ANNA UNIVERSITY :: CHENNAI 600 025

UNIVERSITY DEPARTMENTS

CURRICULUM – R 2008

B.E. AERONAUTICAL ENGINEERING

CURRICULUM FROM III TO VIII SEMESTERS FOR B.E. AERONAUTICAL ENGINEERING

SEMESTER – III

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
MA9211	Mathematics III	3	1	0	4
AE9201	Engineering Fluid Mechanics	3	1	0	4
AU9201	Thermodynamics and Thermal Engineering	3	1	0	4
AU9202	Solid Mechanics	3	1	0	4
EI9211	Electronics & Instrumentation	3	0	0	3
AE9202	Elements of Aeronautics	2	0	0	2
PRACTICAL					
PR9202	Computer Aided Part and Assembly Drawing	0	0	3	2
PR9203	Mechanical Sciences Laboratory	0	0	3	2
	TOTAL	**17**	**4**	**6**	**25**

SEMESTER – IV

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
MA9262	Numerical Methods	3	1	0	4
PR9251	Theory of Machines	3	1	0	4
AE9251	Aircraft Structures – I	3	1	0	4
AE9252	Aerodynamics – I	3	1	0	4
AE9253	Propulsion – I	3	1	0	4
AE9254	Aircraft Systems and Instruments	3	0	0	3
PRACTICAL					
AE9255	Aircraft Structures Laboratory – I	0	0	3	2
AE9256	Aerodynamics Laboratory – I	0	0	3	2
EI9261	Electrical & Electronics Engineering Laboratory	0	0	3	2
	TOTAL	**18**	**5**	**9**	**29**

SEMESTER – V

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
AE9301	Aircraft Structures – II	3	0	0	3
AE9302	Aerodynamics – II	3	0	0	3
AE9303	Propulsion – II	3	0	0	3
AE9304	Aircraft Performance	3	0	0	3
AE9305	Theory of Elasticity	3	0	0	3
AE9306	Experimental Stress Analysis	3	0	0	3
AE9307	Control Engineering	3	0	0	3
PRACTICAL					
AE9308	Aircraft Structures Lab. – II	0	0	3	2
AE9309	Aerodynamics Lab. – II	0	0	3	2
AE9310	Technical Seminar	0	0	2	1
	TOTAL	**21**	**0**	**8**	**26**

SEMESTER – VI

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
AE9351	Aircraft Stability and Control	3	1	0	4
AE9352	Numerical Methods in Fluid Dynamics	3	0	0	3
AE9353	Composite Materials and Structures	3	0	0	3
AE9354	Finite Element Method	3	0	0	3
AE9355	Theory of Vibrations	3	0	0	3
	Elective – I	3	0	0	3
PRACTICAL					
AE9356	Aircraft Design Project – I	0	0	4	2
AE9357	Propulsion Lab	0	0	3	2
AE9358	CAD Laboratory	0	0	3	2
GE9371	Communication Skills and Soft Skills Laboratory	0	0	2	1
	TOTAL	**18**	**1**	**12**	**26**

SEMESTER – VII

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
PR9402	Engineering Management	3	0	0	3
AE9401	Computational Fluid Dynamics	3	0	0	3
AE9402	Heat Transfer	3	0	0	3
	Elective – II	3	0	0	3
	Elective – III	3	0	0	3
	Elective – IV	3	0	0	3
PRACTICAL					
AE9403	Aircraft Design Project – II	0	0	4	2
AE9404	Comprehension and Technical Seminar	0	0	2	1
	TOTAL	**18**	**0**	**6**	**21**

SEMESTER – VIII

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
	Elective – V	3	0	0	3
PRACTICAL					
AE9451	Project Work	0	0	12	6
AE9452	Flight Training	0	0	0	1
	TOTAL	**3**	**0**	**12**	**10**

TOTAL CREDIT: 190

LIST OF ELECTIVES FOR B.E. AERONAUTICAL ENGINEERING

ELECTIVES – I

CODE NO.	COURSE TITLE	L	T	P	C
AE9021	Space Mechanics	3	0	0	3
AE9022	Helicopter Aerodynamics	3	0	0	3
AE9023	Boundary Layer Theory	3	0	0	3
AE9024	Combustion	3	0	0	3
AE9025	Aeroelasticity	3	0	0	3
AE9026	Theory of Plates and Shells	3	0	0	3
AE9027	Avionics	3	0	0	3
AE9028	Structural Dynamics	3	0	0	3
AE9029	Hypersonic Aerodynamics	3	0	0	3
AE9030	Fatigue and Fracture mechanics	3	0	0	3
AE9031	Satellite Technology	3	0	0	3
AE9032	Wind Tunnel techniques	3	0	0	3
AE9033	Approximate Methods in Structural Mechanics	3	0	0	3
AE9034	Industrial Aerodynamics	3	0	0	3
AE9035	Rockets and Missiles	3	0	0	3
AE9036	Experimental Fluid Dynamics	3	0	0	3
AE9037	Airframe Repair and Maintenance	3	0	0	3
AE9038	Aircraft Rules & Regulations – CAR I and II	3	0	0	3
AE9039	Aero engine Repair and Maintenance	3	0	0	3
GE9021	Professional Ethics in Engineering	3	0	0	3
GE9022	Total Quality Management	3	0	0	3
GE9023	Fundamentals of Nanoscience	3	0	0	3

MA9211 **MATHEMATICS III** **L T P C**
(Common to all branches of BE / B.Tech) **3 0 0 3**

AIM:

To facilitate the understanding of the principles and to cultivate the art of formulation physical problems in the language of mathematics

OBJECTIVES:

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic
- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes
- To develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems

UNIT I FOURIER SERIES **9+3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and Cosine series – Complex form of Fourier Series – Parseval's identity – Harmonic Analysis.

UNIT II FOURIER TRANSFORM **9+3**

Fourier integral theorem – Fourier transform pair-Sine and Consine transforms – Properties – Transform of simple function – Convolution theorem - Parseval's identity.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Singular solutions - Lagrange's Linear equation – Integral surface passing through a given curve – Solution of linear equations of higher order with constant coefficients.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Method of separation of Variables – Solutions of one dimensional wave equation and One-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates.

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATION **9+3**

Z-transform-Elementary properties-Inverse z transform – Convolution theorem-Initial and Final value theorems - Formation of difference equation-Solution of difference equation using z transform.

TOTAL: 45+15=60 PERIODS

TEXT BOOK

1. B.S.Grewal, "Higher Engineering Mathematics", Khanna Publications (2007)

REFERENCES

1) Glyn James, "Advanced Modern Engineering Mathematics, Pearson Education (2007)
2) B.V.Ramana, "Higher Engineering Mathematics" Tata McGraw Hill 2007.
3) N.P.Bali, and Manish Goyal, "A Text Book of Engineering 7th Edition (2007) Lakshmi Publications (P) Limited, New Delhi.

AE9201 ENGINEERING FLUID MECHANICS L T P C
3 1 0 4

AIM:
To introduce the concepts of Fluid Mechanics. Pre-requisite: Basics of Physics

OBJECTIVE:
To introduce the concepts of fluid statics viscosity and buoyancy. To make the student understand the basic laws namely, mass momentum and energy. To give an introduction on fluid machinery.

UNIT I BASIC CONCEPTS 15
Introduction – Fluid properties – Newton's viscosity law – Classification of fluids and fluid motion – Fluid statics – Hydrostatic force on submerged surfaces – stability of floating bodies – Dimensional analysis – The Buckingham-Pi theorem – Significant dimensionless groups – Flow similarity and model studies

UNIT II BASIC EQUATIONS OF FLUID FLOW ANALYSIS 15
Basic laws for a system in integral form – Conservation of mass – Newton's 2nd law – Laws of thermodynamics – Application of the basic laws for a control volume – Kinematics – Motion of a fluid particle – Fluid deformation – Differential analysis of fluid motion – Continuity equation – Differential momentum equation – The Navier Stokes equations

UNIT III INCOMPRESSIBLE INVISCID FLOW 8
Euler's equations of motion – Bernoulli's equations – Applications – Methods of pressure measurement – Flow measurement – Orifice plate – Venturi meter – Irrotational flow – Stream function and velocity potential – Laplace equation – Elementary plane flows

UNIT IV INCOMPRESSIBLE VISCOUS FLOW 8
Fully developed laminar flow between infinite parallel plates – Laminar and turbulent flow through pipes – Velocity profiles – Energy considerations in pipe flow – Calculation of head loss Pipe flow problems – Hydraulic and energy grade lines – Moody's diagram

UNIT V FLUID MACHINERY 14
Introduction and classification of fluid machines – Turbo machinery analysis – The angular momentum principle – Euler turbo machine equation – Velocity triangles – Application to fluid systems – Working principle of turbines, fans, blowers, pumps and compressors.

L = 45, T = 15, TOTAL = 60 PERIODS

TEXT BOOKS

1. Shames I H, 'Mechanics of Fluids', Kogakusha, Tokyo, 1998
2. Robert W Fox & Alan T Mc.Donald, 'Introduction to fluid Mechanics', John Wiley and Sons, 1995

REFERENCE BOOKS

1. Yuan S W, 'Foundations of fluid Mechanics', Prentice-Hall, 1987
2. Milne Thompson L M, 'Theoretical Hydrodynamics', MacMillan, 1985
3. Rathakrishnan, E, 'Fundamentals of Fluid Mechanics', Prentice-Hall, 2007

AU9201 THERMODYNAMICS AND THERMAL ENGINEERING L T P C
3 1 0 4

OBJECTIVE

To introduce fundamental concepts in thermodynamics, heat tramsfer, propulsion and refrigeration and air conditioning.

UNIT I BASIC THERMODYNAMICS 16

Systems, Zeroth low, First law. Steady flow energy equation. Heat and work transfer in flow and non-flow processes. Second law, Kelvin-Planck statement - Clausius statement - Concept of Entropy, Clausius inequality, Entropy change in non-flow processes. Properties of gases and vapours.

UNIT II AIR CYCLE AND COMPRESSORS 12

Camot, Otto, Diesel, Dual combustion and Brayton cycles. Air standard efficiency . Mean effective pressure, Reciprocating compressors.

UNIT III STEAM AND JET PROPULSION 12

Properties of steam – Rankine cycle – Steam Nozzles – Simple jet propulsion system – Thrust rocket motor – Specific impulse.

UNIT IV REFRIGERATION AND AIR-CONDITIONING 10

Principles of Psychrometry and refrigeration - Vapour compression - Vapour absorption types - Co-efficient of performance, Properties of refrigerants – Basic Principle and types Air conditioning.

UNIT V HEAT TRANSFER 10

Conduction in parallel, radial and composite wall – Basics of Convective heat transfer - Fundamentals of Radiative heat transfer – Flow through heat exchangers.

L = 45, T = 15, TOTAL : 60 PERIODS

(Use of standard thermodynamic tables, Mollier diagram and Refrigerant property tables are permitted)

TEXT BOOKS

1. Nag.P.K., “Engineering Thermodynamics”, Tata McGraw-Hill, New Delhi, 2007.
2. Rathakrishnan E., “Fundamentals of Engineering Thermodynamics”, Prentice-Hall India, 2005.

REFERENCES

1. Ramalingam K.K. “Thermodynamics”, Sci-Tech Publications, 2006
2. Holman.J.P., “Thermodynamics”, 3rd Ed. McGraw-Hill, 2007.
3. Venwylen and Sontag, “Classical Thermodynamics”, Wiley Eastern, 1987
4. Arora C.P, “ Thermodynamics”, Tata McGraw-Hill, New Delhi, 2003.
5. Merala C, Pother, Craig W, Somerton, “ Thermodynamics for Engineers”, Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.

AU9202 SOLID MECHANICS L T P C
3 1 0 4

UNIT I AXIAL LOADING 12

Stresses and strains – Hooke’s law – stress and strain diagrams - elastic constants – statically determinate and indeterminate problems in tension & compression – thermal stresses – impact loading.

UNIT II STRESSES IN BEAMS 10

Shear force & bending moment diagrams – bending stresses – shear stress variation in beams of symmetric sections – beams of uniform strength.

UNIT III DEFLECTION OF BEAMS 12

Double integration method – Macaulay's method – moment area method – conjugate beam method – principle of superposition – Strain Energy in axial, bending, torsion and shear loadings. Castigliano's theorems and their applications.

UNIT IV TORSION – SPRINGS – COLUMNS 14

Torsion of solid and hollow circular shafts – shear stress variation – power transmission in shafts – open and closed-coiled helical springs – stresses in helical springs – classification of columns – Euler buckling – columns with different end conditions.

UNIT V BIAXIAL STRESSES 12

Stresses in thin-walled pressure vessels – combined bending, torsion and axial loading of circular shafts – Mohr's circle and its construction – determination of principal stresses.

TEXT BOOK

1. Gere & Timoshenko, 'Mechanics of Materials', McGraw Hill, 1993
2. William Nash, Strength of Materials, Tata McGraw Hill, 2004

REFERENCES:

1. Dym,C.L., and Shames,I.H., 'Solid Mechanics', McGraw Hill, Kogakusha, Tokyo, 1973.
2. Stephen Timoshenko, 'Strength of Materials', Vol I & II, CBS Publishers and Distributors, Third Edition.
3. R.K.Rajput, 'Strength of Materials', S. Chand and Co., 1999.
4. Timoshenko,S. and Young,D.H., Elements of Strength of Materials, T.Van Nostrand Co. Inc., Princeton, N.J., 1977.

EI9211 ELECTRONICS & INSTRUMENTATION L T P C
3 0 0 3

UNIT I ELECTRONIC COMPONENTS AND DEVICES 10

Resistors, Capacitors, Inductors and Transformers - properties, types. Simple PN Junction Diodes, Zener diode, Bipolar Junction transistor and Field Effect Transistors – operating principles and characteristics. Other Devices – UJT, SCR, LED, Photodetectors.

UNIT II ANALOG CIRCUITS 10

Rectifier and Power Supply Circuits, clipper, clamper using diodes, Operational Amplifiers (Ideal) – properties and typical circuits like differentiator, integrator, summer, comparator, single-stage BJT's and FET's amplifiers – Multistage Amplifier Principles(Qualitative Treatment only).

UNIT III DIGITAL CIRCUITS 10

Basics of Boolean Logic – Logic Gates, Flip-Flops, Shift-Registers, Counters, Decoders/Drivers, Timer, Display Devices, A/D and D/A Converters.

UNIT IV MEASUREMENTS AND INSTRUMENTS 7

Definitions of Accuracy, Precision, Sensitivity, Resolution, Linearity, Range, Measurement of Electrical Quantities – Voltmeter, Ammeter, Watt-Meter, DMM, CRO, DSO, Transducers and signal conditioning systems for pressure, temperature, acceleration measurements (Qualitative Treatment only).

UNIT V MICROPROCESSORS AND APPLICATIONS 8

Architecture of 8085 processors, Address Modes, Instruction set, simple programming like addition, subtraction, multiplication, logical operation, Peripherals and Interfacing – 8255, 8251. Applications like motor control, keyboard and PC interface, Introduction to Microcontrollers.

TOTAL: 45 PERIODS

TEXT BOOK

1. Millman.J. and Halkias.C., "Integrated Electronics", Tata McGraw Hill, 2004.
2. Paul Horowitz and Wilfred Hill "The Art of Electronics", Cambridge University press,1989.

REFERENCES

1. Donald P Leach, Albert Paul Malvino and Goutam Saha," Digital Principles & Applications",6E, Tata McGraw Hill, 2006.
2. A.K.Sawhney, A course in Electrical and Electronic Measurement and Instrumentation", Dhanpat Raj. and Sons, New Delhi, 1999
3. Helfrick.A.D., and Cooper.W.D., '"Electronic Instrumentation and Measurement techniques", Prentice Hall of India, 1998.
4. Gaonkar. Ramesh S, " Microprocessor Architecture Programming and Applications with 8085", 5th Ed. Penram International Publishing (India). 2003 .
5. Kenneth J.Ayala., "The 8051 Microcontroller Architecture Programming and Applications", 2ed, Penram International Publishing (India).2004.

AE9202 ELEMENTS OF AERONAUTICS L T P C
2 0 0 2

OBJECTIVE

To introduce the basic concepts of aerospace engineering and the current developments in the field.

UNIT I HISTORICAL EVALUATION 8

Early airplanes, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

UNIT II AIRCRAFT CONFIGURATIONS 5

Components of an airplane and their functions. Different types of flight vehicles, classifications. Conventional control, Powered control, Basic instruments for flying, Typical systems for control actuation.

UNIT III INTRODUCTION TO PRINCIPLES OF FLIGHT 6

Physical properties and structure of the atmosphere, Temperature, pressure and altitude relationships, Evolution of lift, drag and moment. Aerofoils, Mach number, Maneuvers.

UNIT IV INTRODUCTION TO AIRPLANE STRUCTURES AND MATERIALS 6

General types of construction, Monocoque, semi-monocoque and geodesic construction, Typical wing and fuselage structure. Metallic and non-metallic materials, Use of aluminium alloy, titanium, stainless steel and composite materials.

UNIT V POWER PLANTS USED IN AIRPLANES 5

Basic ideas about piston, turboprop and jet engines, Use of propeller and jets for thrust production. Comparative merits, Principles of operation of rocket, types of rockets and typical applications, Exploration into space.

TOTAL: 30 PERIODS

TEXT BOOKS

1..Anderson, J.D., “Introduction to Flight”, McGraw-Hill, 1995.

REFERENCE

1..Kermode, A.C., “Flight without Formulae”, McGraw-Hill, 1997.

PR9202 COMPUTER AIDED PART AND ASSEMBLY DRAWING L T P C
0 0 3 2

OBJECTIVE

To impart skills in construction of machine elements and assembly drawing. Also to train the students to read and represent a geometrical tolerances in part drawing.

1. Instruction to machine drawing & production drawing classification of drawing-BIS conventions – Orthographic and sectional views. Reviews of the concepts of limits, tolerance, fits, surface roughness, and symbols terminology used in Production drawing.

2. Machine element joints – Types of joints – Screw fasteners – Pin joints, couplings welded joints.

3. Computer Aided Production Drafting
   Detailed part drawing and assembly drawings (with suitable tolerances, machine sumbols, specification of fit).
   1) Screw jack
   2) Shaper tool head
   3) Non return valve
   4) Plummer block
   5) Foot step drawing
   6) Machine vice
   7) Four jaw chuck of lathe
   8) Lathe tail stock
   9) Square tool post
   10) Universal coupling
   11) Hydraulic & Pneumatic Assembly

TOTAL: 45 PERIODS

PR9203 MECHANICAL SCIENCES LABORATORY L T P C
0 0 3 2

OBJECTIVE
To train the students in testing and quantifying the mechanical properties of Engineering Materials, Engines and Heat Exchangers

List of Experiments

Tension Test

Torsion Test

Testing of springs

Impact test i) Izod, ii) Charpy

Hardness test i) Vickers, ii) Brinell, iii) Rockwell, iv) Shore

Deflection of Beams

Dye Penetrant Test

Performance test on a 4 storke engine

Viscosity determination of the given fluid

Moment of inertial of connecting rod

Determination of Effectiveness of a parallel and counter flow heat exchangers

Valve timing of a 4 stroke engine and port timing of a 2 stroke engine

TOTAL: 45 PERIODS

MA9262 NUMERICAL METHODS L T P C
3 1 0 4

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS (10 +3)
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton-Raphson method- Solution of linear system of equations - Gauss Elimination method – Pivoting - Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigenvalues of a matrix by Power method and by Jacobi's method.

UNIT II INTERPOLATION AND APPROXIMATION (8 + 3)
Interpolation with unequal intervals - Lagrange interpolation – Newton's divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton's forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTATION AND INTEGRATION (9 + 3)
Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules – Romberg's method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS (9 + 3)

Single step-methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first and second order equations - Multi-step methods - Milne's and Adams-Bashforth predictor-corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS (9 + 3)

Finite difference methods for solving two-point linear boundary value problems. Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat-flow equation by explicit and implicit (Crank Nicholson) methods - One dimensional wave equation by explicit method.

L = 45 T = 15 TOTAL: 60 PERIODS

TEXT BOOKS

1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, New Delhi, 2004.
2. Sankara Rao, K. "Numerical methods for Scientists and Engineers', 3rd Edition Prentice Hall of India Private Ltd., New Delhi, 2007.

REFERENCES

1. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 5th Edition, Tata McGraw-Hill, New Delhi, 2007.
2. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", 6th Edition, Pearson Education Asia, New Delhi, 2006.
3. Brian Bradie, "A friendly introduction to Numerical analysis", Pearson Education Asia, New Delhi, 2007.

PR9251 THEORY OF MACHINES L T P C
3 1 0 4

OBJECTIVE

To understand basic concepts of kinematic and dynamic mechanism of various machine elements.

UNIT I MECHANISMS 14

Definition – Machine and Structure – Kinematic link, pair and chain – classification of Kinematic pairs – Constraint & motion – Degrees of freedom slider crank – Single and double – Crank rocker mechanisms – Inversions – applications, Kinematic analysis and synthesis of simple mechanisms – Determination of velocity and acceleration of simple mechanisms.

UNIT II FRICTION 12

Types of friction – friction in screw and nut – pivot and collar – thrust bearings – collar bearing – plate and disc clutches – belt (flat & vee) and rope drives – creep in belts – Jockey pulley – open and crossed belt drives – Ratio of tensions – Effect of centrifugal and initial tensions – Effect of centrifugal and initial tension – condition for maximum power transmission.

UNIT III GEARING AND CAMS 12

Gear profile and geometry – nomenclature of spur & helical gears – laws of gearing – interference – requirement of minimum number of teeth in gears – gear trains – simple and compound gear trains – determination of speed and torque in epicyclic gear trains – cams different types of followers – cam design for different follower motions.

UNIT IV BALANCING 11

Static and dynamic balancing – single and several masses in different planes – primary and secondary balancing of reciprocating masses – balancing single and multi cylinder Engines – Governors and Gyroscopic effects.

UNIT V VIBRATION 11

Free, forced and damped vibrations of single degree of freedom systems – force transmitted to supports – vibration Isolation – vibration absorption – torsional vibration of shafts – single and multirotor systems – geared shafts – critical speed of shafts.

TOTAL: 60 PERIODS

TEXT BOOKS

1. Bansal Dr.R.K. " Theory of Machines" Laxmi Publications (P) Ltd., New Delhi 2001
2 .Rattan S.S."Theory of machines" Tata McGraw Hill publishing Co., New Delhi, 2002.

REFERENCES:

1. Rao J.S.and Dukkipati R.V. "Mechanism and Machine Theory" Second Edition, Wiley Eastern Limited, 1992.
2. Malhotra D.R. and Gupta H.C "The Theory of machines" Satya Prakasam, Tech. India Publications, 1989
3. Gosh A and Mallick A.K. "Theory of Machines and Mechanisms" affiliated east west press, 1989
4. Shingley J.E. and Vicker J.J. Theory of Machines and Mechanisms" McGraw Hill, 1986.
5. Burton Paul "Kinematics and Dynamics of Machinery", Prentice Hall, 1979.

AE9251 AIRCRAFT STRUCTURES – I L T P C
3 1 0 4

UNIT I STATICALLY DETERMINATE STRUCTURES 12

Statically determinate frames – plane truss analysis – method of joints – method of sections – 3-D trusses – the landing gear tripod – beams of two materials.

UNIT II STATICALLY INDETERMINATE STRUCTURES 12

Propped cantilevers – fixed-fixed beams – Clapeyron's 3 moment equation – moment distribution method.

UNIT III ENERGY METHODS 12

Strain energy evaluation in structural members – energy theorems – dummy load & unit load methods – Maxwell's reciprocal theorem – energy methods applied to statically determinate and indeterminate beams, frames, rings & trusses.

UNIT IV COLUMNS 12

Euler's column curve – inelastic buckling – effect of initial curvature – the Southwell plot – columns with eccentricity – use of energy methods – theory of beam columns – beam columns with different end conditions – stresses in beam columns.

UNIT V FAILURE THEORIES 12

Ductile and brittle materials – maximum principal stress theory - maximum principal strain theory - maximum shear stress theory - distortion energy theory – octahedral shear stress theory.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Timoshenko and Gere, `Mechanics of Materials', Tata McGraw Hill, 1993.
2. Bruhn E F, 'Analysis and Design of Flight Vehicle Structures', Tri-State Off-set Company, USA, 1985

REFERENCES

1. Donaldson, B.K., 'Analysis of Aircraft Structures - An Introduction', McGraw Hill, 1993.
2. Megson T M G, `Aircraft Structures for Engineering students' Edward Arnold Publishers.
3. Peery, D.J., and Azar, J.J., Aircraft Structures, 2nd edition, McGraw – Hill, N.Y., 1999.

AE9252 AERODYNAMICS - I L T P C
3 1 0 4

AIM:

To introduce the fundamental principles of theoretical low speed aerodynamics.
Pre-requisite: Basics of Fluid Mechanics

OBJECTIVE:

To introduce the concepts of mass, momentum and energy conservation relating to aerodynamics. To make the student understand the concept of vorticity, irrotationality, theory of airfoils and wing sections. To introduce the basics of viscous flow.

UNIT I REVIEW OF BASIC FLUID MECHANICS 10

System and Control volume approach, substantial, local and convective derivative, Continuity, momentum and energy equations, Inviscid flow, Euler equation, incompressible Bernoulli's Equation. Circulation and Vorticity, Green's Lemma and Stoke's Theorem, Barotropic Flow, Kelvin's theorem, Streamline, Stream Function, Irrotational flow, Potential Function, Equipontential Lines, Elementary Flows and their combinations.

UNIT II TWO DIMENSIONAL INVISCID INCOMPRESSIBLE FLOW 8

Ideal Flow over a circular cylinder, D'Alembert's Paradox, Magnus effect, Kutta Jonkowski's Theorem, Starting Vortex, Kutta condition, Real flow over smooth and rough cylinder.

UNIT III AIRFOIL THEORY 9

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

UNIT IV SUBSONIC WING THEORY 8

Vortex Filament, Biot and Savart Law, Bound Vortex and trailing Vortex, Horse Shoe Vortex, Lifting Line Theory and its limitations.

UNIT V INTRODUCTION TO LAMINAR AND TURBULENT FLOW 10

Boundary layer and boundary layer thickness, displacement thickness, momentum thickness, Energy thickness, Shape parameter, Boundary layer equations for a steady, two dimensional incompressible flow, Boundary Layer growth over a Flat plate, Critical Reynolds Number, Clasius solution, Basics of Turbulent flow, Prandtl's mixing length hypothesis, Free shear layers.

L:45 TOTAL: 45 PERIODS

TEXT BOOKS

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

REFERENCES

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

AE9253 PROPULSION – I L T P C
3 1 0 4

OBJECTIVE

To understand the principles of operation and design of aircraft and spacecraft power plants.

UNIT I FUNDAMENTALS OF GAS TURBINE ENGINES 8

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

UNIT II SUBSONIC AND SUPERSONIC INLETS FOR JET ENGINES 8

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

UNIT III COMBUSTION CHAMBERS 8

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

UNIT IV NOZZLES 8

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

UNIT V COMPRESSORS 13

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

L=45, T=15, TOTAL : 60 PERIODS

TEXT BOOKS

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

REFERENCES

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

AE9254 AIRCRAFT SYSTEMS AND INSTRUMENTS L T P C
3 0 0 3

AIM:

To introduce the types of instruments and systems used in Aircraft.
Pre-requisite: Basics of Aeronautics

OBJECTIVE:

To introduce the hydraulic and pneumatic systems components and operate, types of instruments and its operation including navigational instruments

UNIT I AIRCRAFT SYSTEMS 8

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

UNIT II AIRPLANE CONTROL SYSTEMS 12

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

UNIT III ENGINE SYSTEMS 8

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

UNIT IV AIRCONDITIONING AND PRESSURIZING SYSTEM 8

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

UNIT V AIRCRAFT INSTRUMENTS 9

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

TOTAL : 45 PERIODS

TEXT BOOKS

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

REFERENCES

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

AE9255 AIRCRAFT STRUCTURES LABORATORY – I L T P C
0 0 3 2

LIST OF EXPERIMENTS

1. Deflection of a Simply-Supported Beam
2. Verification of Maxwell's Reciprocal Theorem
3. Tensile testing using the UTM
4. Poisson Ratio Determination
5. Verification of the Superposition Theorem
6. Buckling Load of Slender Eccentric Columns
7. Construction of a Southwell Plot
8. Non-Destructive Testing Procedures
9. Shear Failure of Bolted and Rivetted Joints
10. Bending Modulus of a Sandwich Beam

TOTAL : 45 PERIODS

AE9256 AERODYNAMICS LABORATORY – I L T P C
0 0 3 2

1. Application of Bernoulli's Equation – Venturimeter and Orifice meter.
2. Frictional Loss in laminar flow through pipes.
3. Frictional Loss in turbulent flow through pipes.
4. Calibration of a Subsonic Wind tunnel.
5. Determination of lift for the given airfoil section.
6. Pressure distribution over a smooth circular cylinder.
7. Pressure distribution over a rough circular cylinder.
8. Pressure distribution over a symmetric aerofoil.
9. Pressure distribution over a cambered aerofoil.
10. Flow visualization studies in subsonic flows.

TOTAL: 45 PERIODS

EI9261 ELECTRICAL AND ELECTRONICS ENGINEERING LAB L T P C
0 0 3 2

1. Load test on separately excited DC shunt generator
2. Load test on DC shunt moor
3. Load test on Sϕ Transformer
4. Load test on Induction motor
5. Regulation of 3ϕ Alternator
6. Study of CRO
7. Logic gates
8. Operational amplifiers
9. Time constant of RC circuit
10. Characteristics of LVDT
11. Calibration of Rotometer
12. RTD and thermistor
13. Flapper Nozzle system

TOTAL: 45 PERIODS

AE9301 AIRCRAFT STRUCTURES – II L T P C
3 0 0 3

UNIT I UNSYMMETRICAL BENDING 9

Bending of symmetric beams subject to skew loads - bending stresses in beams of unsymmetrical sections – generalized 'k' method, neutral axis method, principal axis method.

UNIT II SHEAR FLOW IN OPEN SECTIONS 9

Thin walled beams – concept of shear flow – the shear centre and its determination – shear flow distribution in symmetrical and unsymmetrical thin-walled sections – structural idealization – shear flow variation in idealized sections.

UNIT III SHEAR FLOW IN CLOSED SECTIONS 9

Bredt - Batho theory – single-cell and multi-cell tubes subject to torsion – shear flow distribution in thin-walled single & multi-cell structures subject to combined bending torsion – with walls effective and ineffective in bending – shear centre of closed sections.

UNIT IV BUCKLING OF PLATES 8

Bending of thin plates – rectangular sheets under compression - local buckling stress of thin walled sections – crippling strength estimation – thin-walled column strength – load carrying capacity of sheet stiffener panels – effective width.

UNIT V STRESS ANALYSIS OF WING AND FUSELAGE 10

Loads on an aircraft – the V-n diagram – shear force and bending moment distribution over the aircraft wing and fuselage – shear flow in thin-webbed beams with parallel and non-parallel flanges – complete tension field beams – semi-tension field beam theory.

TOTAL : 45 PERIODS

TEXT BOOK

1. Megson T M G , 'Aircraft Structures for Engineering Students', Edward Arnold, 1995.
2. Bruhn. E.H., 'Analysis and Design of Flight Vehicles Structures', Tri-state off-set company, USA, 1985.
3. Howard D Curtis, 'Fundamentals of Aircraft Structural Analysis', WCB-McGraw Hill, 1997

REFEENCES

1. Rivello, R.M., Theory and Analysis of Flight Structures, McGraw Hill, 1993.
2. Peery, D.J., and Azar, J.J., Aircraft Structures, 2nd edition, McGraw – Hill, N.Y., 1999

AE9302 AERODYNAMICS – II L T P C
3 0 0 3

AIM:

To introduce the concepts of High sped aerodynamics.

Pre-requisite: Basics of Fluid Mechanics

OBJECTIVE:

To introduce the concepts of compressibility, to make the student understand the theory behind the formation of shocks and expansion fans in Supersonic flows. To introduce the methodology of measurements in Supersonic flows.

UNIT I FUNDAMENTAL ASPECTS OF COMPRESSIBLE FLOW 8

Compressibility, Continuity, Momentum and energy equation for steady one dimensional flow, compressible Bernoulli's equation, Calorically perfect gas, Mach Number, Speed of sound, Area – Mach number – Velocity relation, Mach cone, Mach angle, One dimensional Isentropic flow through variable area duct, Static and Stagnation properties, Critical conditions, Characteristic Mach number, Area-Mach number relation, Maximum discharge velocity.

UNIT II SHOCK AND EXPANSION WAVES 12

Normal shock relations, Prandtl's relation, Hugoniot equation, Raleigh Supersonic Pitot tube equation, Moving normal shock waves, Oblique shocks, $\vartheta - \beta - M$ relation, Shock Polar, Reflection of oblique shocks, left running and right running waves, Interaction of oblique shock waves, slip line, Rayleigh flow, Fanno flow, Expansion waves, Prandtl-Meyer expansion, Maximum turning angle, Simple and non-simple regions, operating characteristics of Nozzles, under expansion, over expansion.

UNIT III TWO DIMENSIONAL COMPRESSIBLE FLOW 9

Potential equation for 2-dimensional compressible flow, Linearisation of potential equation, perturbation potential, Linearised Pressure Coefficient, Linearised subsonic flow, Prandtl-Glauert rule, Linearised supersonic flow, Method of characteristics.

UNIT IV HIGH SPEED FLOW OVER AIRFOILS, WINGS AND AIRPLANE CONFIGURATION 8

Critical Mach number, Drag divergence Mach number, Shock Stall, Supercritical Airfoil Sections, Transonic area rule, Swept wing, Airfoils for supersonic flows, Lift, drag, Pitching moment and Centre of pressure for supersonic profiles, Shock-expansion theory, wave drag, supersonic wings, Design considerations for supersonic aircrafts.

UNIT V SPECIAL TOPICS 8

Shock-Boundary layer interaction, Wind tunnels for transonic, Supersonic and hypersonic flows, shock tube, Gun tunnels, Supersonic flow visualization, Introduction to Hypersonic Flows, Numerical Analysis of one Dimensional flow.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Anderson, J. D, Modern Compressible Flow, McGraw-Hill & Co., 2002.
2. Rathakrishnan., E, Gas Dynamics, Prentice Hall of India, 2004.

REFERENCES

1. Shapiro, A. H., Dynamics and Thermodynamics of Compressible Fluid Flow, Ronald Press, 1982.
2. Zucrow, M. J. and Anderson, J. D., Elements of Gas Dynamics, McGraw- Hill & Co., 1989.
3. Oosthuizen,P.H., & Carscallen,W.E., Compressible Fluid Flow, McGraw- Hill & Co., 1997.

AE9303 PROPULSION – II L T P C
3 0 0 3

UNIT I NOZZLES FOR JET ENGINES 8

Real flow in nozzles and nozzle efficiency – losses in nozzles – equilibrium flow and frozen flow in nozzles- two phase flow in nozzles – Ejector and variable area nozzles - Interaction of nozzle flow with adjacent surfaces – thrust reversal.

UNIT II RAMJET PROPULSION 8

Operating principle of ramjet engine – various components of ramjet engines and their efficiencies – Combustion in ramjet engine – critical, subcritical and supercritical modes of operation -ramjet engine and its performance characteristics – sample ramjet design calculations – flame stability problems in ramjet combustors –integral ram rockets.

UNIT III HYPERSONIC AIRBREATHING PROPULSION 9

Introduction to hypersonic airbreathing propulsion, hypersonic vehicles and supersonic combustion- need for supersonic combustion for hypersonic propulsion – salient features of scramjet engine and its applications for hypersonic vehicles – problems associated with supersonic combustion – engine/airframe integration aspects of hypersonic vehicles – various types scramjet combustors – fuel injection schemes in scramjet combustors – one dimensional models for supersonic combustion using method of influence coefficients.

UNIT IV CHEMICAL ROCKET PROPULSION 12

Operating principle – specific impulse of a rocket – internal ballistics – rocket performance considerations – solid propellant rockets – selection criteria of solid propellants – propellant grain design considerations – erosive burning in solid rockets – liquid propellant rockets – selection of liquid propellants – various feed systems for liquid rockets -thrust control in liquid rockets – cooling in liquid rockets and the associated heat transfer problems – advantages of liquid rockets over solid rockets - introduction to hybrid propulsion – advantages and limitations of hybrid propulsion - static testing of rockets and safety considerations.

UNIT V ADVANCED PROPULSION TECHNIQUES 8

Introduction to nozzleless propulsion and basic concepts - Electric rocket propulsion – Ion propulsion – Nuclear rocket – comparison of performance of these propulsion systems with chemical rocket propulsion systems - Solar sail.

L = 45, TOTAL: 45 PERIODS

TEXT BOOKS:

1. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 5th Edition, 1993.
2. Mathur, M.L., and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers and Distributors, Delhi, 1988.

REFERENCES:

1. David H. Heiser and David T. Pratt., “Hypersonic Airbreathing Propulsion”, AIAA Education Series, 1999.

AE9304 AIRCRAFT PERFORMANCE L T P C
3 0 0 3

AIM:

To introduce the concepts of Dynamics of Airplanes.
Pre-requisite: Basics of Aerodynamics.

OBJECTIVE:

To make the student understand the performance of airplanes under various flight conditions like take off, cruise, landing, climbing, gliding, turning etc.

UNIT I GENERAL CONCEPTS: 9

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

UNIT II DRAG OF BODIES: 8

Streamlined and bluff body, Types of drag, Effect of Reynold's number on skin friction and pressure drag, Drag reduction of airplanes, Dragpolar, Effect of Mach number on drag polar

UNIT III STEADY LEVEL FLIGHT: 10

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

UNIT IV GLIDING AND CLIMBING FLIGHT: 9

Shallow and steep angles of climb, Rate of climb, Climb hodograph, Maximum Climb angle and Maximum Rate of climb- Effect of design parameters for propeller and jet aircrafts, Absolute and service ceiling, Cruise climb, Gliding flight, Glide hodograph

UNITV ACCELERATD FLIGHT: 9

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

L : 45 TOTAL: 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

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

AE9305 THEORY OF ELASTICITY L T P C

3 0 0 3

UNIT I BASIC EQUATIONS OF ELASTICITY 9

Stress – Strain – Stress Strain relationships - Equations of Equilibrium, Compatibility equations and strains, Boundary Conditions, Saint Venant's principle - Principal Stresses Stress Ellipsoid - Stress invariants.

UNIT II PLANE STRESS AND PLANE STRAIN PROBLEMS 9

Airy's stress function, Biharmonic equations, Polynomial solutions, Simple two dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams.

UNIT III POLAR COORDINATES 9

Equations of equilibrium, Strain displacement relations, Stress – strain relations, Airy's stress function, Axi – symmetric problems, Kirsch, Michell's and Boussinesque problems – Rotating discs.

UNIT IV TORSION 9

Navier's theory, St. Venant's theory, Prandtl's theory on torsion, The semi- inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections.

UNIT V THEORY OF PLATES 9

Classical plate theory – Assumptions – Governing equations – Boundary conditions – Navier's method of solution for simply supported rectangular plates – Levy's method of solution for rectangular plates under different boundary conditions.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Timoshenko, S., and Goodier, T.N., Theory of Elasticity, McGraw – Hill Ltd., Tokyo, 1990.
2. Ansel C Ugural and Saul K Fenster, 'Advanced Strength and Applied Elasticity', 4th Edition, Prentice Hall, New Jersey, 2003.

REFERENCES

1. Wang, C.T., Applied Elasticity, McGraw – Hill Co., New York, 1993.
2. Sokolnikoff, I.S., Mathematical Theory of Elasticity, McGraw – Hill New York, 1978.
3. Enrico Volterra & J.H. Caines, Advanced Strength of Materials, Prentice Hall New Jersey, 1991

AE9306 EXPERIMENTAL STRESS ANALYSIS L T P C
3 0 0 3

UNIT I EXTENSOMETERS 8

Principles of measurements, Accuracy, Sensitivity and range of measurements, Mechanical, Optical, Acoustical and Electrical extensometers and their uses, Advantages and disadvantages**.**

UNIT II ELECTRICAL RESISTANCE STRAIN GAUGES 12

Principle of operation and requirements, Types and their uses, Materials for strain gauge, Calibration and temperature compensation, cross sensitivity, Rosette analysis, Wheastone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators.

UNIT III PHOTOELASTICITY 12

Two dimensional photo elasticity, Photo elastic materials, Concept of light - photoelastic effects, stress optic law, Transmission and Reflection polariscopes, Interpretation of fringe pattern, Compensation and separation techniques, Introduction to three dimensional photo elasticity.

UNIT IV BRITTLE COATING AND MOIRE METHODS 5

Introduction to Moiré techniques, Brittle coating methods and Holography

UNIT V NON – DESTRUCTIVE TESTING 8

Fundamentals of NDT, Radiography, Ultrasonics, Eddy Current testing, Fluorescent Penetrant Testing, Acoustic Emission Technique,

TOTAL: 45 PERIODS

TEXT BOOKS

1. Dally, J.W., and Riley, W.F., Experimental Stress Analysis, McGraw Hill Inc., New York 1998.
2. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., Experimental Stress Analysis, Tata McGraw Hill, New Delhi, 1984.

REFERENCES

1. Hetenyi, M., Hand book of Experimental Stress Analysis, John Wiley and Sons Inc., New York, 1972.
2. Pollock A.A., Acoustic Emission in Acoustics and Vibration Progress, Ed. Stephens R.W.B., Chapman and Hall,1993.
3. Max Mark Frocht, Photo Elasticity, John Wiley and Sons Inc., New York, 1968
4. A.J.Durelli, Applied Stress Analysis, Prentice Hall of India Pvt Ltd., New Delhi, 1970

AE9307 CONTROL ENGINEERING L T P C
3 0 0 3

UNIT I INTRODUCTION: 7

Historical review, Simple pneumatic, hydraulic and thermal systems, Series and parallel system, Analogies, mechanical and electrical components, Development of flight control systems.

UNIT II OPEN AND CLOSED LOOP SYSTEMS: 8

Feedback control systems Block diagram representation of control systems, Reduction of block diagrams, Output to input ratios.

UNIT III CHARACTERISTIC EQUATION AND FUNCTIONS: 8

Laplace transformation, Response of systems to different inputs viz., Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.

UNIT IV CONCEPT OF STABILITY 12

Necessary and sufficient conditions, Routh-Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response.

UNIT V SAMPLED DATA SYSTEMS 10

Z-Transforms Introduction to digital control system, Digital Controllers and Digital PID controllers

L: 45, TOTAL:45 PERIODS

TEXT BOOKS:

1. OGATO, Modern Control Engineering, Prentice-Hall of India Pvt.Ltd., New Delhi, 1998.
2. Azzo, J.J.D. and C.H. Houpis Feed back control system analysis and synthesis, McGraw-Hill international 3rs Edition, 1998.

REFERENCES:

1. Kuo, B.C. Automatic control systems, Prentice-Hall of India Pvt.Lted., New Delhi, 1998.
2. Houpis, C.H. and Lamont, G.B. Digital control Systesm, McGraw Hill Book co., New York, U.S.A. 1995.
3. Naresh K Sinha, Control Systems, New Age International Publishers, New Delhi, 98.

AE9308 AIRCRAFT STRUCTURES LAB – II L T P C
0 0 3 2

LIST OF EXPERIMENTS

1. Unsymmetrical Bending of a Cantilever Beam
2. Combined bending and Torsion of a Hollow Circular Tube
3. Material Fringe Constant of a Photoelastic Model
4. Shear Centre of a Channel Section
5. Free Vibration of a Cantilever Beam
6. Fabrication of a Composite Laminate
7. Preparation of Test Specimens
8. Material Properties of a Composite Laminate
9. Wagner beam – Tension field beam
10. Forced Vibration of Beams

TOTAL: 45 PERIODS

AE9309 AERODYNAMICS LABORATORY- II L T P C
0 0 3 2

1. Pressure distribution over a finite wing of symmetric aerofoil section.
2. Pressure distribution over a finite wing of cambered aerofoil section.
3. Pressure distribution over a Nose cone model.
4. Determination of Base drag of a missile model.
5. Determination of profile drag of bodies by wake survey method.
6. Study of flow field over a backward facing step.
7. Pressure distribution over a water tank model for various wind speeds.
8. Velocity profiles for different simulated terrains.
9. Calibration of Supersonic Wind Tunnel.
10. Flow visualization studies in supersonic flows.

TOTAL: 45 PERIODS

AE9310 **TECHNICAL SEMINAR** **L T P C**
(*Common to all Branches)* **0 0 2 1**

OBJECTIVE

During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for a duration of about 8 to 10 minutes. In a session of three periods per week, 15 students are expected to present the seminar. A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.

Students are encouraged to use various teaching aids such as over head projectors, power point presentation and demonstrative models. This will enable them to gain confidence in facing the placement interviews.

AE9351 **AIRCRAFT STABILITY & CONTROL** **L T P C**
3 1 0 4

AIM: To introduce the concepts of stability and control of airplanes.

PRE-REQUISITE: Basics of Aerodynamics

OBJECTIVE:
To make the student understand the concepts of stable and nonstable configuration of airplanes. To introduce the concepts of control of airplanes under various operating conditions.

UNIT I STATIC LONGITUDINAL STABILITY AND CONTROL 15
General concepts-Degrees of freedom of a rigid body, Static and dynamic stability, Need for stability in an airplane, inherently and marginally stable airplanes, Stability and Controllability, Requirements of control surfaces, criteria for longitudinal static stability, contribution to stability by wing, tail, fuselage, wing fuselage combination, Total longitudinal stability, Neutral point-Stick fixed and Stick free aspects, Free elevator factor, static margin, Hinge moment, Power effects on stability-propeller and jet aircrafts, longitudinal control, Movement of centre of gravity, elevator control effectiveness, elevator control power, elevator angle to trim, elevator angle per g, maneuver point, Stick force gradient and stick force per g, Aerodynamic balancing

UNIT II STATIC DIRECTIONAL STABILITY AND CONTROL 12
Directional stability-yaw and sideslip, Criterion of directional stability, contribution to static directional stability by wing, fuselage, tail, Power effects on directional stability-propeller and jet aircrafts, Rudder fixed and rudder free aspects, Rudder lock and Dorsal fin, Directional control, rudder control effectiveness, rudder requirements, adverse yaw, asymmetric power condition, spin recovery

UNIT III STATIC LATERAL STABILTY AND CONTROL 12
Lateral stability-Dihedral effect, criterion for lateral stability, evaluation of lateral stability-contribution of fuselage, wing, wing fuselage, tail, total static lateral stability, lateral control, aileron control power, aileron effectiveness, strip theory estimation of aileron effectiveness, roll control by spoilers, aileron reversal, aileron reversal speed

UNIT IV DYNAMIC LONGITUDINAL STABILITY 11
Aircraft Equations of motion, small disturbance theory, Estimation of longitudinal stability derivatives stability derivatives, Routh's discriminant, solving the stability quartic, Phugoid motion, Factors affecting the period and damping.

UNIT V DYNAMIC LATERAL AND DIRECTIONAL STABILITY 10

Dutch roll and spiral instability, Auto rotation and spin, Stability derivatives for lateral and directional dynamics.

L:45 TOTAL: 60 PERIODS

TEXT BOOKS

1. Perkins C.D. & Hage R.E. Airplane performance, stability and control, John Wiley & Sons 1976.
2. Nelson, R.C. Flight Stability & Automatic Control, McGraw Hill, 1998.

REFERENCES

1. McCormick, B.W. Aerodynamics, Aeronautics & Flight Mechanics John Wiley, 1995.
2. Babister, A.W. Aircraft Stability and response, Pergamon Press, 1980
3. Etkin, B., Dynamics of Flight Stability and Control, John Wiley, New York, 1982.
4. Pamadi, B.N. Performnce, Stability, Dynamics, and Control of Airplanes, AIAA Education Series, 2004

AE9352 NUMERICAL METHODS IN FLUID DYNAMICS L T P C
3 0 0 3

UNIT I INTRODUCTION TO NUMERICAL METHODS IN FLUID DYNAMICS 8

Introduction to numerical fluid dynamics and the role of numerical methods in modern fluid dynamics - Introduction to governing equations of fluid dynamics and modeling of fluid flow – Eulerian and Lagrangian approaches - The substantial derivative and the physical meaning of divergence of a vector

UNIT II DERIVATION OF GOVERNING EQUATION 9

Derivation of energy equation and the common form of all fluid flow governing equations - The conservation forms of fluid flow governing equations and the various forms of energy equation - Introduction and derivation of species equation and preliminary concepts on combustion modeling - Governing equations for viscous and inviscid flows.

UNIT III BOUNDARY CONDITIONS AND MATHEMATICAL NATURE OF FLUID DYNAMIC EQUATIONS 8

Boundary conditions for various types of fluid flow conditions - Introduction to mathematical properties of fluid dynamic equations and classification of partial differential equations - General behaviour of different classes of partial differential equations and their relation to fluid dynamics - A general discussion on hyperbolic, parabolic and elliptic equations – well posed problems.

UNIT IV DISCRETIZATION, STABILITY ANALYSIS AND PANEL METHODS 9

Introduction to discretization of partial differential equations - Derivation of elementary finite difference equations - Basic aspects of finite difference equations - Errors and analysis of stability - Introduction to panel methods - Basic aspects of uniform, source and vortex flows - Source panel method – nonlifting flows over arbitrary two-dimensional bodies - Vortex panel method – lifting flows over arbitrary two-dimensional bodies - Applications of panel methods.

UNIT V NUMERICAL METHODS FOR STEADY SUPERSONIC FLOWS 11

Introduction to numerical techniques for steady supersonic flows - Philosophy of method of characteristics - Determination of the characteristic lines – two dimensional irrotational flow - Determination of the Compatibility equations and Unit processes - Regions of Influence and Domains of Dependence - Supersonic nozzle design using method of characteristics - Application of method of characteristics for Axisymmetric Irrotational Flow and rotational flow - Introduction to three dimensional method of characteristics - Description of Mc Cormack's Predictor – Corrector technique - Stability Criterion – CFL criterion - Shock capturing Vs Shock fitting techniques: conservation Vs nonconservation forms of governing equations - transonic flows and transonic similarity - Numerical solution to small perturbation velocity potential equation.

L = 45: TOTAL: 45 PERIODS

TEXT BOOKS:

1. John D. Anderson, " Modern Compressible Flow", Mc.Graw Hill, 1999.
2. C.A.J. Fletcher, "Computational Techniques for Fluid Dynamics 1" Springer Verlag,1995.

REFERENCES:

1. T. J. Chung, "Computational Fluid Dynamics", Cambridge University Press, 2002.
1. C. Hirch, "Numerical Computation of Internal and External Flows" Volume-1, John Wiley and Sons, 1994.
3. C.A.J. Fletcher, "Computational Techniques for Fluid Dynamics 2", Springer Verlag, 1995.

AE9353 COMPOSITE MATERIALS AND STRUCTURES L T P C
3 0 0 3

UNIT I MICROMECHANICS 10

Introduction - Advantages and application of composite materials - reinforcements and matrices - Micro mechanics – Mechanics of materials approach, elasticity approach to determine material properties – Fibre Volume ratio – Mass fraction – Effect of voids, hygro thermal effects on a lamina.

UNIT II MACROMECHANICS 10

Generalized Hooke's Law - Elastic constants for anisotropic, orthotropic and isotropic materials - Macro Mechanics – Stress-strain relations with respect to natural axis, arbitrary axis – Determination of material properties - Experimental characterization of lamina.

UNIT III LAMINATED PLATES 10

Governing differential equation for a unidirectional lamina and general laminate, angle ply and cross ply laminate, Failure criteria for composites.

UNIT IV FABRICATION PROCESS 8

Various open and closed mould processes, Manufacture of fibers, Types of resins, properties and applications, Netting analysis.

UNIT V SANDWICH CONSTRUCTIONS 7

Basic design concepts of sandwich construction - Materials used for sandwich construction - Failure modes of sandwich panels - Bending stress and shear flow in composite beams.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Jones, R.M., "Mechanics of Composite Materials," Taylor & Francis, II Edition, 2000.
2. Madhuji Mukhapadhyay, Mechanics of Composite Materials and Structures, University Press, 2004

REFERENCES

1. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites," John Wiley and sons. Inc., New York, 1995.
2. Lubin, G., Handbook on Advanced Plastics and Fibre Glass, Von Nostrand Reinhold Co., New York, 1989.
3. Autar K Kaw, 'Mechanics of Composite Materials', CRC Press, 1997.
4. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Nostrand Reinhold Company, New York 1998
5. Allen Baker, Composite Materials for Aircraft Structures, AIAA Series, II Edition, 1999.

AE9354 FINITE ELEMENT METHODS L T P C
3 0 0 3

UNIT I INTRODUCTION 8

Review of various approximate methods – Raleigh Ritz's, Galerkin and finite difference methods- Governing equation and convergence criteria of finite element method.

UNIT II DISCRETE ELEMENTS 10

Bar elements, uniform section, mechanical and thermal loading, varying section, truss analysis. Beam element - problems for various loadings and boundary conditions - longitudinal and lateral vibration. Use of local and natural coordinates.

UNIT III CONTINUUM ELEMENTS 8

Plane stress, Plane strain and axisymmetric problems, constant and linear strain, triangular elements, stiffness matrix, axisymmetric load vector,

UNIT IV ISOPARAMETRIC ELEMENTS 10

Definitions, Shape function for 4, 8 and 9 nodal quadrilateral elements, Stiffness matrix and consistent load vector, Gaussian integration

UNIT V FIELD PROBLEM 9

Heat transfer problems, Steady state fin problems, Derivation of element matrices for two dimensional problems, Torsion problems

TOTAL: 45 PERIODS

TEXT BOOK

1. Tirupathi.R. Chandrapatha and Ashok D. Belegundu – Introduction to Finite Elements in Engineering – Printice Hall India, Third Edition, 2003.
2. Rao. S.S., Finite Element Methods in Engineering, Butterworth and Heinemann, 2001

REFERENCES

1. Reddy J.N. – An Introduction to Finite Element Method – McGraw Hill – 2000.
2. Krishnamurthy, C.S., Finite Element Analysis, Tata McGraw Hill, 2000.
3. Bathe, K.J. and Wilson, E.L., Numerical Methods in Finite Elements Analysis, Prentice Hall of India, 1985.
4. Robert D Cook, David S Malkus, Michael E Plesha, 'Concepts and Applications of Finite Element Analysis', 4th edition, John Wiley and Sons, Inc., 2003.
5. Larry J Segerlind, 'Applied Finite Element Analysis', Second Edition, John Wiley and Sons, Inc. 1984.

AE9355 THEORY OF VIBRATIONS L T P C
3 0 0 3

UNIT I SINGLE DEGREE OF FREEDOM SYSTEMS 10

Introduction to simple harmonic motion, D'Alembert's Principle, Free vibrations – Damped vibrations – Forced Vibrations, with and without damping – support excitation – Vibration measuring instruments.

UNIT II MULTI DEGREES OF FREEDOM SYSTEMS 10

Two degrees of freedom systems - Static and Dynamic couplings - vibration absorber- Principal co-ordinates - Principal modes and orthogonal condition - Eigen value problems - Hamilton's principle - Lagrangean equations and application.

UNIT III CONTINUOUS SYSTEMS 8

Vibration of elastic bodies - Vibration of strings - Longitudinal - Lateral and Torsional vibrations

UNIT IV APPROXIMATE METHODS 9

Approximate methods - Rayleigh's method - Dunkerlay's method – Rayleigh-Ritz method, Matrix Iteration method.

UNITV ELEMENTS OF AEROELASTICITY 8

Vibration due to coupling of bending and torsion - Aeroelastic problems - Collars triangle - Wing Divergence - Aileron Control reversal – Flutter – Buffeting.

TOTAL: 45 PERIODS

TEXT BOOKS

1.Thomson W T, 'Theory of Vibration with Application' - CBS Publishers, 1990.
2.G.K.Grover, "Mechanical Vibrations", 7th Edition, Nem Chand Brothers, Roorkee, India, 2003

REFERENCES

1. Timoshenko S., Vibration Problems in Engineering – John Wiley and Sons, New York, 1993.
2. Bisplinghoff R.L., Ashely H and Hogman R.L., Aeroelasticity – Addision Wesley Publication, New york, 1983.
3. William W Seto, 'Mechanical Vibrations' – McGraw Hill, Schaum Series.
4. TSE. F.S., Morse, I.F., Hunkle, R.T., Mechanical Vibrations – Prentice Hall, New York, 1984.
5. Leonard Meirovitch, 'Elements of Vibration Analysis' – McGraw Hill International Edition Clarence W DeSilva, `Vibration – Fundamentals and Practice', CRC Press, Special Indian Edition, 2005

AE9356 AIRCRAFT DESIGN PROJECT - I L T P C
0 0 4 2

Students in a group of four or five students are assigned the design of an Airplane (or Helicopter or any other flight vehicle), to given preliminary specifications. The following are the assignments to be carried out:

1. Comparative studies of different types of airplanes and their specifications and performance details.

2. Preliminary weight estimations, selection of main parameters, power plant selection, aerofoil, Wing, tail and control surfaces, landing gear

3. Preparation of layouts of balance diagram and three view drawings.

4. Drag estimation, detailed performance, Calculations and stability estimates, V_n diagram.

TOTAL: 60 PERIODS

AE9357 PROPULSION LABORATORY L T P C
0 0 3 2

1. Velocity profiles of free jets.
2. Velocity profiles of wall jets.
3. Study of free convective heat transfer over a flat plate.
4. Study of forced convective heat transfer over a flat plate.
5. Combustion Studies in a model jet engine combustor.
6. Flame stabilization studies using conical flame holders.
7. Study of hybrid rocket propulsion system
8. Burn rate measurements of solid propellants
9. Ignition delay measurements of solid propellants.
10. Velocity and pressure measurements of co-axial jets
11. Flow visualization of secondary injection in a supersonic cross flow
12. Supersonic external flow visualization over a supersonic inlet.

TOTAL: 45 PERIODS

AE9358 CAD LABORATORY LT P C
0 0 3 2

1. Three View diagram of Aircraft.
2. Estimation of forces and design of members in plane and space trusses using software package.
3. Design of Landing gear.
4. Design of joints – bolted, riveted and welded joints.
5. Drafting of Aircraft Wing Structural Elements.
6. Drafting of Aircraft Fuselage Structural Elements.
7. Static analysis of beams using software packages.
8. Static analysis of Plates.
9. Static analysis of Shells.
10. Dynamic analysis of beams.
11. Thermal analysis of Structures.

TOTAL: 45 PERIODS

GE9371 COMMUNICATION SKILLS AND SOFT SKILLS LAB L T P C
0 0 2 1

AIM:
To enhance the overall capability of students and to equip them with the necessary Communication Skills and Soft Skills that would help them excel in their profession.

OBJECTIVES:
- To equip students of engineering and technology with effective speaking and listening skills in English.
- To help them develop their soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their job.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment exercises.

1. PC based session

A. Career Lab (15 periods) Viewing and discussing audio-visual materials

1. **Resume / Report Preparation / Letter Writing:** (3)
   Letter writing – Job application with Resume - Project report - Email etiquette.
2. **Presentation skills:** (3)
   Elements of effective presentation – Structure of presentation - Presentation tools – Body language.
3. **Soft Skills:** (3)
   Time management – Stress management – Assertiveness – Negotiation strategies, Psychometrics - Analytical and logical reasoning.

4. **Group Discussion:** (3)
   Group discussion as part of selection process, Structure of group discussion Strategies in group discussion – Mock group discussions.
5. **Interview Skills:** (3)
   Kinds of interviews – Interview techniques – Corporate culture – Mock interviews.

TOTAL: 45 PERIODS

II. Class Room Session

1. **Resume / Report Preparation / Letter writing**: Students prepare their own resume and report. (9)
2. **Presentation Skills:** Students make presentations on given topics. (12)
3. **Group Discussion**: Students participate in group discussions. (12)
4. **Interview Skills**: Students participate in Mock Interviews (12)

Note: Classroom sessions are practice sessions.

REFERENCES:

1. Prakash P, **Verbal and Non-Verbal Reasoning**, Macmillan India Ltd., 2nd Edition, New Delhi, 2004.
2. John Seely, **The Oxford Guide to Writing and Speaking**, Oxford University Press, New Delhi 2004.
3. Paul V Anderson, **Technical Communication**, Thomson Wadsworth , 6th Edition, New Delhi, 2007.
4. Edgar Thorpe and Showick Thorpe, **Objective English**, Pearson Education, 2nd Edition, New Delhi 2007.
5. David Evans, **Decision maker**, CUP, 1997

Lab Requirement:

1. Teacher console and systems for students.
2. English Language Lab Software
3. Tape recorders

PR9402 ENGINEERING MANAGEMENT L T P C
3 0 0 3

OBJECTIVES :

To train production Engineer to manage industrial scenario

UNIT I PRINCIPLES OF MANAGEMENT AND PERSONNEL MANAGEMENT 7

General principles of management - management functions - organization - types - comparison - functions of personnel management - recruitment training leadership/motivation - communication - Conflict - Industrial relations - trade union.

UNIT II INVENTORY MANAGEMENT 11

Purpose of Inventory - Cost related to inventory - Basic EOO model - variations in EOO model - Finite Production, quantity discounts - ABC Analysis - MRP

UNIT III OPERATIONS MANAGEMENT 11

Plant Location - Layout - Materials Handling - Method Study - Time Study - Ergonomics - Aggregate Planning - Value Analysis

UNIT IV FINANCIAL MANAGEMENT 11

Capital - Types - sources - break even analysis - financial statements - income statement - balance sheet - capital bUdgeting - working capital management - inventory pricing.

UNIT V MARKETING MANAGEMENT 11

Functions of marketing - Sales promotion methods - advertising - product packaging - marketing variables - distribution channels - organization - market research - market research techniques.

TOTAL: 45 PERIODS

TEXT BOOKS

1. R. Kesavan, C.Elanchezhian and T.Sundar Selwyn - Engineering management Eswar Press, 2005
2. R. Panneerselvam - Production and Operations Management - Prentice Hall of India, 2003

REFERENCES:

1. Koontz and Odonnel-"Essentials of Management", McGraw Hill 1992.
2. Philips Kotler - "Principles of Marketing", Prentice Hall of India, 1995.
3. I.M. Pandey - "Financial Management", Vikas Publishing house, 1995.
4. K.K.Ahuja - "Personnel Management", Kalyane Publication 1992.
5. K.Panneerselvam - "Production and Operations Management" - Prentice Hall of India, 2003.
6. Martand T. Telesand - "Industrial and Business Management" - S.Chand & Co., 2001.
7. R. Kesavan, C.Elanchezian and BVijayaramnath - "Production Planning and Control", Anuratha Publishing Co. Ltd., Chennai - 2008.

AE9401 COMPUTATIONAL FLUID DYNAMICS L T P C

3 0 0 3

UNIT I GRID GENERATION 8

Introduction to grid generation in computational fluid dynamics - Structured grid generation techniques – algebraic methods, conformal mapping and methods using partial differential equations - Basic ideas in numerical grid generation and mapping - Boundary value problem of numerical grid generation- grid control functions- branch cut - The boundary conditions of first kind – orthogonality of grid lines- boundary point grid control - Introduction to adaptive grids.

UNIT II SOLUTION OF BOUNDARY LAYER EQUATIONS 8

Introduction to boundary layer equations and their solution - Description of Prandtl's boundary layer equations and the hierarchy 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 the boundary layer equations and illustration of solution of a tridiagonal system of linear algebraic equations.

UNIT III EXPLICIT TIME DEPENDENT METHODS 10

Introduction to time dependent methods - Explicit time dependent methods – Euler, Backward Euler, One step trapezoidal, Backward differencing, two-step trapezoidal, Leap Frog and Adams-Bashforth Methods - 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 IMPLICIT TIME DEPENDENT METHODS 9

Introduction to implicit methods and respective stability properties of explicit and implicit methods - Stiff problems- absolute stability and stability of numerical methods for the integration of partial differential equations - Construction of implicit methods for time dependent problems - Linearization, choice of explicit operator and numerical dissipation aspects - Choice of the linear system solution strategy – one dimensional and two-dimensional problems by implicit methods.

UNIT V FINITE VOLUME METHOD 10

Introduction to Finite volume Method - Different Flux evaluation schemes, central, upwind, exponential and hybrid schemes - Staggered grid approach - Pressure-Velocity coupling - SIMPLE, SIMPLER algorithms- pressure correction equation (both incompressible and compressible forms) - Application of Finite Volume Method for 1-D and 2-D problems.

L: =45, TOTAL: 45 PERIODS

TEXT BOOKS:

1. C.A.J. Fletcher, "Computational Techniques for Fluid Dynamics 1" Springer Verlag,1995.
2. C.A.J. Fletcher, "Computational Techniques for Fluid Dynamics 2", Springer Verlag, 1995

REFERENCES:

1. H.K. Versteeg and W. Malalsekera "An Introduction to Computational Fluid Dynamics, The Finite Volume Method", Longman Scientific & Technical, 1995.
2. T. J. Chung, "Computational Fluid Dynamics", Cambridge University Press, 2002.
3. C. Hirch, "Numerical Computation of Internal and External Flows" Volume-2, John Wiley and Sons, 1994.

AE9402 HEAT TRANSFER L T P C
3 0 0 3

AIM:

To make the students familiarized with the course on basics of heat transfer and practical application of the course

OBJECTIVE:

The students who under go this course may be able to apply their knowledge gained in real time works which may be beneficial to the research area involving heat transfer .

PRE-REQUISITE: Knowledge of Thermodynamics

UNIT I FUNDAMENTALS 2

Modes of heat transfer : Conduction – Convection - Radiation

UNIT II HEAT CONDUCTION 8

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

UNIT III FREE AND FORCED CONVECTION 15

Convection fundamentals: Basic equations, Boundary layer concept, Dimensional analysis

Free Convention: Laminar boundary layer equation-Free convection in atmosphere free convection on a vertical flat plate – Integral method-Empirical relation in free convection –External flows. **Forced convection:** Forced convection - Laminar and turbulent convective heat transfer analysis in flows between parallel plates, over a flat plate and in a circular pipe. Empirical relations - numerical techniques in problem solving.

UNIT IV RADIATIVE HEAT TRANSFER AND HEAT EXCHANGERS 12

Concept of black body-Intensity of radiation-Laws of Black body Radiation-Radiation from non black surfaces- real surfaces – Radiation between surfaces-Radiation shape factors-Radiation shields. **HEAT EXCHANGERS:** Types-overall heat transfer coefficient- LMTD- NTU method of heat exchanger Analysis.

UNIT V HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING 8

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

TOTAL: 45 PERIODS

TEXT BOOKS:

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

REFERENCES

1. Sachdeva, S.C., " Fundamentals of Engineering Heat and Mass Transfer " , Wiley Eastern Ltd., NewDelhi, 1981.
2. Sutton, G.P., " Rocket Propulsion Elements ", John Wiley and Sons, 5th Edn.1986.
3. Mathur, M.and Sharma, R.P., " Gas Turbine and Jet and Rocket Propulsion " , Standard Publishers, NewDelhi 1988.

AE9403 AIRCRAFT DESIGN PROJECT – II L T P C
0 0 4 2

Each group of students is assigned the continuation of the design project – I or any other, as the case may be. The following are the assignments to be carried out.

1. Preliminary design of an aircraft wing – Shrenck's curve, structural load distribution, shear force, bending moment and torque diagrams
2. Detailed design of an aircraft wing – design of spars and stringers, bending stress and shear flow calculations – buckling analysis of wing panels
3. Preliminary design of an aircraft fuselage – load distribution on an aircraft fuselage
4. Detailed design of an aircraft fuselage – design of bulkheads and longerons – bending stress and shear flow calculations – buckling analysis of fuselage panels
5. Design of control surfaces - balancing and maneuvering loads on the tail plane and aileron, rudder loads
6. Design of wing-root attachment
7. Landing gear design
8. Preparation of a detailed design report with CAD drawings

TOTAL: 60 PERIODS

AE9404 COMPREHENSION AND TECHNICAL SEMINAR L T P C
0 0 2 1

Comprehension will be conducted with a written test during the semester and one viva-voce examination at the end of the semester in all the subjects during their course of study. The written test will consist of questions of multiple choices, objective type; fill in the blanks, true or false and short answer type questions. Also the students have to give a seminar on a topic relevance to the study.

AE9451 PROJECT WORK L T P C
0 0 12 6

Students in a group of two or three will be assigned a project involving – design – fabrication - theoretical studies - experimental studies on some problem related to Aerospace Engineering. Continuous internal assessment marks for the project will be given during project review meetings. The student has to prepare and present a detailed project report at the end of the semester and give a talk about the work done. End semester examination mark will be based on viva voce examination.

PRACTICAL: 180

AE9452 FLIGHT TRAINING L T P C
0 0 3 1

1. C.G. determination
2. Calibration of ASI and Altimeter
3. Calibration of special instruments
4. Cruise and climb performance
5. Determination of stick fixed & stick free neutral points
6. Determination of stick fixed & stick free maneuver points
7. Verification of Lateral-directional equations of motion for a steady state side slip maneuver
8. Verification of Lateral-directional equations of motion for a steady state coordinated turn
9. Flight determination of drag polar of a glider
10. Demonstration of Phugoid motion and Dutch roll

TOTAL: 45 PERIODS

AE9021 SPACE MECHANICS L T P C
3 0 0 3

UNIT I BASIC CONCEPTS AND THE GENERAL N- BODY PROBLEM 10

The solar system – reference frames and coordinate systems – terminology related to the celestial sphere and its associated concepts – Kepler's laws of planetary motion and proof of the laws – Newton's universal law of gravitation - the many body problem - Lagrange-Jacobi identity – the circular restricted three body problem – libration points – the general N-body problem – two body problem – relations between position and time.

UNIT II SATELLITE INJECTION AND SATELLITE PERTURBATIONS 10

General aspects of satellite injection – satellite orbit transfer – various cases – orbit deviations due to injection errors – special and general perturbations – Cowell's method and Encke's method – method of variations of orbital elements – general perturbations approach.

UNIT III INTERPLANETARY TRAJECTORIES 8

Two-dimensional interplanetary trajectories – fast interplanetary trajectories – three dimensional interplanetary trajectories – launch of interplanetary spacecraft – trajectory estimation about the target planet – concept of sphere of influence – Lambert's theorem

UNIT IV BALLISTIC MISSILE TRAJECTORIES 9

Introduction to ballistic missile trajectories – boost phase – the ballistic phase – trajectory geometry – optimal flights – time of flight – re-entry phase – the position of impact point – influence coefficients.

UNIT V MATERIALS FOR SPACECRAFT 8

Space environment – peculiarities of space environment – effect of space environment on materials of spacecraft structure – materials required for the construction of space craft – TPS for re-entry space vehicles.

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS:

1. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co.,Ltd, London, 1982
2. Parker, E.R., "Materials for Missiles and Spacecraft", Mc.Graw Hill Book Co. Inc., 1982.

REFERENCES:

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1993.

AE9022 HELICOPTER AERODYNAMICS L T P C
3 0 0 3

AIM:

To introduce the basis of Helicopter Aerodynamics

PRE-REQUISITE: Basics of Aerodynamics

OBJECTIVE:

To introduce the concepts of ideal rotor theory and ground effect machines. To make the student understand the theory behind hovercrafts and VTOL and STOL aircrafts.

UNIT I ELEMENTS OF HELICOPTER AERODYNAMICS 8

Configurations based on Torque reaction – Jet rotors and compound helicopters – Methods of Control, rotor blade pitch control, –Collective pitch and and Cyclic pitch – Lead – Lag and flapping hinges

UNIT II IDEAL ROTOR THEORY 12

Hovering performance – Momentum and simple blade element theories – Figure of merit – Profile and induced power estimation – Constant Chord and ideal twist rotors.

UNIT III POWER ESTIMATES 10

Induced, profile and parasite power requirements in forward flight – Performance curves with effects of altitude – Preliminary ideas on helicopter stability.

UNIT IV LIFT, PROPULSION AND CONTROL OF V/STOL AIRCRAFT 8

Various configurations – propeller, rotor, ducted fan and jet lift – Tilt wing and vectored thrust –Performance of VTOL and STOL aircraft in hover, transition and forward motion.

UNIT V GROUND EFFECT MACHINES 7

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.

L : 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Gessow, A.and Myers, G. C., Aerodynamics of Helicopter, MacMillan & Co., 1987.
2. Gupta, L., Helicopter Engineering, Himalayan Books, 1996.

REFERENCES

1. Johnson, W., Helicopter Theory, Princeton University Press, 1980.
2. MacCromick, B. W., Aerodynamics of V/STOL Flight, Academic Press, 1987.

AE9023 BOUNDARY LAYER THEORY L T P C
3 0 0 3

AIM:

To introduce the fundaments of boundary layer theory

PRE-REQUISITE: Basics of fluid mechanics.

OBJECTIVES:

To make the student understand the importance of viscosity and boundary layer in fluid flow. To introduce the theory behind laminar and turbulent boundary layers.

UNIT I FUNDAMENTAL EQUATIONS OF VICOUS FLOW 8

Fundamental equations of viscous flow, Conservation of mass, Conservation of Momentum-Navier-Stokes equations, Energy equation, Mathematical character of basic equations, Dimensional parameters in viscous flow, Nondimensionalising the basic equations and boundary conditions, vorticity considerations, creeping flow, boundary layer flow

UNIT II SOLUTIONS OF VICOUS FLOW EQUATIONS 10

Solutions of viscous flow equations, Couette flows, Hagen-Poisuelle flow, Flow between rotating concentric cylinders, Combined Couette-Poiseuille Flow between parallel plates, Creeping motion, Stokes solution for an immersed sphere, Development of boundary layer, Displacement thickness, momentum and energy thickness.

UNIT III LAMINAR BOUNDARY LAYER EQUATIONS 12

Laminar boundary layer equations, Flat plate Integral analysis of Karman – Integral analysis of energy equation – Laminar boundary layer equations – boundary layer over a curved body-Flow separation- similarity solutions, Blasius solution for flat-plate flow, Falkner–Skan wedge flows, Boundary layer temperature profiles for constant plate temperature –Reynold's analogy, Integral equation of Boundary layer – Pohlhausen method – Thermal boundary layer calculations

UNIT IV TURBULENT BOUNDARY LAYER 8

Turbulence-physical and mathematical description, Two-dimensional turbulent boundary layer equations — Velocity profiles – The law of the wall – The law of the wake – Turbulent flow in pipes and channels – Turbulent boundary layer on a flat plate – Boundary layers with pressure gradient, Eddy Viscosity, mixing length , Turbulence modeling

UNIT V COMPRESSIBLE BOUNDARY LAYERS 7

Compressible boundary layer equations, Recovery factor, similarity solutions, laminar supersonic Cone rule, shock-boundary layer interaction

L : 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. White, F. M., Viscous Fluid Flow, McGraw-Hill & Co., Inc., New York., 1985.

REFERENCE BOOKS

1. Schlicting, H., Boundary Layer Theory, McGraw-Hill, New York, 1979.
2. Reynolds, A, J., Turbulent Flows Engineering, John Wiley and Sons, 1980.

AE9024 COMBUSTION L T P C
3 0 0 3

UNIT I FUNDAMENTAL CONCEPTS IN COMBUSTION, CHEMICAL KINETICS AND FLAMES 9

Thermo chemical equations – heat of reaction- first, second and third order reactions – premixed flames – diffusion flames – measurement of burning velocity – various methods – effect of various parameters on burning velocity – flame stability – deflagration – detonation – Rankine-Hugoniot curves – radiation by flames

UNIT II COMBUSTION IN AIRCRAFT PISTON ENGINES 8

Introduction to combustion in aircraft piston engines – various factors affecting the combustion efficiency - fuels used for combustion in aircraft piston engines and their selection – detonation in piston engine combustion and the methods to prevent the detonation

UNIT III COMBUSTION IN GAS TURBINE AND RAMJET ENGINES 10

Combustion in gas turbine combustion chambers - recirculation – combustion efficiency, factors affecting combustion efficiency, fuels used for gas turbine combustion chambers – combustion stability – ramjet combustion – differences between the design of ramjet combustion chambers and gas turbine combustion chambers- flame holders types – numerical problems.

UNIT IV SUPERSONIC COMBUSTION 9

Introduction to supersonic combustion – need for supersonic combustion for hypersonic airbreathing propulsion- supersonic combustion controlled by diffusion, mixing and heat convection – analysis of reactions and mixing processes - supersonic burning with detonation shocks - various types of supersonic combustors.

UNIT V COMBUSTION IN SOLID, LIQUID AND HYBRID ROCKETS 9

Solid propellant combustion - double and composite propellant combustion – various combustion models – combustion in liquid rocket engines – single fuel droplet combustion model – combustion hybrid rockets

L:45, TOTAL: 45 PERIODS

TEXT BOOKS

1. Sharma, S.P., and Chandra Mohan, "Fuels and Combustion", Tata Mc. Graw Hill Publishing Co., Ltd., New Delhi, 1987.
2. Mathur, M.L., and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers and Distributors, Delhi, 1988.

REFERENCES

1. Loh, W.H.T., "Jet, Rocket, Nuclear, Ion and Electric Propulsion: Theory and Design", Springer Verlag, New York, 1982.
2. Beer, J.M., and Chiger, N.A. "Combustion Aerodynamics", Applied Science Publishers Ltd., London, 1981.
3. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1993.

AE9025 AEROELASTICITY L T P C
3 0 0 3

UNIT I AEROELASTICITY PHENOMENA: 8

Vibration of beams due to coupling between bending and torsion - The aero-elastic triangle of forces - Stability versus response problems – Aeroelasticity in Aircraft Design – Vertex induced vibration.

UNIT II DIVERGENCE OF A LIFTING SURFACE: 10

Simple two dimensional idealizations – Strip theory – Fredholm integral equation of the second kind – Exact solutions for simple rectangular wings – Semirigid assumption and approximate solutions – Generalized coordinates – Successive approximations – Numerical approximations using matrix equations.

UNIT III STEADY STATE AEROELASTIC PROBLEMS: 10

Loss and reversal of aileron control – Critical aileron reversal speed – Aileron efficiency – Semirigid theory and successive approximations – Lift distributions – Rigid and elastic wings.

UNIT IV FLUTTER PHENOMENON: 12

Non-dimensional parameters – Stiffness criteria Dynamic mass balancing – Model experiments – Dimensional similarity – Flutter analysis – Two dimensional thin airfoils in steady incompressible flow – Quasisteady aerodynamic derivatives – Galerkin method for critical speed – Stability of distributed motion – Torsion flexure flutter – Solution of the flutter determinant – Methods of determining the critical flutter speeds – Flutter prevention and control.

UNIT V EXAMPLES OF AEROELASTIC PROBLEMS IN CIVIL AND MECHANICAL ENGINEERING: 5

Galloping of transmission lines and flow induced vibrations of tall slender structures and suspension bridges.

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Fung, Y.C. An Introduction to theory of aeroelasticity, John Wiley & Sons Inc., New York, 1985.

REFERENCES

1. Bisplinghoff., R.L. Ashley, H., and Halfmann, R.L. Aeroelasticity, Addison Wesley Publishing Co., Inc. II ed. 1987.
2. Broadbent, E.G., Elementary Theory of Aeroelasticity, BunHill Publications Ltd., 1986.
3. Scanlan, R.H. and Rosenbanusm, R., Introduction to the Study of Aircraft Vibration and Flutter, Macmillian Co., N.Y., 1991.

AE9026 THEORY OF PLATES AND SHELLS L T P C
3 0 0 3

UNIT I CLASSICAL PLATE THEORY 8

Classical Plate Theory – Assumptions – Differential Equations – Boundary Conditions – Axi-Symmetric Loading

UNIT II PLATES OF VARIOUS SHADES 10

Navier's Method of Solution for Simply Supported Rectangular Plates – Levy's Method of Solution for Rectangular Plates under Different Boundary Conditions – Annular Plates – Plates of other shapes.

UNIT III EIGEN VALUE ANALYSIS 8

Stability and Free Vibration Analysis of Rectangular Plates.

UNIT IV APPROXIMATE METHODS 10

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

UNIT V SHELLS 9

Basic Concepts of Shell Type of Structures – Membrane and Bending Theories for Circular Cylindrical Shells.

TOTAL : 45 PERIODS

TEXT BOOK :

1. Timoshenko, S.P. Winowsky. S., and Kreger, Theory of Plates and Shells, McGraw Hill Book Co., 1990.
2. Varadhan.T.K. & Bhaskar.K., "Analysis of Plates – Theory and Problems", Narosa Publishing House, 2000

REFERENCES:

1. Flugge, W. Stresses in Shells, Springer – Verlag, 1985.
2. Timoshenko, S.P. and Gere, J.M., Theory of Elastic Stability, McGraw Hill Book Co.1986.
3. Harry Kraus, 'Thin Elastic Shells', John Wiley and Sons, 1987.
4. Llyod Hamilton Donald, "Beams, Plates and Shells", McGraw Hill, 1976.
5. Ansel Ugural, Stresses in Plates & Shells, McGraw Hill, 1981
6. Reddy.J.N., "Theory & Analysis of Elastic Plates", CRC, I Edition 1999

AE9027 AVIONICS L T P C
3 0 0 3

UNIT I INTRODUCTION TO AVIONICS: 7

Need for avionics in civil and military aircraft and space systems – Integrated avionics and weapon systems – Typical avionics subsystems, design, technologies.

UNIT II PRINCIPLE OF DIGITAL SYSTEMS 10

Digital computer – Microprocessors – Memories.

UNIT III DIGITAL AVIONICS ARCHITECTURE: 8

Avionics system architecture – Databuses – MIL-STD-1553B – ARINC – 420 – ARINC – 629.

UNIT IV FLIGHT DECKS AND COCKPITS: 8

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.

UNIT V INTODUCTION TO AVIONICS SYSTEMS: 12

Communications systems- Navigation systems – Flight control systems – Radar – Electronic Warfare – Utility systems Reliability and maintainability – Certification.

L : 45, TOTAL: 45 PERIODS

TEXT BOOKS:

1. Middleton, D.H., Ed., Avionics systems, Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
2. Spitzer, C.R. Digital Avionics Systems, Prentice-Hall, Englewood Cliffs, N.J., U.S.A. 1987.

REFERENCES:

1. Malvino, A.P. and Leach, D.P. Digital Principles and Applications, Tata McGraw Hill, 1990.
2. Gaokar, R.S. Microprocessors Architecture-Programming and Applications, Wiley and Sons Ltd., New Delhi, 1990.

AE9028 STRUCTURAL DYNAMICS L T P C
3 0 0 3

UNIT I FORCE DEFLECTION PROPERTIES OF STRUCTURES 9

Constraints and Generalized coordinates – Virtual work and generalized forces – Force – Deflection influence functions – stiffness and flexibility methods.

UNIT II PRINCIPLES OF DYNAMICS 9

Free and forced vibrations of systems with finite degrees of freedom – Damped oscillations – D" Alembert's principle – Hamilton's principle – Lagrangean equations of motion and applications.

UNIT III NATURAL MODES OF VIBRATION 9

Equations of motion for free vibrations solution of Eigen value problems – Normal coordinates and orthogonality relations.

UNIT IV ENERGY METHODS 9

Rayleigh's principle – Rayleigh – Ritz method – Coupled natural modes – Effect of rotary inertia and shear on lateral vibrations of beams – Natural vibrations of plates.

UNIT V APPROXIMATE METHODS 9

Approximate methods of evaluating the Eigen frequencies and the dynamics response of continuous systems – Matrix methods of dynamic stress analysis.

TOTAL: 45 PERIODS

TEXT BOOKS :

1. F.S. Tse, I.E. Morse and H.T. Hinkle, “Mechanical Vibration”, Prentice Hall of India Pvt. Ltd, New Delhi, 1988.
2. W.C. Hurty and M.F. Rubinstein, “Dynamics of Structures”, Prentice Hall of India Pvt. Ltd., New Delhi 1987.

REFERENCES :

1. R.K. Vierck, “Vibration Analysis”, 2nd Edition, Thomas Y. Crowell & Co Harper & Row Publishers, New York, U.S.A. 1989.
2. S.P. Timoshenko ad D.H. Young, “Vinration Problems in Engineering”, John Willey & Sons Inc., 1984.
3. Von. Karman and A.Biot, “Mathematical Methods in Engineering”, McGraw-Hill Book Co., New York, 1985.

AE9029 HYPERSONIC AERODYNAMICS L T P C
3 0 0 3

UNIT I FUNDAMENTALS OF HYPERSONIC AERODYNAMICS 9

Introduction to hypersonic aerodynamics – differences between hypersonic aerodynamics and supersonic aerodynamics - concept of thin shock layers and entropy layers – hypersonic flight paths – hypersonic similarity parameters – shock wave and expansion wave relations of inviscid hypersonic flows.

UNIT II SIMPLE SOLUTION METHODS FOR HYPERSONIC INVISCID FLOWS 9

Local surface inclination methods – Newtonian theory – modified Newtonian law – tangent wedge and tangent cone and shock expansion methods – approximate methods - hypersonic small disturbance theory – thin shock layer theory.

UNIT III VISCOUS HYPERSONIC FLOW THEORY 9

Boundary layer equations for hypersonic flow – hypersonic boundary layers – self similar and non self similar boundary layers – solution methods for non self similar boundary layers – aerodynamic heating.

UNIT IV VISCOUS INTERACTIONS IN HYPERSONIC FLOWS 9

Introduction to the concept of viscous interaction in hypersonic flows - Strong and weak viscous interactions - hypersonic viscous interaction similarity parameter – introduction to shock wave boundary layer interactions.

UNIT V INTRODUCTION TO HIGH TEMPERATURE EFFECTS 9

Nature of high temperature flows – chemical effects in air – real and perfect gases – Gibb’s free energy and entropy - chemically reacting mixtures – recombination and dissociation.

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS:

1. John D. Anderson. Jr., “Hypersonic and High Temperature Gas Dynamics”, Mc.Graw hill Series, New York, 1996.

REFERENCES:

1. John D. Anderson. Jr., “Modern Compressible flow with historical Perspective”, Mc. Graw Hill Publishing Company, New York, 1996.
2. John T. Bertin, “Hypersonic Aerothermodynamics”, published by AIAA Inc., Washington. D.C., 1994.

AE9030 FATIGUE AND FRACTURE MECHANICS L T P C
3 0 0 3

UNIT I FATIGUE OF STRUCTURES 7

S.N. curves - Endurance limits - Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams - Notches and stress concentrations - Neuber’s stress concentration factors - Plastic stress concentration factors - Notched S.N. curves.

UNIT II STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR 10

Low cycle and high cycle fatigue - Coffin - Manson’s relation - Transition life - cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques -Cumulative damage - Miner’s theory - Other theories.

UNIT III PHYSICAL ASPECTS OF FATIGUE 10

Phase in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations - fatigue fracture surfaces.

UNIT IV FRACTURE MECHANICS 10

Strength of cracked bodies - Potential energy and surface energy - Griffith’s theory - Irwin - Orwin extension of Griffith’s theory to ductile materials - stress analysis of “cracked bodies - Effect of thickness on fracture tough-“ness - stress intensity factors for typical ‘geometries.

UNIT V FATIGUE DESIGN AND TESTINIG 8

Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in aerospace structures - Application to composite materials and structures.

TOTAL: 45 PERIODS

TEXT BOOK :

1. Prasanth Kumar – Elements of fracture mechanics – Wheeter publication, 1999.
2. Barrois W, Ripely, E.L., “Fatigue of aircraft structure,” _ Pergamon press. Oxford, 1983.

REFERENCES:

1. Sih C.G., “Mechanics of fracture.” Vol - I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989.
2. Knott, J.F., “Fundamentals of Fracture Mechanics,” - Buterworth & Co., Ltd., London, 1983.
3. Kare Hellan ,’Introduction to Fracture Mechanics’, McGraw Hill, Singapore,1985

AE9031 SATELLITE TECHNOLOGY L T P C
3 0 0 3

UNIT I INTRODUCTION TO SATELLITE SYSTEMS 9

Common satellite applications and missions – Typical spacecraft orbits – Definitions of spin the three axis stabilization-Space environment – Launch vehicles – Satellite system and their functions (structure, thermal, mechanisms, power, propulsion, guidance and control, bus electronics).

UNIT II ORBITAL MECHANICS 9

Fundamental of flight dynamics – Time and coordinate systems – Orbit determination and prediction – Orbital maneuvers – GPS systems and application for satellite/orbit determination – Ground station network requirements.

UNIT III SATELLITE STRUCTURES & THERMAL CONTROL 9

Satellite mechanical and structural configuration: Satellite configuration choices, launch loads, separation induced loads, deployment requirements – Design and analysis of satellite structures – Structural materials and fabrication – The need of thermal control: externally induced thermal environment – Internally induced thermal environment - Heat transfer mechanism: internal to the spacecraft and external heat load variations – Thermal control systems: active and passive methods.

UNIT IV SPACECRAFT CONTROL 9

Control requirements: attitude control and station keeping functions, type of control maneuvers – Stabilization schemes: spin stabilization, gravity gradient methods, 3 axis stabilization – Commonly used control systems: mass expulsion systems, momentum exchange systems, gyro and magnetic torquer - Sensors star and sun sensors, earth sensor, magnetometers and inertial sensors

UNIT V POWER SYSTEM AND BUS ELECTRONICS 9

Solar panels: Silicon and Ga-As cells, power generation capacity, efficiency – Space battery systems – battery types, characteristics and efficiency parameters – Power electronics. Telemetry and telecommand systems: Tm & TC functions, generally employed communication bands (UHF/VHF, S, L, Ku, Ka etc), their characteristics and applications- Coding Systems – Onboard computer- Ground checkout Systems.

L 45 TOTAL : 45 PERIODS

TEXT BOOKS

1. Analysis and Design of Flight Vehicle Structures, Tri-State off set company, USA, 1980.
2. Space Systems Engineering Rilay, FF, McGraw Hill, 1982.
3. Principles of Astronautics Vertregt.M., Elsvier Publishing Company, 1985.
4. Introduction Space Flight, Francis J. Hale Prentice Hall, 1994.
5. Space Vehicle Design, Michael D. Griffin and James R. French, AIAAEducation Series, 1991.

REFERENCES

1. Spacecraft Thermal Control, Hand Book, Aerospace Press, 2002.
2. Structural Design of Missiles & Space Craft Lewis H. Abraham, McGrawHill, 1992.
3. Space Communications Systems, Richard.F, Filipowsky Eugen I Muehllorf Princtice Hall, 1995.
4. Hughes, P.C. Space Craft Altitude Dynamics, Wilsey, 1986.
5. Gebmart, Heat Transfer, McGraw Hill, Martin J. Communication Satellite Systems, McGraw Hill, 1978.

AE9032 WIND TUNNEL TECHNIQUES L T P C
3 0 0 3

UNIT I PRINCIPLES OF MODEL TESTING: 6

Buckingham Theorem – Non dimensional numbers – Scale effect – Geometric Kinematic and Dynamic similarities.

UNIT II WIND TUNNELS: 8

Classification – special problems of testing in subsonic, transonic, supersonic and hypersonic speed regions – Layouts – sizing and design parameters.

UNIT III CALIBRATION OF WIND TUNNELS: 10

Test section speed – Horizontal buoyancy – Flow angularities – Turbulence measurements – Associated instrumentation – Calibration of supersonic tunnels.

UNIT IV WIND TUNNEL MEASUREMENTS: 12

Steady and Unsteady Pressure and velocity measurements – Force measurements – Three component and six component balances – Internal balances – Principles of Hotwire Anemometer.

UNIT V FLOW VISUALIZAITON 9

Smoke and Tuft grid techniques – Dye injection special techniques – Optical methods of flow visualization.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rae, W.H. and Pope, A., Low Speed Wind Tunnel Testing, John Wiley Publication, 1984.

REFERENCES:

1 Pope, A., and Goin, L., High Speed Wind Tunnel Testing, John Wiley, 1985.
Bradsaw Experimental Fluid Mechanics.

AE9033 APPROXIMATE METHODS IN STRUCTURAL MECHANICS L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Exact method versus approximate method – Need for approximate methods – Approximate methods used in the solution procedure for equilibrium and eigen value problems – Numerical integration.

UNIT II ENERGY METHODS: 9

Review of basic energy principles – Application to statically determinate and indeterminate structures. Free vibration and stability analysis – Beams and columns – Variational principle.

UNIT III METHOD OF WEIGHTED RESIDUALS: 9

Application of Galerkin, collection, least square methods of analysis for beams.

UNIT IV FINITE DIFFERENCE METHOD: 9

Application to statics, dynamics and stability analysis of beams and plates.

UNIT V FINITE ELEMENT METHOD: 9

Application of truss, bar, beam and two dimensional elements

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Szilard, R. Theory and Analysis of Plates – Classical and Numerical Methods, Prentice Hall, 1984.
2. Chajes, A. Principles of Structural Stability Theory, Prentice Hall., Inc., 1987.

REFERENCES :

1. Tauchert, T.R. Energy Principles in Structural Mechanics, McGraw Hill, International Student Edition, 1989.
2. Bathe, K.J. and Wilson, E.L. Numerical Methods in Finite Element Method, Prentice Hall (India) Ltd., 1985.

AE9034 INDUSTRIAL AERODYNAMICS L T P C
3 0 0 3

UNIT I ATMOSPHERE 9

Types of winds, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows.

UNIT II WIND ENERGY COLLECTORS 9

Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory.

UNIT III VEHICLE AERODYNAMICS 9

Power requirements and drag coefficients of automobiles, Effects of cut back angle, Aerodynamics of trains and Hovercraft.

UNIT IV BUILDING AERODYNAMICS 9

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.

UNIT V FLOW INDUCED VIBRATIONS 9

Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, Galloping and stall flutter.

L : 45, TOTAL : 45 PERIODS

TEXT BOOKS

1. M.Sovran (Ed), “Aerodynamics and drag mechanisms of bluff bodies and road vehicles”, Plenum press, New York, 1978.
2. P. Sachs, “Winds forces in engineering”, Pergamon Press, 1978.

REFERENCES

1. R.D. Blevins, “Flow induced vibrations”, Van Nostrand, 1990.
2. N.G. Calvent, “Wind Power Principles”, Charles Griffin & Co., London, 1979.

AE9035 ROCKETS AND MISSILES L T P C
3 0 0 3

UNIT I ROCKET SYSTEMS 10

Ignition system in rockets – types of igniters and igniter design considerations – injection system and propellant feed systems of liquid rockets and their design considerations – design considerations of liquid rocket thrust chambers – combustion mechanisms of liquid and solid propellants.

UNIT II AERODYNAMICS OF ROCKETS AND MISSILES 10

Airframe components of rockets and missiles – forces acting on a missile while passing through atmosphere – classification of missiles – slender body aerodynamics - method of describing forces and moments – lift force and lateral moment –lateral aerodynamic damping moment – longitudinal moment – drag estimation – body upwash and body downwash in missiles – rocket dispersion.

UNIT III ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD 10

One dimensional and two-dimensional rocket motions in free space and homogeneous gravitational fields – description of vertical, inclined and gravity turn trajectories – determination of range and altitude – simple approximations to burn out velocity and altitude – estimation of culmination time and altitude.

UNIT IV STAGING AND CONTROL OF ROCKETS AND MISSILES 9

Design philosophy behind multistaging of launch vehicles and ballistic missiles – multistage vehicle optimization – stage separation techniques in atmosphere and in space – stage separation dynamics and lateral separation characteristics – various types of thrust vector control methods including secondary injection thrust vector control – numerical problems on stage separation and multistaging.

UNIT V MATERIALS FOR ROCKETS AND MISSILES 6

Selection criteria of materials for rockets and missiles – materials for various airframe components and engine parts – materials for thrust control devices – various adverse conditions faced by aerospace vehicles and the requirement of materials to perform under these conditions.

L: 45, TOTAL: 45 PERIODS

TEXT BOOKS:

1. Cornelisse, J.W., “Rocket Propulsion and Space Dynamics”, J.W. Freeman & Co.,Ltd, London, 1982
2. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 5th Edition, 1993.

REFERENCES:

1. Parker, E.R., “Materials for Missiles and Spacecraft”, Mc.Graw Hill Book Co. Inc., 1982.
2. Mathur, M.L., and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers and Distributors, Delhi, 1988.

AE9036 EXPERIMENTAL FLUID MECHANICS L T P C
3 0 0 3

AIM:
This course provides the backbone for the graduates on Aerodynamics Experimentation.

OBJECTIVE:
To provide extensive treatment of the operating principles and limitations of pressure and temperature measurements. To cover both operating and application procedures of hot wire anemometer. To describe flow visualization techniques and to highlight in depth discussion of analog methods.

UNIT I BASIC MEASUREMENTS IN FLUID MECHANICS 7
Objective of experimental studies – Fluid mechanics measurements – Properties of fluids – Measuring instruments – Performance terms associated with measurement systems – Direct measurements - Analogue methods – Flow visualization – Components of measuring systems – Importance of model studies.

UNIT II WIND TUNNEL MEASEUREMENTS 10
Characteristic features, operation and performance of low speed, transonic, supersonic and special tunnels - Power losses in a wind tunnel – Instrumentation and calibration of wind tunnels – Turbulence- Wind tunnel balance – Wire balance – Strut-type – Platform-type – Yoke-type – Pyramid type – Strain gauge balance – Balance calibration.

UNIT III FLOW VISUALIZATION AND ANALOGUE METHODS 9
Visualization techniques – Smoke tunnel – Hele-Shaw apparatus - Interferometer – Fringe-Displacement method – Schlieren system – Shadowgraph - Hydraulic analogy – Hydraulic jumps – Electrolytic tank

UNIT IV PRESSURE, VELOCITY AND TEMPERATURE MEASUREMENTS 9
Pitot-Static tube characteristics - Velocity measurements - Hot-wire anemometry – Constant current and Constant temperature Hot-Wire anemometer – Pressure measurement techniques - Pressure transducers – Temperature measurements.

UNIT V SPECIAL FLOWS AND UNCERTAINTY ANALYSIS 10
Experiments on Taylor-Proudman theorem and Ekman layer – Measurements in boundary layers - Data acquisition and processing – Signal conditioning - Uncertainty analysis – Estimation of measurement errors – External estimate of the error – Internal estimate of the error – Uncertainty calculation - Uses of uncertainty analysis.

TOTAL: 45 PERIODS

TEXT BOOK

1. Rathakrishnan, E., “Instrumentation, Measurements, and Experiments in Fluids,” CRC Press – Taylor & Francis, 2007.
2. Robert B Northrop, “Introduction to Instrumentation and Measurements”, Second Edition, CRC Press, Taylor & Francis, 2006.

AE9037 AIRFRAME MAINTENANCE AND REPAIR PRACTICE L T P C
3 0 0 3

AIM:
To make the students familiarize with the aircraft maintenance procedures and practices.
Pre-requisite: Basics of Aircraft components and elements of Aeronautics.

OBJECTIVE:
To make the students to understand the Airframe components and the tools used to maintain the components. Defect investigation, methods to carry out investigation and the detailed maintenance and practice procedures.

UNIT I WELDING IN AIRCRAFT STRUCTURAL COMPONENTS: 9
Equipments used in welding shop and their maintenance - Ensuring quality welds - Welding jigs and fixtures - Soldering and brazing.sheet metal repair and maintenance: Selection of materials; Repair schemes; Fabrication of replacement patches; Tools: power/hand; Repair techniques; Close tolerance fasteners; Sealing compounds; Forming/shaping; Calculation of weight of completed repair; Effect of weight change on surrounding structure. Sheet metal inspection - N.D.T. Testing.

UNIT II PLASTICS AND COMPOSITES IN AIRCRAFT: 9
PLASTICS IN AIRCRAFT: Review of types of plastics used in airplanes - Maintenance and repair of plastic components - Repair of cracks, holes etc., various repairs schemes - Scopes.
ADVANCED COMPOSITES IN AIRCRAFT :
Cleaning of fibre reinforced plastic (FRP) materials prior to repair; Break test;
Repair Schemes; FRP/honeycomb sandwich materials; laminated FRP structural members and skin panels; Tools/equipment; Vacuum-bag process. Special precautions - Autoclaves.

UNIT III AIRCRAFT JACKING, ASSEMBLY AND RIGGING: 9
Airplane jacking and weighing and C.G. Location. Balancing of control surfaces - Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor.

UNIT IV REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM: 12
Trouble shooting and maintenance practices - Service and inspection - Inspection and maintenance of landing gear systems. - Inspection and maintenance of air-conditioning and pressurization system, water and waste system. Installation and maintenance of Instruments - handling - Testing - Inspection. Inspection and maintenance of auxiliary systems - Fire protection systems - Ice protection system - Rain removal system -Position and warning system - Auxiliary Power Units (APUs).

UNIT V SAFETY PRACTICES: 8
Hazardous materials storage and handling, Aircraft furnishing practices - Equipments. Trouble shooting.Theory and practices.

TOTAL: 45 PERIODS

REFERENCES:

1. Larry Reithmeir, " Aircraft Repair Manual ", Palamar Books, Marquette, 1992.
2. Brimm D.J. Bogges H.E., " Aircraft Maintenance ", Pitman Publishing corp., New York, 1940.
3. Kroes, Watkins, Delp, " Aircraft Maintenance and Repair ", McGraw Hill, New York, 1992.

AE9038 AIRCRAFT RULES AND REGULATION C.A.R.I AND II L T P C
3 0 0 3

UNIT I C.A.R SERIES 'A' - PROCEDURE FOR CIVIL AIR WORTHINESS REQUIRMENTS AND RESPONSIBILITY OPERATORS VIS-A-VIS AIR WORTHINESS DIRECTORATE: 8

Responsibilities of operators / owners; Procedure of CAR issue, amendments etc., Objectives and targets of airworthiness directorate; Airworthiness regulations and safety oversight of engineering activities of operators.

C.A.R. SERIES 'B' - ISSUE APPROVAL OF COCKPIT CHECK LIST, MEL, CDL:
Deficiency list (MEL & CDL); Preparation and use of cockpit check list and emergency list.

UNIT II C.A.R. SERIES 'C' - DEFECT RECORDING, MONITORING, INVESTIGATION AND REPORTING 7

Defect recording, reporting, investigation, rectification and analysis; Flight report; Reporting and rectification of defects observed on aircraft; Analytical study of in-fight readings & recordings; Maintenance control by reliability Method.

C.A.R. SERIES 'D' - AND AIRCRAFT MAINTENANCE PROGRAMMES:

Reliability Programme (Engines); Aircraft maintenance programme & their approval; On condition maintenance of reciprocating engines; TBO - Revision programme; Maintenance of fuel and oil uplift and consumption records - Light aircraft engines; Fixing routine maintenance periods and component TBOs - Initial & revisions.

UNIT III C.A.R. SERIES 'E' - APPROVAL OF ORGANISATIONS: 10

Approval of organizations in categories A, B, C, D, E, F, & G; Requirements of infrastructure at stations other than parent base.

C.A.R. SERIES 'F' - AIR WORTHINESS AND CONTINUED AIR WORTHINESS:
Procedure relating to registration of aircraft; Procedure for issue / revalidation of Type Certificate of aircraft and its engines / propeller; Issue / revalidation of Certificate of Airworthiness; Requirements for renewal of Certificate of Airworthiness.

UNIT IV C.A.R. SERIES 'L' - AIRCRAFT MAINTENANCE ENGINEER - LICENSING: 8

Issue of AME Licence, its classification and experience requirements, Complete Series 'L'.

C.A.R. SERIES 'M' MANDATORY MODIFICATIONS AND INSPECTIONS:
Mandatory Modifications / Inspections.

UNIT V C.A.R. SERIES 'T' - FLIGHT TESTING OF AIRCRAFT: 12

Flight testing of (Series) aircraft for issue of C of A; Fight testing of aircraft for which C or A had been previously issued. C.A.R. SERIES 'X' - MISCELLANEOUS REQUIREMENTS: Registration Markings of aircraft; Weight and balance control of an aircraft; Provision of first aid kits & Physician's kit in an aircraft; Use furnishing materials in an aircraft; Concessions; Aircraft log books; Document to be carried on board on Indian registered aircraft; Procedure for issue of taxy permit; Procedure for issue of type approval of aircraft components and equipment including instruments.

TOTAL: 45 PERIODS

REFERENCES:

1. " Aircraft Manual (India) ", Volume - Latest Edition, The English Book Store, 17-1, Connaught Circus, New Delhi.
2. " Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness) ", Published by DGCA, The English Book Store, 17-1, Connaught Circus, New Delhi.
3. " Aeronautical Information Circulars (relating to Airworthiness) ", from DGCA.
4. " Advisory Circulars ", form DGCA.

AE9039 AERO ENGINE REPAIRS AND MAINTENANCE L T P C
3 0 0 3

AIM:

To make the students to familiarize with the Aircraft engine maintenance procedure and practice.

Pre-requisite: Must have knowledge of basics of Aeronautics and engine components.

UNIT I **5**

Classification of piston engines - Principles of operation - Function of components - Materials used - Details of starting the engines - carburetion and Fuel injection systems for small and large engines - Ignition system components - spark plug detail - Engine operating conditions at various altitudes – Engine power measurements – Classification of engine lubricants and fuels – Induction, Exhaust and cooling system - Maintenance and inspection check to be carried out.

Inspection and maintenance and trouble shooting - Inspection of all engine components - Daily and routine checks - Overhaul procedures - Compression testing of cylinders - Special inspection schedules - Engine fuel, control and exhaust systems - Engine mount and super charger - Checks and inspection procedures.

UNIT II **2**

Propeller theory - operation, construction assembly and installation -Pitch change mechanism-Propeller axie system- Damage and repair criteria - General Inspection procedures - Checks on constant speed propellers - Pitch setting, Propeller Balancing, Blade cuffs, Governor/Propeller operating conditions – Damage and repair criteria.

UNIT III **6**

Symptoms of failure - Fault diagnostics - Case studies of different engine systems - Rectification during testing equipments for overhaul: Tools and equipments requirements for various checks and alignment during overhauling - Tools for inspection - Tools for safety and for visual inspection - Methods and instruments for non destructive testing techniques - Equipment for replacement of parts and their repair. Engine testing: Engine testing procedures and schedule preparation - Online maintenance.

UNIT IV **12**

Types of jet engines – Fundamental principles – Bearings and seals - Inlets - compressors- turbines-exhaust section – classification and types of lubrication and fuels- Materials used - Details of control, starting around running and operating procedures – Inspection and Maintenance- permissible limits of damage and repair criteria of engine components- internal inspection of engines- compressor washing- field balancing of compressor fans- Component maintenance procedures - Systems maintenance procedures - use of instruments for online maintenance - Special inspection procedures-Foreign Object Damage - Blade damage .

5

UNIT V

Engine Overhaul - Overhaul procedures - Inspections and cleaning of components - Repairs schedules for overhaul - Balancing of Gas turbine components.

Trouble Shooting: Procedures for trouble shooting - Condition monitoring of the engine on ground and at altitude - engine health monitoring and corrective methods.

TOTAL: 45 PERIODS

REFERENCES:

1. Kroes & Wild, " Aircraft Power plants ", 7th Edition - McGraw Hill, New York, 1994.
2. Turbomeca, " Gas Turbine Engines ", The English Book Store ", New Delhi, 1993.
3. United Technologies Pratt & Whitney, " The Aircraft Gas turbine Engine and its Operatio” The English Book Store, New Delhi.

GE9021 PROFESSIONAL ETHICS IN ENGINEERING L T P C
3 0 0 3

AIM:

To sensitize the engineering students on blending both technical and ethical responsibilities.

OBJECTIVES:

- Identify the core values that shape the ethical behavior of an engineer.
- Utilize opportunities to explore one's own values in ethical issues.
- Become aware of ethical concerns and conflicts.
- Enhance familiarity with codes of conduct.
- Increase the ability to recognize and resolve ethical dilemmas.

UNIT I ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal

UNIT IV RESPONSIBILITIES AND RIGHTS 9

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 9

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct

TOTAL: **45 PERIODS**

TEXT BOOKS :

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York (2005).
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, (2000).

REFERENCES:

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, (1999).
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, (2003)
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, (2001)
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, (2004)
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003)

GE9022 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

AIM:

To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

OBJECTIVES:

- To understand the various principles, practices of TQM to achieve quality.
- To learn the various statistical approaches for Quality control.
- To understand the TQM tools for continuous process improvement.
- To learn the importance of ISO and Quality systems.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT II TQM PRINCIPLES 9

Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

TOTAL: 45 PERIODS

TEXT BOOK

1. Dale H.Besterfiled, et at., “Total Quality Management”, Pearson Education Asia, Third Edition, Indian Reprint (2006).

REFERENCES

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition (2003).
3. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd. (2006)
4. Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”, Prentice Hall (India) Pvt. Ltd. (2006)

GE9023 FUNDAMENTALS OF NANOSCIENCE L T P C
3 0 0 3

AIM:

To make the students understand the importance ,relevance and potentialities of this emerging field of study.

OBJECTIVES:

- Study the basic nano technology and nano science.
- Understand interdisciplinary nature of this field.
- Understand the important role of physics, chemistry ,biology.
- Recognize that the rules of nano science are fundamentally different than those we experience.
- Study the basic fabrication strategies of nano science.

UNIT I INTRODUCTION 10

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles-quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II PREPARATION METHODS 10

Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES 5

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

UNIT IV PREPARATION ENVIRONMENTS 10

Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

UNIT V CHARECTERISATION TECHNIQUES 10

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

TOTAL: 45 PERIODS

TEXT BOOKS

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale charecterisation of surfaces & Interfaces”, 2nd Edition, Weinheim Cambridge, Wiley-VCH, 2000

REFERENCES

1. G Timp (Editor), “Nanotechnology”, AIP press/Springer, 1999
2. Akhlesh Lakhtakia (Editor), “The Hand Book of Nano Technology,Nanometer Structure”, Theory, Modeling and Simulations”, Prentice-Hall of India (P) Ltd, New Delhi, 2007.