Company Ltd., New Delhi, India.
2. Ludlow. R, Panton. F (1998), *The Essence of Effective Communications*, Prentice Hall of India Pvt. Ltd., New Delhi, India.

REFERENCE BOOKS:

1. Adair .J (2003), *Effective Communication,* Pan Macmillan, London.
2. Pan Mcmillan Thill J. V, Bovee G. L (1993), *Excellence in Business Communication,* Tata McGraw Hill, New York.
3. Bowman J.P, Branchaw P. P (1987), *Business Communications: From Process to Product*, Dryden Press, Chicago.

B. Tech. AE VII SEMESTER

INTELLECTUAL PROPERTY AND PATENT RIGHTS

(Interdepartmental Elective - II)

Common to AE, EEE, ME & CE

Course Code: **A1020**

L	T	P	C
4	-	-	4

UNIT - I

INTRODUCTION TO INTELLECTUAL PROPERTY: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT - II

TRADE MARKS: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark' trade mark registration processes.

UNIT - III

LAW OF COPY RIGHTS : Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right regisffation, notice of copy right' international copy right law.

LAW OF PATENTS: Foundation of patent law, patent searching process' ownership rights and transfer.

UNIT - IV

TRADE SECRETS: Trade secrete law, determination of trade secrete status' liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

UNFAIR COMPETITION: Misappropriation right of publicity, false advertising.

UNIT - V

NEW DEVELOPMENT OF INTELLECTUAL PROPERTY: New developments in trade mark law; copy right law patent law, intellectual property audits'. International overview on intellectual property, international - trade mark law, copy right law, international patent law, and international development trade secrets law.

TEXT BOOKS:

1. Deborah. E. Bouchoux (2009*), Intellectual property*, Cengage learning, India.
2. Deborah. E. Bouchoux (2001), *Protecting your companies intellectual property*, AMACOM, USA.

REFERENCE BOOKS:

1. Prabudda ganguli (2003), *Intellectual property right*, Tata McGraw Hill Publishing company ltd., India.
2. Robert Hisrich, Michael P. Peter, Dean A. Shepherd (2010), *Entrepreneurship*, Tata Mc Graw Hill, India.

B. Tech. AE VII SEMESTER

PROJECT PLANNING AND MANAGEMENT

Interdepartmental Elective - II

(Common to AE, EEE, ME & CE)

Course Code: **A1021**

L	T	P	C
4	-	-	4

UNIT - I

PERT AND CPM : Introduction, origin of PERT and CPM, planning, scheduling and controlling, bar charts, milestone charts, weaknesses in bar charts, PERT and CPM networks comparison, event, activity, rules for drawing networks, numbering the events (Fulkerson's law), dummy activities.

UNIT - II

CPM - PERT NETWORK ANALYSIS : Time estimate, expected time, earliest allowable occurrence time, latest allowable occurrence time, slack, project duration, probability of completion, start and finish time estimates, floats, project scheduling, critical and sub-critical path. Updating - process of updating, when to update.

UNIT - III

CPM COST MODEL AND RESOURCES ALLOCATIONS, RESOURCE SCHEDULING : Cost analysis, direct and indirect costs, operation time, normal and crash times and costs, optimizing project cost, crash limit, free float limit, optimization. Resource smoothening, resource leveling.

UNIT - IV

MANAGEMENT: Scope of construction management, significance of construction management, concept of scientific management, psychology in management, a historical account of management philosophy, qualities of manager, the roles/functions performed by effective and competent managers, the manager - as a decision maker, as a motivator, as a communication-link, as a conflict resolver, as a well wisher of co-employees and the employer etc.

UNIT - V

ORGANIZATION: Types of organization, merits and demerits of different types of organization, authority, policy, recruitment process and training; development of personnel department; labor problems; labor legislation in India; 'workmen's compensation act of 1923 and minimum wages act of 1948', and subsequent amendments. Safety in construction.

TEXT BOOKS:

1. Punmia, Khandelwal (2006), *Project planning and control with PERT and CPM*, 3rd edition, Laxmi Publications, New Delhi, India.

REFERENCE BOOKS:

1. L. S. Srinath (1975), *PERT and CPM*, 2nd Edition, Afflicted East West Press Pvt. Ltd, New Delhi, India.
2. U. K. Shrivastava (1999), Construction Planning and Management, Galgotia Publications Pvt. Ltd., New Delhi.

B. Tech. AE VII SEMESTER

SPACE MECHANICS
(Professional Elective - I)

Course Code: **A1726**

L	T	P	C
3	1	-	4

UNIT - I

BASIC CONCEPTS: The solar system, Reference frames and coordinate systems, The celestial sphere, The ecliptic, Motion of vernal equinox, Sidereal time, Solar Time, Standard Time, The earth's atmosphere

THE GENERAL N-BODY PROBLEM: The many body problem, Lagrange-Jacobi identity. The circular restricted three-body problem, Libration points, Relative Motion in the N-body problem

UNIT - II

THE TWO-BODY PROBLEM: Equations of motion-General characteristics of motion for different orbits-Relations between position and time for different orbits, Expansions in elliptic motion, Orbital Elements. Relation between orbital elements and position and velocity.

THE LAUNCHING OF A SATELLITE: Launch vehicle ascent trajectories, General aspects of satellite injection. Dependence of orbital parameters on in-plane injection parameters, Launch vehicle performances, Orbit deviations due to injection errors

UNIT - III

PERTURBED SATELLITE ORBITS: Special and general perturbations- Cowell's Method, Encke's method. Method of variations of orbital elements, General perturbations approach

INTERPLANETARY TRAJECTORIES: Two-dimensional interplanetary trajectories, Fast interplanetary trajectories, Three dimensional interplanetary trajectories. Launch of interplanetary spacecraft. Trajectory about the target planet

UNIT - IV

BALLISTIC MISSILE TRAJECTORIES: The boost phase, the ballistic phase, Trajectory geometry, optimal flights. Time of flight, Re-entry phase. The position of the impact point, Influence coefficients.

UNIT - V

LOW-THRUST TRAJECTORIES: Equations of Motion. Constant radial thrust acceleration, Constant tangential thrust (Characteristics of the motion>), Linearization of the equations of motion, Performance analysis.

TEXT BOOKS:

1. J. W. Cornelisse (1979), *Rocket Propulsion and Spaceflight Dynamics*, Pitman Publishing, London.
2. William E. Wiesel (2010), *Spaceflight Dynamics*, 3rd edition, McGraw-Hill, New Delhi.

REFERENCE BOOKS:

1. Charles D. Brown (1998), *Spacecraft Mission Design*, 2nd Edition, AIAA Education Series, USA.
2. Vladimir A. Chobotov (2002), *Orbital Mechanics*, 3rd Edition, AIAA Education Series, USA.
3. David A. Vellado (2007), *Fundamentals of Astrodynamics and Applications*, 3rd Edition, Springer, Germany.

B. Tech. AE VII SEMESTER

AERO ELASTICITY
(Professional Elective - I)

Course Code: **A1727**

L	T	P	C
3	1	-	4

UNIT - I

INTRODUCTION: Introduction to Aero elasticity COLLARS Triangle, Aerodynamics and interactions of Structural and Inertial forces Static and Dynamic Aero Elasticity Phenomena. Simple Two dimensional idealization of flow, String Theory, Fredholm Integral equations of Second Kind Exact Solutions for simple rectangular wings.

UNIT - II

ANLYTICAL METHODS: Formulations of Structural Dynamics Equation and Coupling effects for panels and plates, generalized coordinates, Lagrange's Equations of motion Hamilton's Principle Orthogonality conditions. Static Aero elastic Studies Divergences, control reversal, Aileron reversal speed, Aileron efficiency, lift distribution, Rigid and elastic wings.

UNIT - III

EXPERIMENTAL ANALYSIS: Non-dimensional Parameters, stiffness criteria, dynamic mass balancing, model experiments and dimensional similarity, flutter analysis.

EQUATIONS OF AERO ELASTIC: Formulation of Aero elastic Equations for a Typical Section, Quasi Steady Aerodynamic derivatives, modal equations Galerkins method of analysis.

UNIT - IV

FLUTTER: Stability of motion of Continua Torsion flexure flutter, Solution of flutter determinant, method of determining the classical flutter speed, Flutter Prevention and control.

UNIT - V

AERO ELASTICITY APPLICATIONS: Application of Aero Elasticity in Engineering Problems, Galloping of transmission lines, flow induces vibrations of tall slender structures and suspension Budges.

TEXT BOOKS:

1. Dewey H. Hodges, G. Alvin Pierce (2011), *Introduction to Structural Dynamics and Aero Elasticity*, 2nd edition, Cambridge University Press, UK.
2. Fung Y. C. (2008), *An introduction to the Theory of Aero Elasticity*, Dover Publications, USA.
3. Jan R. Wright (2008), *Introduction to Aircraft Aero Elasticity and Loads*, John Wiley, USA.

REFERENCE BOOKS:

1. Raymond L. Bisplinghoff, Holt Ashely (2002), *Principles of Aeroelasticity*, Drovers Publications, USA.
2. Adamu Yebi (2010), *Vibration Analysis of Cracked Composite Aircraft Wing Modeled as Shell*, VMD Verlag, New Delhi.
3. E. H. Dwell (1995), *A Modern Course in Aero elasticity*, Springer Publishers, Germany.

B. Tech. AE VII Semester

FATIGUE AND FRACTURE MECHANICS

(Professional Elective - I)

Course Code: **A1728**

L	T	P	C
3	1	-	4

UNIT - I

FATIGUE OF STRUCTURES: S-N Curves, Endurance limit, Effect of mean stress, Notches and stress concentrations, Neuber's stress concentration factors, Plastic stress concentration factor, Notched S-N curves.

DESIGN OF COMPONENTS: Goodman, Gerber and Soderberg relations and diagrams, Modified Goodman Diagram, Design of components subjected to axial, bending, torsion loads and combination of them.

UNIT - II

STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR: Low cycle and high cycle fatigue, Coffin Manson's relation, Transition life, cyclic strain hardening and softening.

LOAD ASPECTS: Analysis of load histories, Cycle counting techniques, Cumulative damage, Miner's theory, other theories.

UNIT - III

PHYSICAL ASPECTS OF FATIGUE: Phase in fatigue life, Crack initiation, Crack growth, Final fracture, Dislocations, Fatigue fracture surfaces.

FRACTURE MECHANICS: Strength of cracked bodies, Potential energy and surface energy, Griffith's theory, Irwin-Orwin extension of Griffith's theory to ductile materials.

UNIT - IV

STRESS ANALYSIS: Stress analysis of cracked bodies, Effect of thickness on fracture toughness, Stress intensity factors for typical geometries. Introduction of finite element approach for crack propagation studies.

UNIT - V

FATIGUE DESIGN AND TESTING: Safe life and fail-safe design philosophies, Importance of fracture mechanics in aerospace structure, Application to composite materials structures.

TEXT BOOKS:

1. J. F. Knott (1983), *Fundamentals of Fracture Mechanics*, Butter Worth & Co., Publishers Ltd., London.
2. C. G. Sih (1989) *Mechanics of Fracture*, Vol. I, Sijthoff and Noordhoff International Publishing Co., Netherlands.

REFERENCE BOOKS:

1. W. Barrois, E. L. Ripley (1983), *Fatigue of Aircraft Structures*, Pergamum Pres., Oxford, USA.

B. Tech. AE VII SEMESTER

NANO TECHNOLOGY

(Professional Elective - I)

Course Code: **A1344**

L	T	P	C
3	1	-	4

UNIT - I

INTRODUCTION TO NANOTECHNOLOGY: Importance of nano scale, Nanostructure types, electronic, magnetic, optical Properties of Nano materials, top-down and bottom- up approach to nanostructures.

QUANTUM MECHANICAL PHENOMENON IN NANOSTRUCTURES: Quantum confinement of electrons in semiconductor Nano structures, one dimensional confinement (Quantum wires), two dimensional confinements (Quantum Wells), three dimensional confinements (Quantum dots).

UNIT - II

CARBON NANO STRUCTURES: Carbon nano tubes (CNTs), Fullerenes, C60, C80 and C240 Nanostructures, Properties (mechanical, optical and electrical) and applications.

UNIT - III

FABRICATION OF NANO MATERIALS: Physical Methods: Inert gas condensation, Arc discharge, RF plasma, Plasma arc technique, Ion sputtering, Laser ablation, Laser pyrolysis, Molecular beam epitaxy, Chemical vapour deposition method.

NANO SCALE CHARACTERIZATION TECHNIQUES: Scanning probe techniques (AFM, STM, SEM, TEM), XRD

UNIT - IV

NANO DEVICES AND NANO MEDICINE: Lab on chip for bio-analysis, Core/shell Nano particles in drug delivery systems (site specific and targeted drug delivery), cancer treatment, and bone tissue treatment.

UNIT - V

NANO AND MOLECULAR ELECTRONICS: Resonant-Tunneling structures, single electron tunneling, Single Electron transistors, coulomb blockade, giant magneto resistance, tunneling magneto resistance.

NANOLITHOGRAPHY AND NANO MANIPULATION: E-beam lithography and SEM based nanolithography and nano manipulation, Ion beam lithography, oxidation and metallization, Mask and its application, Deep UV lithography, X-ray based lithography.

TEXT BOOKS:

1. Charles. P. Pode (2010), *Introduction to nanotechnology*, Reprint Edition, Springer, Germany.
2. Bharat Bhusan (2010), *Springer Handbook of Nanotechnology,* 3rd edition, Springer, Germany.

REFERENCES BOOKS:

1. Phani kumar (2012), *Principles of nanotechnology*, 3rd edition, Scitech publications, India.
2. Challa S, S. Kumar (2007), *Nanofabrication towards biomedical application: Techniques, tools, Application and Impact,* 1st edition, Wiley, VCH USA.
3. Hari Singh Nalwa (2011), *Encyclopedia of Nanotechnology*, American Scientific Publishers, USA.
4. S. Dutta (2009), *Electron Transport in Mesoscopic systems*, 8th Print, Cambridge University press, UK.

B. Tech. AE VII SEMESTER

BOUNDARY LAYER THEORY

(Professional Elective - I)

Course Code: **A1729**

L	T	P	C
3	1	-	4

UNIT - I

BASIC LAWS: Basic laws of fluid flow: Continuity, momentum and energy equations as applied to system and control volume, Concept of flow fields.

FUNDAMENTALS OF BOUNDARY LAYER THEORY: Viscous fluid flow, Boundary conditions. Development of boundary layer, Estimation of boundary layer thickness. Displacement thickness, momentum and energy thickness for two-dimensional flows. General stress system in a deformable body, General strain system.

UNIT - II

LAMINAR BOUNDARY LAYER: Analysis of flow past a flat plate and a cylinder, Integral relation of Karman, Integral analysis of energy equation, laminar boundary layer equations, Flow separation, Blasius solution for flat–plate flow, Boundary layer temperature profiles for constant plate temperature.

UNIT - III

NAVIER STOKES EQUATION: Relation between stress and strain system in a solid body (Hooke's Law). Relation between stress and strain rate system in liquids and gases (Stroke's Law). The Navier - Strokes Equation (N-S), General properties of Navier - Stokes Equation.

EXACT SOLUTION OF N-S EQUATION: Two dimensional flow through a straight channel, Hagen - Poiseulle flow, suddenly accelerated plane wall, Flow near a rotating disk, Very slow motion: Parallel flow past a sphere.

UNIT - IV

BOUNDARY LAYER METHODS: Falkner Skan Wedge flows, Integral equation of Boundary layer - Pohlhausen method, Thermal boundary calculations: One parameter and two parameter integral methods.

UNIT - V

INCOMPRESSIBLE TURBULENT MEAN FLOW: Two-dimensional turbulent boundary layer equations, Integral relations, Eddy viscosity theories, Velocity profiles.

COMPRESSIBLE - BOUNDARY LAYER FLOW: The law of the wall, the law of the wake, Turbulent flow in pipes and channels, Turbulent boundary on a flat plate, Boundary layers with pressure gradient.

TEXT BOOKS:

1. S. B. Pope (2010), *Turbulent flows*, Reprinted Edition, Cambridge University Press, USA.
2. Hermann Schlichting (2004), *Boundary Layer Theory*, 8th edition, Springer, Germany.
3. Panton R. L (2005), *Incompressible Flow*, 3rd Edition, John Wiley & Sons, USA.

REFERENCE BOOKS:

1. Biman Chandra Chetia (2010), *Fuzzy Modeling of the Boundary-Layer Theory*, Vdm Verlag, New York
2. White F. M (2007), *Viscous fluid Flow*, 3rd edition, McGraw Hill, New Delhi

B. Tech. AE VII SEMESTER

EXPERIMENTAL STRESS ANALYSIS

(Professional Elective - I)

Course Code: **A1730**

L	T	P	C
3	1	-	4

UNIT - I

MEASUREMENTS: Basic principles, Accuracy, Sensitivity, Range Measurements, Errors.

EXTENSOMETERS: Mechanical, Optical, Acoustical and Electrical extensometers and their use, Advantage and disadvantage.

UNIT - II

STRAIN GAUGE - PRINCIPLES: Principles and operation of electrical strain gauge, Requirement, Type and their uses, Material for strain gauge, Calibration, Cross sensitivity, Rosette Analysis.

STRAIN GAUGE - STRAIN MEASUREMENT: Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, Strain indicator.

UNIT - III

PHOTOELASTICITY: Two dimensional Photo elasticity, Concept of Light, Photo, elastic effects, Stress and optic law.

FRINGE INTERPOLATION TECHNIQUS: Interpretation of fringe pattern, Compensation and separation techniques, Photo elastic material.

UNIT - IV

NON-DESTRUCTIVE TESTING - I: Fundamentals of Non Destructive Testing, Radiography, Ultrasonic Inspection, Ultrasonic C-Scan, Magnetic particles Inspection, Fluorescent penetrant technique, Eddy current testing, Acoustic Emission Technique.

UNIT - V

NON-DESTRUCTIVE TESTING - II: Fundamentals of brittle coating methods, Introduction to Moiré Techniques, Holography, Thermography.

TEXT BOOKS:

1. Daily J. W, Riley W. F (2005), *Experimental Stress Analysis*, 4th edition, McGraw- Hill, New Delhi.
2. Thomas G. Beckwith, Maragoni, Lienhard (2009), Mechanical Measurements, 6th edition, Pearson Education, New Delhi.
3. Prasad (2011), *Non- Destructive Test and Evaluation of Materials*, 1st edition, Tata McGraw-Hill, New Delhi.
4. R. Halmshaw (1991), Non-*Destructive Testing*, 2nd edition, Edward Arnold, New York.

REFERENCE BOOKS:

1. Sadhu Singh (2009), *Experimental stress Analysis*, 3rd edition, Khanna Publications, New Delhi.
2. L S Srinath (1984), *Experimental Stress Analysis,* 2nd edition, Tata McGraw-Hill, New Delhi.

B. Tech. AE VII SEMESTER

COMPUTER AIDED AIRCRAFT MODELING AND ASSEMBLY LAB

Course Code: **A1731**

L	T	P	C
-	-	3	2

DESIGN OF THE AIRCRAFT COMPONENTS USING CATIA

1. Design of airfoils and wings
2. Design of fuselage with seating arrangement
3. Design of propeller shaft and blades
4. Design of landing gear
5. Design of horizontal and vertical stabilizer
6. Design of nose cone
7. Design of door of aircraft

ASSEMBLY OF THE AIRCRAFT COMPONENTS USING PRO-E

1. Assemble the wings to fuselage
2. Assemble the seating arrangement in fuselage
3. Assemble the engine along with propeller shaft and blades in fuselage
4. Assemble the landing gears to fuselage
5. Assemble the horizontal and vertical to fuselage
6. Assemble the door to fuselage

B. Tech. AE VII SEMESTER

HEAT TRANSFER AND COMPUTATIONAL FLUID DYNAMICS (CFD) LAB

Course Code: **A1732**

L	T	P	C
-	-	3	2

HEAT TRANSFER LAB

1. Composite slab apparatus overall heat transfer co efficient
2. Heat transfer through lagged pipe
3. Heat transfer through a concentric sphere
4. Thermal conductivity of given metal rod
5. Heat transfer in pin-fin
6. Experiment on transient heat conduction
7. Heat transfer in forced convection apparatus
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger
10. Emissive apparatus

CFD LAB

1. Numerical solutions for any one of the following using Finite Difference method
    a. Elliptic Equations
    b. Parabolic Equations
    c. Hyperbolic Equations
2. Grid generations for any one of the following
    a. Algebraically stretched Cartesian grids
    b. Elliptic Grids
3. Numerical Solutions for any one of the following
    a. Vortex Panel method
    b. Source Panel method
    c. Incompressible Coutte flow
    d. Supersonic flow over a flat plate
    e. Grid generation of aerofoil NACA 0012

EQUIPMENT NEEDED FOR CFD LAB

1. Computers P- IV with 1GB Ram and parallel computational facilities 60 nos / 60 students a batch.
2. 60 educational version licenses of
    a. MAT LAB
    b. Ansys
    c. Nastran
    d. Pro – E
    e. CFX

SYLLABI FOR VIII SEMESTER

B. Tech. AE VIII SEMESTER

AIRCRAFT SYSTEMS AND INSTRUMENTATION

Course Code: **A1734**

L	T	P	C
3	1	-	4

UNIT - I

FLIGHT CONTROL SYSTEMS: Principles of flight control, flight control surfaces, control surface actuation, flight control linkage systems, trim and feel. Power control, mechanical, direct drive, electromechanical, electro-hydrostatic actuation ,multiple redundancy. The fly by wire system. Airbus and Boeing implementations. Inter-relationship of flight control, guidance and vehicle management systems.

UNIT - II

ENGINE CONTROL SYSTEMS: The engine control problem, fuel flow control, air flow control, control system parameters, example systems, design criteria. Engine starting, fuel control, ignition control, engine rotation, throttle levers, engine indications. Engine control on a modern civil aircraft. Integrated flight and propulsion control.

FUEL SYSTEMS: Characteristics of aircraft fuel systems, fuel system components, fuel transfer pumps, fuel booster pumps, fuel transfer valves, non return valves. Fuel quantity measurement systems, level sensors, fuel gauging probes. Fuel system operation, fuel pressurization, engine feed, fuel transfer, use of fuel as heat sink, external fuel tanks, fuel jettison, in-flight refueling. Integrated civil aircraft fuel systems.

UNIT - III

HYDRAULIC SYSTEMS: Importance of hydraulic systems, functions to be performed, the hydraulic circuit, actuation, the hydraulic fluid, hydraulic piping, hydraulic pump, fluid conditioning, the reservoir, emergency power sources. Aircraft applications, examples of B Ae, Airbus, Boeing implementations. The landing gear system for retraction, steering, braking and anti-skid.

ELECTRICAL SYSTEMS: Aircraft electrical system characteristics, power (AC and DC) generation. Power generation control, voltage regulation, parallel operation, supervisory and protection functions. Modern electrical power generation types, constant frequency, variable frequency, variable speed constant frequency types. Primary power distribution, power conversion and energy storage. Secondary power distribution, power switching, load protection. Electrical loads, motors and actuators, lighting, heating, subsystem controllers, ground power. Emergency power generation. Electrical load management system.

UNIT - IV

PNEUMATIC SYSTEMS AND ENVIRONMENTAL CONTROL SYSTEMS: Use of pneumatic power in aircraft. Sources of pneumatic power, the engine bleed air, engine bleed air control. Users of pneumatic power, wing and engine anti-ice, engine start, thrust reversers, hydraulic system, pitot static systems. The need for controlled environment in aircraft. Sources of heat. Environmental control system design, ram air cooling, fuel cooling, engine bleed, bleed flow and temperature control. Refrigeration systems, air cycle and vapour cycle systems, turbo fan, boot strap, reversed boot strap systems. Humidity control. Air distribution systems. Cabin pressurization, g tolerance, rain dispersal, anti-misting and demisting.

AIR CRAFT INSTRUMENTATION: Basics of Aircraft; Aircraft instruments-Types and Cockpit Layout; Air data Instruments; Directional Systems; Gyroscopic and Advanced Flight Instruments; Engine Instruments-Power and Thrust; Engine Fuel Indicators; Electronic Flight Instrument System (EFIS); Aircraft Navigation Systems; Automatic Flight Control System (AFCS); Airborne Radars; Flight Management Systems (FMS); Aircraft Communication Addressing and Reporting System (ACARS/ATN) and Future Air Navigation (FAN); Black Boxes (Cockpit Voice Recorder and Flight data Recorder); Aircraft Safety and warning Systems; Electronic Warfare (EW)

UNIT - V

AIRCRAFT INSTRUMENTATION - SENSORS AND DISPLAYS: Air data sensors, magnetic sensing, inertial sensing, radar sensors. The electromechanical instrumented flight deck, early flight deck instruments, attitude direction indicator, horizontal situation indicator, altimeter, airspeed indicator. Advanced flight deck display system architectures, display systems, display media, future flight deck displays.

SYSTEMS DESIGN AND DEVELOPMENT: System design, specifications and requirement, regulations, guidelines and certification. Safety processes, functional hazard analysis, preliminary systems safety analysis, system safety analysis, common cause analysis. Requirements capture, top-down approach and bottoms-up approach. Fault tree analysis, failure mode and effects analysis, component reliability, dispatch reliability, Markov analysis. Development processes,

software and hardware. Product life cycle phases - concept, definition, design, build, test, operate and disposal or refurbish. Major review processes. Software development process, verification and integration with hardware.

TEXT BOOKS:

1. Allan Seabridge, Ian Moir (2008), *Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration,* 3rd edition, John Willey & Sons, USA.
2. S. Nagabhushana, L. K Sudha (2010), *Aircraft instrumentation and systems,* I. K. International Publishing House, New York.
3. Moir I, Seabridge A (2006), *Civil Avionics Systems*, John Willey & Sons, USA.

REFERENCE BOOKS:

1. E. H. J. Pallett (2010), Aircraft Instruments and Integrated Systems, New Edition, Pearson Education, New Delhi.
2. Harris D (2004), *Flight Instruments and Automatic Flight Control Systems*, 6th edition, Blackwell Science. New York, USA.

B. Tech. AE VIII SEMESTER

ADVANCED COMPUTATIONAL FLUID DYNAMICS

(Professional Elective - II)

Course Code: **A1735**

L	T	P	C
3	1	-	4

UNIT - I

PANEL METHODS: Introduction to panel method, Basic aspects of uniform source and vortex flows, Source panel method, Non-lifting flows over arbitrary two-dimensional bodies.

VORTEX PANEL METHOD: Vortex panel method Lifting flows over arbitrary two-dimensional bodies.

UNIT - II

METHOD OF CHARACTERISTICS: Introduction to numerical techniques for steady supersonic flows, Philosophy of method of characteristics. Determination of characteristic lines, Two-dimensional irrotational flow. Determination of the compatibility equation and unit processes. Regions of influence and Domains of dependence.

APPLICATIONS OF METHOD OF CHARACTERISTICS: Supersonic nozzle design using method of characteristics, Description of Mc Cormack's predictors - Corrector techniques.

UNIT - III

TIME DEPENDENT METHODS - I: Stability of Solution, Explicit time dependent methods: Euler, Backward Euler, One step trapezoidal, Backward differencing, methods, Leap Frog method.

TIME DEPENDENT METHODS - II: Description of Lax-Wendroff Scheme and Mac Cormack's two-step predictor - Corrector method. Description of time split methods and Approximate factorization schemes.

UNIT - IV

BOUNDARY LAYER EQUATION: Introduction to boundary layer equations and their solutions. Description of the boundary layer equations. Transformation of boundary layer equations and the numerical solution method. Choice of discretization model and the generalized Crank- Nicholson Scheme. Discretization of boundary layer equations and illustration of solutions of a tridiagonal system of linear algebraic equations.

UNIT - V

TRANSONIC RELAXATION METHOD: Theoretical aspects of transonic flows, Small Perturbation flows, Transonic small perturbation equations, Central and Backward difference schemes, Shock capturing vs. shock fitting techniques: Conservation vs. non conservation forms of governing equations, Line relaxation techniques.

TEXT BOOKS:

1. T. J. Chung (2010), *Computational Fluid Dynamics*, 2nd edition, Cambridge University Press, USA.
2. John D. Anderson (2010), *Computational Fluid Dynamics*, McGraw Hill, New Delhi.
3. John C. Tannehill, Richard H. Pletcher (1997), *Computational Fluid Mechanics and Heat transfer*, 2nd edition, Taylor & Francis Group, New York.

REFERENCE BOOKS:

1. Ronnie Anderson (2012), *Computational Fluid Dynamics for Engineers*, Cambridge University Press, USA.
2. Jean-Jacques Chattot (2010), *Computational aerodynamics and fluid dynamics an introduction*, Springer, Germany.

B. Tech. AE VIII SEMESTER

INDUSTRIAL AERODYNAMICS
(Professional Elective - II)

Course Code: **A1736**

L	T	P	C
3	1	-	4

UNIT - I

ATMOSPHERE: Types of winds, Causes of variation of wind, Effect of terrain on gradient height.

ATMOSPHERIC BOUNDARY LAYER: Pressure and velocity distribution over the rising car, Wind tunnel model for atmospheric boundary layer, variation of drag force for various positions of the rising car.

UNIT - II

VEHICLE AERODYNAMICS: Power requirements and drag coefficients of automobiles, Effects of cut back angle, Aerodynamics of trains and hovercraft.

UNIT - III

WIND ENERGY COLLECTORS-I: Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory.

WIND ENERGY COLLECTORS-II: Working principles of horizontal and vertical axis machines, Design of axial machines.

UNIT - IV

BUILDING AERODYNAMICS: Pressure distribution on low-rise buildings, Wind forces on buildings, Environmental winds in city blocks, Special problems of tall buildings, Building codes, Building ventilation and architectural aerodynamics, Interference effect of Building.

UNIT - V

FLOW INDUCED VIBRATIONS: Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, galloping and stall flutter.

DESIGN OF CHIMNEY: Height of chimney for various gas effluents, Effective height of chimney, flume rise, Different types of flume rise for various climatic conditions.

TEXT BOOKS:

1. Blevins R. D (2001), *Flow Induced Vibrations*, Krieger Publishing Company, USA.
2. Thomas E. Kissell (2011), *Introduction to Wind Power Principles*, Prentice Hall, New York.

REFERENCE BOOKS:

1. Scorer R. S. (1978), *Environmental Aerodynamics*, Halsted Press. New York.
2. Gargeshwari Suryanarayana (2010), *Aerodynamic Drag Reduction of Bluff Bodies*, Lap Lambert Academic Publishing, USA.
3. Sovran M (1978), *Aerodynamics Drag Mechanisms of Bluff Bodies and Road Vehicles*, Plenum Press, New Delhi.
4. Shigehiko Kaneko (2008), *Flow-Induced Vibrations: Classifications and Lessons from Practical Experiences*, Elsevier, USA.

B. Tech. AE VIII SEMESTER

HYPERSONIC AERODYNAMICS

(Professional Elective - II)

Course Code: **A1737**

L	T	P	C
3	1	-	4

UNIT - I

FUNDAMENTALS OF HYPERSONIC FLOWS: Importance/properties of hypersonic flow-Basic equations boundary conditions for inviscid flow, shock wave shapes, flow over a wedge.

HYPERSONIC APPROXIMATIONS: Prandtl-Meyer flow, Axi-symmetric flow over a cone, Flow over a flat plate.

UNIT - II

HYPERSONIC AERODYNAMIC HEATING: Reference temperature method-Entropy layer effects on aerodynamic heating.

UNIT - III

HYPERSONIC SMALL DISTURBANCE THEORY: Flow over a wedge and a cone, Blast wave analogy, Newtonian impact theory, Busemann centrifugal correction, Shock expansion method, Tangent cone and tangent wedge methods.

BASIC ASPECTS OF HYPERSONIC VISCOUS FLOWS: Introduction to viscous flow and pressure interactions over a flat plate, Boundary layers.

UNIT - IV

HYPERSONIC VISCOUS INTERACTIONS: Strong and weak interactions-Shock wave/ boundary layer interactions.

HYPERSONIC VEHICLE DESIGN: Hypersonic propulsion and vehicle design.

UNIT - V

RAREFIED GAS DYNAMICS: Rarefied flow regimes, Kinetic theory of gases-Gas-surface interaction, Aerodynamic forces in hypersonic free molecular flow around simple geometries.

TEXT BOOKS:

1. John David Anderson (2006), *Hypersonic and High Temperature Gas Dynamics*, 2nd edition, AIAA Education Series, USA.
2. John J. Bertin (1994), *Hypersonic Aerothermodynamics*, AIAA Education Series, USA.

REFERENCE BOOKS:

1. Cherni C. G (1961), *Introduction to Hypersonic flow*, Academic Press, New York.
2. Hayes W. D and Probstein R F (1966), *Hypersonic Flow Theory*, 2nd edition, Academic Press, New York.
3. Cox R. N, Crabtree L. P (1965), *Elements of Hypersonic Aerodynamics*, Academic press, New York.

B. Tech. AE VIII SEMESTER

AIRPORT MANAGEMENT
(Professional Elective - II)

Course Code: **A1738**

L	T	P	C
3	1	-	4

UNIT - I

AIRPORTS AND AIRPORT SYSTEMS: Introduction, Airport Management on an international level, Rules that govern airport management, Airport ownership and organization, Airport organization chart, Airport manager and public relations.

THE AIRFIELD: Components of an airport, the airfield, Navigation aids (NAVAIDS) located on airfields, Air traffic Control and surveillance facilities located on the airfield, Weather reporting facilities located on airfields, security infrastructure on airfields.

UNIT - II

AIRSPACE AND AIR TRAFFIC CONTROL: Air traffic control management and operating infrastructure, Basics of air traffic control. Current and future enhancements to air traffic control.

AIRPORT TERMINALS AND GROUND ACCESS: Historical development of airport terminals, Components of airport terminal, Airport ground access.

UNIT - III

AIRPORT OPERATIONS MANAGEMENT: Pavement management-Aircraft rescue and fire fighting (ARFF) Snow and ice control, Safety inspection programs, Bird and wildlife hazard management.

AIRPORT SECURITY: Transportation Security Administration-Security at commercial service airports, Security at general aviation airports.

UNIT - IV

AIRPORT FINACIAL MANAGEMENT: Airport financial accounting-Revenue strategies at commercial airports, Pricing of air port facilities and services, Variation in the sources of operating revenues. Rise in airport financial burdens, Air port funding, Airport financing, Private Investment, Sale of air port.

UNIT - V

AIRPORT CAPACITY AND DELAY: Defining capacity, Factors effecting capacity and delay, Estimating capacity, Simulation Models. Defining delay, Analytical estimates of delay: queuing diagram, Approaches to reducing delay, Administrative and demand management.

TEXT BOOKS:

1. Alexander T. Wells, John G. Wensveen (2008), *Air Transportation: A Management Perspective*, 8th edition, Ashgate Publishing, New Delhi.
2. Alexander T. Wells and Seth B. Young (2011), *Airport Planning and Management*, 6th edition, McGraw-Hill, New Delhi.

REFRENCE BOOKS:

1. Amedeo Odoni, Peter Belobaba and Tom Reynolds(2012), *Airport Systems: Planning, Design and Management,2nd Edition,* McGraw Hill, New Delhi
2. Richard D Neufville (2012), *Airport Systems: Planning, Design and Management,* 2nd edition, McGraw Hill, New Delhi.

B. Tech. AE VIII SEMESTER

NON DESTRUCTIVE TESTING
(Professional Elective - II)

Course Code: **A1739**

L	T	P	C
3	1	-	4

UNIT - I

INTRODUCTION- VISUAL METHODS: Optical aids, In-situ metallographic, Optical holographic methods, Dynamic inspection.

UNIT - II

PENETRANT FLAW DETECTION: Principles, Process, Penetrant systems, Liquid penetrant materials, Emulsifiers, cleaners developers, sensitivity, Advantages, Limitations - Applications.

UNIT - III

RADIOGRAPHIC METHODS: Limitations, Principles of radiography, sources of radiation, Ionizing radiation, X-rays sources, Gama-rays sources Recording of radiation, Radiographic sensitivity, Fluoroscopic methods.

ULTRASONIC TESTING OF MATERIALS: Advantages, disadvantages, Applications, Generation of. Ultrasonic waves, general characteristics of ultrasonic waves. Methods and instruments for ultrasonic materials testing.

LASER TESTING OF MATERIALS: Advantages, disadvantages, Applications, Generation of laser, general characteristics of laser - methods and instruments for laser materials testing.

UNIT - IV

MAGNETIC METHODS: Advantages, Limitations, Methods of generating fields: magnetic particles and suspending liquids Magnetography, field sensitive probes: applications.

ELECTRICAL METHODS: *Eddy current methods*: potential-drop methods, applications.

UNIT - V

ELECTROMAGNETIC TESTING: Magnetism: Magnetic domains: Magnetization curves: Magnetic Hysteresis: Hysteresis-loop tests: comparator - bridge tests Absolute single-coil system: applications.

OTHER METHODS: Acoustic Emission methods, Acoustic methods: Leak detection: Thermal inspection.

TEXT BOOKS:

1. Prasad (2011), *Non- Destructive Test And Evaluation of Materials*, 1st edition, Tata McGraw-Hill, New Delhi.
2. R. Halmshaw (1991), *Non-Destructive Testing*, 2nd Edition, Edward Arnold, USA.

REFERENCE BOOKS:

1. Jack Blitz (1997), *Electrical and Magnetic Methods of Non-Destructive Testing,* Springer, Germany.
2. Jack Blitz (1997), *Ultrasonic Methods of Non-Destructive Testing,* Springer, Germany.
3. Ravi Prakash(2009), *Non-destructive Testing Techniques*, 2nd Edition, New Academic Science Ltd, USA.

B. Tech. AE VIII SEMESTER

THEORY OF PLATES AND SHELLS

(Professional Elective - II)

Course Code: **A1740**

L	T	P	C
3	1	-	4

UNIT - I

CLASSICAL PLATE THEORY: Classical Plate Theory, Assumptions, Differential Equation, Boundary Conditions.

UNIT - II

EIGEN VALUE ANALYSIS: Stability and free Vibration Analysis of Rectangular Plates.

UNIT - III

PLATES OF VARIOUS SHADES: Navier's Method of Solution for Simply Supported Rectangular Plates, Leavy's Method of Solution for Rectangular Plates under Different Boundary Conditions.

GOVERNING EQUATIONS: Solution for Axi-symmetric loading, Annular Plates, Plates of other shapes.

UNIT - IV

APPROXIMATE METHODS: Rayleigh - Ritz, Galerkin Methods, Finite Difference Method. Application to Rectangular Plates for Static, Free Vibration and Stability Analysis.

UNIT - V

SHELLS: Basic Concepts of Shell Type of Structures, Membrane and Bending Theories for Circular Cylindrical Shells.

TEXT BOOKS:

1. S. P. Winowsky, Kreger Timoshenko (1990), *Theory of Plates and Shells*, 2nd edition, McGraw-Hill, New Delhi.
2. Ansel C. Ugural (2009), *Stresses in Beams, Plates and Shells,* 3rd edition, CRC Press, New York.

REFERENCE BOOKS:

1. Flgge W. (1990), *Stresses in Shells*, 2nd edition, Springer, Germany.
2. Timoshenko S. P., Gere J. M. (2009), *Theory of Elastic Stability,* 2nd edition, Dover Publications, USA.

B. Tech. AE VIII SEMESTER

ROCKETS AND MISSILES
(Professional Elective - III)

Course Code: **A1741**

L	T	P	C
3	1	-	4

UNIT - I

SOLID PROPELLANT ROCKET SYSTEMS: Ignition system in rockets, Types of igniters, Igniter design considerations, Combustion system of solid rockets.

LIQUID PROPELLANT ROCKET SYSTEMS: Design consideration of liquid rocket combustion chamber, injector, propellant feed lines, valves, propellant tank outlet and helium pressurized and turbine feed systems, Propellant slosh , Propellant hammer, Geysering effect in cryogenic rocket engines.

UNIT - II

AERODYNAMICS OF ROCKETS AND MISSILES: Airframe components of rockets and missiles, Forces acting on a missile while passing through atmosphere, Classification of missiles. Method of describing aerodynamic forces and moments, Lateral aerodynamic moment, Lateral damping moment and longitudinal moment of a rocket-Lift and drag forces, Drag estimation, Body upwash and downwash in missiles, Rocket dispersion.

UNIT - III

TWO-DIMENSIONAL ROCKET MOTION IN VACUUM: Equations of motion, Rocket Motion in free space (Tsiokovsky's equation, Rocket Parameters, Burnout range), Rocket Motion in a homogeneous gravitational field (Vertical flight, Constant Pitch angle, Gravity turns).

MULTI-STAGE ROCKET: Nomenclature of the multi-stage rocket, Ideal Velocity of the multi-stage rocket, Vertical ascent in a homogeneous gravitational field and in vacuum (Burnout velocity- Culmination altitude-Vertical ascent of a two-stage rocket).

UNIT - IV

ATTITUDE CONTROL OF ROCKETS AND MISSILES: Rocket thrust vector control, Methods of thrust vector control, Thrust magnitude control, Thrust Termination.

SEPARATION SYSTEMS FOR ROCKETS AND MISSILES: Stage separation dynamics, Separation techniques.

UNIT - V

MATERIALS FOR ROCKETS AND MISSILES: Criteria for Selection of materials for rockets and missiles, Choice of materials at cryogenic temperatures, extremely high temperatures. Requirement of materials for thermal protection and pressure vessels.

TEXT BOOKS:

1. Martin J. L. Turner (2008), *Rocket and Spacecraft Propulsion principles, practice and new developments,* 3rd edition, Springer, USA.
2. Sutton G.P. (2010), *Rocket Propulsion Elements*, John Wiley / BSP Books, USA.
3. Cornelissse J. W. (1980), *Rocket Propulsion and Space Dynamics*, Pitman Publishing, London.

REFERENCE BOOKS:

1. S. S. Chin (1982), *Missile Configuration Design*, McGraw- Hill, New Delhi.
2. Bong Wie (2008), *Space Vehicle Dynamics and Control*, AIAA Educatioal Series, USA.
3. Earl R Parker (1998), *Materials for Missiles and Spacecraft*, McGraw Hill, New Delhi.

B. Tech. AE VIII SEMESTER

PROPELLANT TECHNOLOGY
(Professional Elective - III)

Course Code: **A1742**

L	T	P	C
3	1	-	4

UNIT - I

LIQUID FUELS: Properties and tests for petroleum products, Motor gasoline, Aviation gasoline, Aviation turbine fuels, Requirements of aviation fuels of kerosene type and high flash point type, Requirements for fuel oils.

UNIT - II

SOLID PROPELLANTS - I: Single base propellants, Double base propellants, Composite propellants, CMBD propellants, Metallized composite propellants. Introduction to different fuels and oxidizers of composite propellants. Brief introduction to composite theory of composite and double base propellants.

UNIT - III

CRYOGENIC PROPELLANTS - I: Introduction to cryogenic propellants, Liquid hydrogen, liquid oxygen, liquid nitrogen and liquid nitrogen and liquid helium and their properties.

THEORY: Behind the production of low temperature, Expansion engine, Cascade process, Joule Thompson effect, Magnetic effect, Ortho and para H2, Helium 4 and Helium 3. Ideal cycles and efficiency of cryo systems, Storing of cryogenic propellants, Cryogenic loading problems.

UNIT - IV

LIQUID PROPELLANTS - I: Various liquid propellants and their properties, Monopropellants and bipropellant system, concept of ullage, Ignition studies of liquid propellants. Propellant loading tolerances, inventory, Volume versus mass loading. Loading measurement and control, Outage control.

UNIT - V

PROPELLANT TESTING: Laboratory testing, Arc Image Furnace, Ignitability studies. Differential Thermal Analysis, Thermo-gravimetric analysis, Particle size measurement Micro-merograph, Strand burner tests impulse bomb, Performance estimation.

TEXT BOOKS:

1. Cornelissse J. W. (1980), *Rocket Propulsion and Space Dynamics*, Pitman Publishing, London.

REFERENCE BOOKS:

1. Shutton, G. P. (2010), *Rocket Propulsion Elements*, John Wiley / BSP Books, USA.
2. Samir Sarkar (2009), *Fuels and Combustion*, 3rd edition, Universities Press /CRC Press, New York.
3. Mathur M, Sharma R. P. (2010), *Gas Turbine and Jet and Rocket Propulsion,* Standard Publishers, New Delhi.

B. Tech. AE VIII SEMESTER

HELICOPTER ENGINEERING

(Professional Elective - III)

Course Code: **A1743**

L	T	P	C
3	1	-	4

UNIT - I

ELEMENTS OF HELICOPTER AERODYNAMICS: Configurations based on torque reaction, Jet rotors and compound helicopters.

ROTOR CONTROL: Methods of control, Collective and cyclic pitch changes, Lead-lag and flapping hinges.

UNIT - II

IDEAL ROTAR THEORY: Hovering performances, Momentum and simple blade element theories.

ROTOR PERFORMANCE: Figures of merit, Profile and induced power estimation, Constant chord and ideal twist rotors.

UNIT - III

POWER ESTIMATES: Induced, Profile and Parasite power requirements in forward flight, Performances curves with effects of altitude.

STABILITY AND TRIM: Preliminary ideas on helicopter stability.

UNIT - IV

LIFT AND CONTROL OF V/S TOL AIRCRAFT: Various configuration, Propeller, Rotor ducted fan and jet lift, Tilt wing and vectored thrust, Performances of VTOL and STOL aircraft in hover, Transition and Forward motion.

UNIT - V

GROUND EFFECT MACHINES: Types, Hover height, Lift augmentation and power calculations for plenum chamber and peripheral jet machines. Drag of hovercraft on land and water. Applications of hovercraft.

TEXT BOOKS:

1. Johnson Wayne (2011), *Helicopter Theory*, 1st edition, Sterling Publishing House, New York.
2. McCormick B. W. (2010), *Aerodynamics, Aeronautics and Flight Mechanics,* 2nd edition, Wiley India Ltd, New Delhi, India.

REFERENCES BOOKS:

1. Alfred Gessow, Garry C. Myers (2007), *Aerodynamics of Helicopter*, 2nd edition, F. Ungar Pub. Co, New York.
2. McCormick B.W. (1998), *Aerodynamics of V/STOL Flight*, Dover Publications, USA.
3. John M. Seddon (2011), *Basic Helicopter Aerodynamics*, John Wiley & Sons, USA.

B. Tech. AE VIII SEMESTER

DESIGN OF AIRCRAFT STRUCTURES

(Professional Elective - III)

Course Code: **A1744**

L	T	P	C
3	1	-	4

UNIT - I

OVERVIEW OF THE AIRCRAFT DESIGN PROCESS: Introduction, Phases of Aircraft Design, Aircraft Conceptual Design Process, Conceptual Stage, Preliminary Design, Detailed Design, Design Methodologies.

FUNDAMENTALS OF STRUCTURAL ANALYSIS: Review of Hooke's Law, Principal stresses, Equilibrium and Compatibility, Determinate Structures, St Venant's Principle, Conservation of Energy, Stress Transformation, Stress Strain Relations.

INTRODUCTION TO AIRCRAFT STRUCTURES: Types of Structural members of Fuselage and wing section Ribs, Spars, Frames, Stringers, Longeron, Splices, Sectional Properties of structural members and their loads, Types of structural joints, Type of Loads on structural joints.

UNIT - II

AIRCRAFT LOADS: Aerodynamic Loads, Inertial Loads, Loads due to engine, Actuator Loads, Maneuver Loads, VN diagrams, Gust Loads, Ground Loads, Ground conditions, Miscellaneous Loads.

AIRCRAFT MATERIALS AND MANUFACTURING PROCESSES : Material selection criteria, Aluminum Alloys, Titanium Alloys, Steel Alloys, Magnesium Alloys, copper Alloys, Nimonic Alloys, Non Metallic Materials, Composite Materials, Use of Advanced materials Smart materials, Manufacturing of A/C structural members, Overview of Types of manufacturing processes for Composites, Sheet metal Fabrication ,Machining, Welding, Super plastic Forming And Diffusion Bonding.

UNIT - III

STRUCTURAL ANALYSIS OF AIRCRAFT STRUCTURES: Theory of Plates, Analysis of plates for bending, stresses due to bending, Plate deflection under different end conditions, Strain energy due to bending of circular, rectangular plates, Plate buckling, Compression buckling, shear buckling, Buckling due to in plane bending moments, Analysis of stiffened panels in buckling, Rectangular plate buckling, Analysis of Stiffened panels in Post buckling, Post buckling under shear.

SAMPLE EXERCISES: Theory of Shells-Analysis of Shell Panels for Buckling, Compression loading, Shear Loading / Shell Shear Factor, Circumferential Buckling Stress.

SAMPLE EXERCISES: Theory of Beams-Symmetric Beams in Pure Bending, Deflection of beams, Unsymmetrical Beams in Bending, Plastic Bending of beams, Shear Stresses due to Bending in Thin Walled Beams, Bending of Open Section Beams, Bending of Closed Section Beams, Shear Stresses due to Torsion in Thin Walled Beams.

SAMPLE EXERCISES: Theory of Torsion- Shafts of Non-Circular Sections, Torsion in Closed Section Beams, Torsion in Open Section Beams, Multi Cell Sections.

UNIT - IV

AIRWORTHINESS AND AIRCRAFT CERTIFICATION: Definition, Airworthiness Regulations, Regulatory Bodies, Type certification, General Requirements, Requirements Related to Aircraft Design Covers, Performance and Flight Requirements, Airframe Requirements, Landing Requirements, Fatigue and Failsafe requirements, Emergency Provisions, Emergency Landing requirements.

UNIT - V

AIRCRAFT STRUCTURAL REPAIR: Types of Structural damage, Nonconformance, Rework, Repair, Allowable damage Limit, Repairable Damage Limit, Overview of ADL Analysis, Types of Repair, Repair Considerations and best practices.

TEXT BOOKS:

1. Daniel P. Raymer(2012), *Aircraft Design-A Conceptual Approach*, 5th edition, AIAA Education Series, USA.
2. Michael Niu (2006), *Airframe Structural Design*, 3rd edition, Conmilit Press, New York.
3. Michael Niu (2007), *Airframe Stress Analysis and Sizing* , 2nd edition, Conmilit Press, New York.

REFERENCE BOOKS:

1. Roger D. Schaufele (2007), *The Elements of Aircraft Preliminary Design,* Aries Publications, New York.
2. Frank Delp, Michael J. Kroes, William A. Watkins(2002), *Aircraft Maintenance and Repair*, 6th edition, McGraw Hill, New Delhi.
3. T. H. G. Megson (2010), *Introduction to Aircraft Structural Analysis*, Utterworth - Heinemann Publications, New Delhi, India.
4. B. K. Donaldson (2012), *Analysis of Aircraft Structures,* Cambridge Universities Press , USA.

B. Tech. AE VIII SEMESTER

HYDRAULICS AND PNEUMATICS SYSTEMS

(Professional Elective - III)

Course Code: **A1745**

L	T	P	C
3	1	-	4

UNIT - I

INTRODUCTION TO HYDRAULIC POWER: Pascal's law and problems on Pascal's Law, continuity equations, introduction to conversion of units. Structure of Hydraulic Control System. The Source of Hydraulic Power: Pumps Pumping theory, pump classification, gear pumps, vane pumps, piston pumps, pump performance, pump selection. Variable displacement pumps.

HYDRAULIC ACTUATORS AND MOTORS: Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder loading, Hydraulic Rotary Actuators, Gear motors, vane motors, piston motors, Hydraulic motor theoretical torque, power and flow rate, hydraulic motor performance.

UNIT - II

CONTROL COMPONENTS IN HYDRAULIC SYSTEMS: Directional Control Valves, Symbolic representation, Constructional features, pressure control valves, direct and pilot operated types, flow control valves.

HYDRAULIC CIRCUIT DESIGN AND ANALYSIS: Control of single and double, acting Hydraulic Cylinder, regenerative circuit, pump unloading circuit, Double pump Hydraulic system, Counter Balance Valve application, Hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve, cylinder synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors, accumulators and accumulator circuits.

UNIT - III

MAINTENANCE OF HYDRAULIC SYSTEMS: Hydraulic oils; Desirable properties, general type of fluids, sealing devices, reservoir system, filters and strainers, problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control, trouble shooting.

INTRODUCTION TO PNEUMATIC CONTROL: Choice of working medium, characteristics of compressed air. Structure of Pneumatic control system. Pneumatic Actuators: Linear cylinders, Types, conventional type of cylinder working, end position cushioning, seals, mounting arrangements applications. Rod–less cylinders, types, working advantages. Rotary cylinder types construction and application. Design parameters, selection.

UNIT - IV

DIRECTIONAL CONTROL VALVES: Symbolic representation as per ISO 1219 and ISO 5599. Design and constructional aspects, poppet valves, slide valves spool valve, suspended seat type slide valve. Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, use of memory valve. Flow control valves and speed control of cylinders supply air throttling and exhaust air throttling use of quick exhaust valve. Signal processing elements: Use of Logic gates – OR and AND gates pneumatic applications. Practical examples involving the use of logic gates. Pressure dependent controls types construction, practical applications. Time dependent controls Principle, construction, practical applications.

UNIT - V

MULTI-CYLINDER APPLICATIONS: Coordinated and sequential motion control. Motion and control diagrams – Signal elimination methods. Cascading method principle. Practical application examples (up to two cylinders) using cascading method (using reversing valves). Electro-Pneumatic control: Principles-signal input and output pilot assisted solenoid control of directional control valves, use of relay and contactors. Control circuitry for simple single cylinder applications. Compressed air: Production of compressed air – compressors, preparation of compressed air- Driers, Filters, Regulators, Lubricators, Distribution of compressed air- Piping layout.

TEXT BOOKS:

1. Anthony Esposito (2009), *Fluid Power with applications*, 7th edition, Pearson education, New Delhi.
2. Andrew Parr (2011), *Hydraulics and Pneumatics: A Technician's and Engineer's Guide*, 3rd edition, Elsevier, USA.

REFERENCE BOOKS:

1. S. R. Majumdar (2002), *Oil Hydraulic Systems - Principles and Maintenance*, Tata McGraw Hill, New Delhi.
2. S. R. Majumdar (2010), *Pneumatic Systems: Principles and Maintenance*, Tata McGraw Hill, New Delhi.
3. John J. Pippenge (1999), *Industrial Hydraulics*, McGraw- Hill, New Delhi.

B. Tech. AE VIII SEMESTER

AIR LINE MANAGEMENT
(Professional Elective - III)

Course Code: **A1746**

L	T	P	C
3	1	-	4

UNIT - I

AIRLINE INDUSTRY: Structure of Airline Industry (Domestic & International), Growth and Regulation, Deregulation, Major and National Carriers, Regional Carriers, Economic characteristics of the Airlines.

AIRLINE MANAGEMENT AND ORGANIZATION: Levels of Management, Decision Making, Functions of Management, Staff Departments, Line Departments.

UNIT - II

INTRODUCTION TO AIRLINE PLANNING: Airline Planning Process, Airline Terminology and Measures: airline demand, airline supply, average load factor, unit revenue, Airline Planning decisions: Fleet Planning, Route evaluation, Schedule development, Pricing, Revenue Management.

FLEET PLANNING AND ROUTE EVALUATION: Factors in Fleet Planning, Hub and Spoke System, Technical Aspects, Fleet Rationalization, Fleet Commonality, Long Range Aircraft, Noise Restrictions, Factors in Design and Development, Fleet Planning Process; Route Evaluation in Hub Networks, Route profitability estimation issues, Demand Driven Dispatch.

UNIT - III

AIRLINE SCHEDULING: The Mission of Scheduling, Equipment Maintenance, Flight Operations and Crew Scheduling, Ground Operations and Facility Limitations, Schedule Planning and Coordination, Equipment Assignment and Types of Schedules, Hub and Spoke Scheduling, Data Limitations in Airline Scheduling.

AIRLINE PRICING, DEMAND AND OUTPUT: Airline pricing and demand, Determinants of demand, changes in demand, Elasticity of demand, determinants of elasticity; Types of passenger fares, Pricing process. Airline costs, Pricing and output determination.

UNIT - IV

AIR CARGO: Introduction, Market for airfreight, Types of airfreight rates: general commodity rates, specific commodity rates, Exception rates, joint rates, priority reserves air freight, speed package service, container rates, specific air freight services, assembly service, distribution service, pickup and delivery service. Factors affecting the air freight rates: costs of service, volume of traffic, directionality ,characteristics of traffic, value of service, competition.

UNIT - V

REVENUE MANAGEMENT: Revenue management objectives, Air line revenue maximization. Differential Pricing, Yield management, Revenue management techniques, Flight over booking, Flight leg revenue management, Origin, Destination control.

TEXT BOOKS:

1. Alexander T. Wells, John G. Wensveen (2008), *Air Transportation: A Management Perspective*, 8th edition, Ashgate Publishing, New Delhi.
2. Charles Banfe (1992), *Airline Management*, Prentice Hall, New York.

REFERENCE BOOKS:

1. Stephen Shaw (2011), *Airline Marketing and Mangement*, 7th edition, Ashgate Publishing, New Delhi.
2. Massond Bazargan (2012), *Airline Operations and Scheduling*, 2nd edition, Ashgate Publishing, New Delhi.

B. Tech. AE VIII SEMESTER

COMPUTATIONAL ANALYSIS OF AIRCRAFT STRUCTURES LAB

Course Code: **A1747**

L	T	P	C
-	-	6	2

LIST OF EXPERIMENTS:

1. Landing gear
2. Aerofoil and Wings
3. Propeller shaft and blades
4. Fuselage
5. Nose cone
6. Nozzles
7. Final Assembly

Note: Analysis of the Aircraft components using Ansys

B. Tech. AE VIII SEMESTER

TECHNICAL SEMINAR

Course Code: **A1748**

L	T	P	C
-	-	6	2

1. OBJECTIVE:

Seminar is an important component of learning in an Engineering College, where the student gets acquainted with preparing a report & presentation on a topic.

2. **PERIODICITY / FREQUENCY OF EVALUATION: Twice**

3. PARAMETERS OF EVALUATION:

1. The seminar shall have two components, one chosen by the student from the course-work without repetition and approved by the faculty supervisor. The other component is suggested by the supervisor and can be a reproduction of the concept in any standard research paper or an extension of concept from earlier course work.
2. The two components of the seminar are distributed between two halves of the semester and are evaluated for 50 marks each. The average of the two components shall be taken as the final score.
3. The students shall be required to submit the rough drafts of the seminar outputs within one week of the commencement of the class work.
4. Supervisor shall make suggestions for modification in the rough draft. The final draft shall be presented by the student within a week thereafter.
5. Presentation schedules will be prepared by different Departments in line with the academic calendar.

The Seminars shall be evaluated in two stages as follows:

A. Rough draft

In this stage, the student should collect information from various sources on the topic and collate them in a systematic manner. He/ She may take the help of the concerned supervisor.

The report should be typed in “MS-Word” file with “calibri” font, with font size of 16 for main heading, 14 for sub-headings and 11 for the body text. The contents should also be arranged in Power Point Presentation with relevant diagrams, pictures and illustrations. It should normally contain 18 to 25 slides, consisting of the followings:

1.	Topic, name of the student & guide	1 Slide
2.	List of contents	1 Slide
3.	Introduction	1 - 2 Slides
4.	Descriptions of the topic (point-wise)	7 - 10 Slides
5.	Images, circuits etc.	6 - 8 Slides
6.	Conclusion	1 - 2 Slides
7.	References/Bibliography	1 Slide

The soft copy of the rough draft of the seminar presentation in MS Power Point format along with the draft Report should be submitted to the concerned supervisor, with a copy to the concerned HOD within 30 days of the commencement of class work.

The evaluation of the Rough draft shall generally be based upon the following.

1.	Punctuality in submission of rough draft and discussion	2 Marks
2.	Resources from which the seminar have been based	2 Marks
3.	Report	3 Marks
4.	Lay out, and content of Presentation	3 Marks
5.	Depth of the students knowledge in the subject	5 Marks
Total		15 Marks

After evaluation of the first draft the supervisor shall suggest further reading, additional work and fine tuning, to improve the quality of the seminar work.

Within 7 days of the submission of the rough draft, the students are to submit the final draft incorporating the suggestions made by the supervisor.

B. Presentation:

After finalization of the final draft, the students shall be allotted dates for presentation (in the designated seminar classes) and they shall then present it in presence students, supervisor, faculties of the department and at least one faculty from some department / other department.

The student shall submit 3 copies of the Report neatly bound along with 2 soft copies of the PPT in DVD medium. The students shall also distribute the title and abstract of the seminar in hard copy to the audience. The final presentation has to be delivered with 18-25 slides.

The evaluation of the Presentation shall generally be based upon the following.

1.	Contents	10 Marks
2.	Delivery	10 Marks
3.	Relevance and interest the topic creates	5 Marks
4.	Ability to involve the spectators	5 Marks
5.	Question answer session	5 Marks
Total		35 Marks

4. WHO WILL EVALUATE?

The presentation of the seminar topics shall be made before an internal evaluation committee comprising the Head of the Department or his/her nominee, seminar supervisor and a senior faculty of the department / other department.

B. Tech. AE VIII SEMESTER

COMPREHENSIVE VIVA

Course Code: **A1749**

L	T	P	C
-	-	-	2

1. OBJECTIVE:

- To enable the examiners to assess the candidate's knowledge in his or her particular field of learning.
- To test the student's awareness of the latest developments and relate them to the knowledge acquired during the classroom teaching.

2. PARAMETERS OF EVALUATION:

Subject Knowledge	Current Awareness	Career Orientation	Communication Skills	Total
20	10	10	10	50

3. WHO WILL EVALUATE?

The comprehensive Viva will be conducted by a committee comprising Head of the Department or his/her nominee, two senior faculty of the respective department and an external examiner from outside the college. The comprehensive viva shall be evaluated for 50 marks at the end of VIII semester. A minimum of 40% of maximum marks shall be obtained to earn the corresponding credits.

4. **PERIODICITY / FREQUENCY OF EVALUATION: Once**

5. PEDAGOGY:

- The viva will be held on a face to face basis.
- The students will be expected to answer the questions related to latest developments and all courses taken till date.
- Viva voce will be conducted within week before the beginning of midterm examinations. However, in exceptional circumstances it can be scheduled immediately after the end of midterm examinations.
- Students will have to make themselves available on the date of the viva voce.

B. Tech. AE VIII SEMESTER

MINI PROJECT / PROJECT WORK

Course Code: **A1750/ A1733**

L	T	P	C
-	-	12	8

1. OBJECTIVE:

The main objective of the Project Work is for the students to learn and experience all the major phases and processes involved in solving "real life engineering problems".

2. EXPECTED OUTCOME:

The major outcome of the B. Tech project must be well-trained students. More specifically students must have acquired:

- System integration skills
- Documentation skills
- Project management skills
- Problem solving skills

2. PROJECT SELECTION:

Projects are suggested by the faculty, with or without collaboration with an industry. All faculty are to suggest projects. Students are also encouraged to give project proposals after identifying a faculty who would be willing to supervisor the work. A Project brief is to be given by the faculty to the group defining the project comprehensively.

All B. Tech major projects are to be done in the Institute. For industry specified projects, students will be permitted to spend 1-2 weeks in the industry on recommendation by the supervisor. The number of students per batch should be between 2 and 4. If more number of students is really needed, the project may be split into functional modules and given to subgroups.

4. WHO WILL EVALUATE?

The end semester examination shall be based on the report submitted and a viva-voce exam for 150 marks by committee comprising of the Head of the Department, project supervisor and an external examiner.

5. EVALUATION:

The basic purpose is to assess the student competencies with regard to his project work. More specifically to assess the student's individual contribution to the project, to establish the level of understanding of basic theoretical knowledge relevant to the project and to ensure that the student has good understanding and appreciation of design and development decisions taken in the course of the project. It is desirable that all faculty members are present for the evaluations as this is a platform to get to know the student projects and to motivate the students to do good projects. The faculty should adopt a clear and consistent pattern of asking questions from general to specific aspects of the project. The presentation and evaluation is open to other students of the department.

The project work shall be evaluated for 200 marks out of which 50 marks for internal evaluation and 150 marks for end-semester evaluation. The evaluation shall be done on the following basis

Semester VII	**Semester VIII**
Preliminary Evaluation - 10 marks	Design Evaluation II - 25 marks
Design Evaluation I - 15 marks	Final Evaluation – 150 marks

6. GUIDELINES FOR THE PREPARATION OF B. TECH PROJECT REPORTS

1.1. Project reports should be typed neatly only on one side of the paper with 1.5 or double line spacing on a A4 size bond paper (210 x 297 mm). The margins should be: Left - 1.25", Right - 1", Top and Bottom - 0.75".

1.2. The total number of reports to be prepared are:

- One copy to the department
- One copy to the concerned guide(s)
- One copy to the candidate.

1.3. Before taking the final printout, the approval of the concerned guide(s) is mandatory and suggested corrections, if any, must be incorporated.

1.4. For making copies dry tone Xerox is suggested.

1.5. Every copy of the report must contain

- Inner title page (White)
- Outer title page with a plastic cover
- Certificate in the format enclosed both from the college and the organization where the project is carried out.
- An abstract (synopsis) not exceeding 100 words, indicating salient features of the work.

6.6. The organization of the report should be as follows:

1.	Inner title page	Usually numbered in roman
2.	Abstract or Synopsis	
3.	Acknowledgments	
4.	Table of Contents	
5.	List of table & figures (optional)	

6.7 Chapters (to be numbered) containing Introduction, which usually specifies the scope of work and its importance and relation to previous work and the present developments, Main body of the report divided appropriately into chapters, sections and subsections.

- The chapters, sections and subsections may be numbered in the decimal form for e.g. Chapter 2, sections as 2.1, 2.2 etc., and subsections as 2.2.3, 2.5.1 etc.
- The report should be typed in "MS-Word" file with "calibri" font. The chapter must be left or right justified (font size 16). Followed by the title of chapter centered (font size 18), section/subsection numbers along with their headings must be left justified with section number and its heading in font size 16 and subsection and its heading in font size 14. The body or the text of the report should have font size 11.
- The figures and tables must be numbered chapter wise for e.g.: Fig. 2.1 Block diagram of a serial binary adder, Table 3.1 Primitive flow table, etc.
- The last chapter should contain the summary of the work carried, contributions if any, their utility along with the scope for further work.

6.8. Reference OR Bibliography: The references should be **numbered serially** in the order of their occurrence in the text and their numbers should be indicated within square brackets for e.g. [3]. The section on references should list them in serial order in the following format.

1. For textbooks - A.V. Oppenheim and R.W. Schafer, Digital Signal Processing, Englewood, N.J., Prentice Hall, 3 Edition, 1975.
2. For papers - Devid, Insulation design to combat pollution problem, Proc of IEEE, PAS, Vol 71, Aug 1981, pp 1901-1907.

6.9. Only SI units are to be used in the report. Important equations must be numbered in decimal form for e.g. **V = IZ** ..... **(3.2)**

6.10. All equation numbers should be right justified.

6.11. The project report should be brief and include descriptions of work carried out by others only to the minimum extent necessary. Verbatim reproduction of material available elsewhere should be strictly avoided. Where short excerpts from published work are desired to be included, they should be within quotation marks appropriately referenced.

6.12. Proper attention is to be paid not only to the technical contents but also to the organization of the report and clarity of the expression. Due care should be taken to avoid spelling and typing errors. The student should note that report-write-up forms the important component in the overall evaluation of the project

6.13. Hardware projects must include: the component layout, complete circuit with the component list containing the name of the component, numbers used, etc. and the main component data sheets as Appendix. At the time of report submissions, the students must hand over a copy of these details to the project coordinator and see that they are entered in proper registers maintained in the department.

6.14. Software projects must include a virus free disc, containing the software developed by them along with the read me file. Read me file should contain the details of the variables used, salient features of the software and procedure of using them: compiling procedure, details of the computer hardware/software requirements to run the same, etc. If the developed software uses any public domain software downloaded from some site, then the address of the site along with the module name etc. must be included on a separate sheet. It must be properly acknowledged in the acknowledgments.

6.15. Sponsored Projects must also satisfy the above requirements along with statement of accounts, bills for the same dully attested by the concerned guides to process further, They must also produce NOC from the concerned guide before taking the internal viva examination.

6.16. The reports submitted to the department/guide(s) must be hard bounded, with a plastic covering.

6.17. Separator sheets, used if any, between chapters, should be of thin paper

VARDHAMAN COLLEGE OF ENGINEERING

(Autonomous)

Shamshabad – 501 218, Hyderabad

Department of ……..

CERTIFICATE

Certified that the project work entitled …….. carried out by Mr./Ms. ……., Roll Number ……, a bonafide student of ……in partial fulfillment for the award of **Bachelor of Technology** in …… of the Jawaharlal Nehru Technological University, Hyderabad during the year …….. It is certified that all corrections / suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the departmental library. The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

Name & Signature of the Guide **Name Signature of the HOD** **Signature of the Principal**

External Viva

Name of the examiners Signature with date

1.

2.

Certificate issued at the Organization where the project was carried out

(On a separate sheet, If applicable)

NAME OF THE INDUSTRY / ORGANIZATION, Address with pin code

CERTIFICATE

Certified that the project work entitled …….. carried out by Mr./Ms . ……., Roll Number……, a bonafide student of ……in partial fulfillment for the award of **Bachelor of Technology** in …… of the Jawaharlal Nehru Technological University, Hyderabad during the year …….. It is certified that, he/she has completed the project satisfactorily

Name & Signature of the Guide **Name & Signature of the Head of Organization**

7. **DISTRIBUTION OF MARKS FOR B.TECH DISSERTATION EVALUATION**

S No.	Particulars	Max. Marks
1	Relevance of the subject in the present context	**10**
2	Literature Survey	**10**
3	Problem formulation	**20**
4	Experimental observation / theoretical modeling	**10**
5	Results – Presentation & Discussion	**20**
6	Conclusions and scope for future work	**10**
7	Overall presentation of the Thesis / Oral presentation	**40**
8	Project Report Writing	**30**
Total Marks		**150**