BHARATH INSTITUTE OF HIGHER EDUCATION AND RESEARCH

B.TECH - AERONAUTICAL ENGINEERING

CURRICULUM

Regulations 2012

III – VIII SEMESTERS

SEMESTER III

SUBJECT CODE	COURSE TITLE	L	T	P	TCH	C
THEORY						
BMA301	Mathematics – III	4	1	0	5	4
BAN301	Fundamentals of Aeronautics and Astronautics	3	0	0	3	3
BAN302	Fundamentals of Fluid Mechanics	4	1	0	5	4
BAN303	Fundamentals of Aero - Thermodynamics	4	1	0	5	4
BAN304	Fundamentals of Structural Mechanics	4	1	0	5	4
BAN305	Mechanics of Machines	3	1	0	4	4
PRACTICALS						
BAN3L1	Fluid Mechanics and Machineries Laboratory	0	0	2	2	2
BAN3L2	Strength of Materials Laboratory	0	0	2	2	2
BME3L1	Machine Drawing	0	0	3	3	2
TOTAL					**34**	**29**

SEMESTER IV

SUBJECT CODE	COURSE TITLE	L	T	P	TCH	C
THEORY						
BMA402	Numerical Methods	4	1	0	5	4
BAN401	Aircraft Structures – I	4	1	0	5	4
BAN402	Aerodynamics – I	4	1	0	5	4
BAN403	Aircraft Propulsion	4	1	0	5	4

BAN404	Aircraft Systems and Instrumentation	3	0	0	3	3
BAN405	Manufacturing Engineering	4	0	0	4	4
PRACTICALS						
BAN4L1	Aircraft Structures Laboratory - I	0	0	3	3	2
BAN4L2	Aerodynamics Laboratory - I	0	0	3	3	2
BAN4L3	Manufacturing Engineering Laboratory	0	0	2	2	2
TOTAL					**35**	**29**

SEMESTER V

SUBJECT CODE	**COURSE TITLE**	**L**	**T**	**P**	**TCH**	**C**
THEORY						
BAN501	Aircraft Structures – II	3	1	0	4	4
BAN502	Aerodynamics – II	3	1	0	4	4
BAN503	Advanced Aerospace Propulsion	3	1	0	4	4
BAN504	Theory of Elasticity	3	1	0	4	4
BAN505	Aircraft Performance	3	0	0	3	3
BCE507	Environmental Studies	3	0	0	3	3
PRACTICALS						
BAN5V1	Value Added Program - I[$]	2	0	0	2	1
BAN5L1	Aircraft Structures Laboratory – II	0	0	3	3	2
BAN5L2	Aerodynamics Laboratory – II	0	0	3	3	2
BAN5L3	Aero Design and Modeling Laboratory	0	0	3	3	1
BAN5S1	Computer Skills and Development- I[*]	0	0	0	0	1
TOTAL					**33**	**29**

$- Technical seminar and Soft skill development program.

*- Each student shall undergo 50 hours of hands on experience in one or two engineering design and modeling software training relevant to Aeronautical Department. Also must produce a certificate.

SEMESTER VI

SUBJECT CODE	COURSE TITLE	L	T	P	TCH	C
THEORY						
BAN601	Aircraft Stability and Control	3	1	0	4	4
BAN602	Aerospace Structural Materials and Composites	3	1	0	4	4
BAN603	Finite Element Methods	3	1	0	4	4
BAN604	Heat Transfer	3	0	0	3	3
BAN605	Basics of Aircraft Maintenance and Repair	3	0	0	3	3
--	Elective – I	3	0	0	3	3
PRACTICALS						
BAN6V1	Value Added Program – II[$]	2	0	0	2	1
BAN6L1	Aircraft System Laboratory	0	0	3	3	2
BAN6L2	Propulsion Laboratory	0	0	3	3	2
BAN6L3	Aircraft Design Project – I	0	0	4	4	2
BAN6S2	Computer Skills and Development – II*	0	0	0	0	1
TOTAL					**33**	**29**

$ - Communication Skill development program

*- Each student must undergo 50 hours of hands on experience in Analysis software training and also must produce a certificate.

SEMESTER VII

SUBJECT CODE	COURSE TITLE	L	T	P	TCH	C
THEORY						
BAN701	Computational Fluid Dynamics	3	1	0	4	4
BAN702	Avionics	3	0	0	3	3
BAN703	Control Engineering	3	0	0	3	3
BBA704	Principles of Management and Professional Ethics	3	0	0	3	3
-	Elective – II	3	0	0	3	3
-	Elective – III	3	0	0	3	3
PRACTICALS						
BAN7L1	Airframe and Aero Engine Repair Lab	0	0	3	3	2
BAN7L2	Avionics laboratory	0	0	3	3	2
BAN7L3	Aircraft Design Project – II	0	0	4	4	2
BAN7L4	Flight Training Laboratory	0	0	0	0	1
BAN7P1	Project Work Phase I	0	0	4	4	1
TOTAL					**33**	**27**

SEMESTER VIII

SUBJECT CODE	COURSE TITLE	L	T	P	TCH	C
THEORY						
BAN801	Rockets and Missiles	3	0	0	3	3
-	Elective –IV	3	0	0	3	3
-	Elective –V	3	0	0	3	3
PRACTICALS						
BAN8P1	Project	0	0	15	15	6
	Comprehension	0	0	0	0	1
TOTAL					**24**	**16**

LIST OF ELECTIVES

Options for Elective I:

Code No.	Course Title	L	T	P	TCH	C
BANE01	Airframe Maintenance and Repair	3	0	0	3	3
BANE02	An Introduction to Combustion	3	0	0	3	3
BANE03	Experimental Stress Analysis	3	0	0	3	3
BANE04	Experimental Aerodynamics	3	0	0	3	3

Options for Elective II:

Code No.	Course Title	L	T	P	TCH	C
BANE05	Aircraft Engine Repair and Maintenance	3	0	0	3	3
BANE06	Helicopter Aerodynamics	3	0	0	3	3
BANE07	Theory of Vibrations	3	0	0	3	3
BANE08	Boundary Layer Theory	3	0	0	3	3
BANE09	Theory of Turbulent Flows	3	0	0	3	3

Options for Elective III:

Code No.	Course Title	L	T	P	TCH	C
BANE10	Helicopter Maintenance	3	0	0	3	3
BANE11	Theory of Plates and Shells	3	0	0	3	3
BANE12	Hypersonic Aerodynamics	3	0	0	3	3
BANE13	Nano Science and Technology	3	0	0	3	3

Options for Elective IV:

Code No.	Course Title	L	T	P	TCH	C
BANE14	Airport Management	3	0	0	3	3
BANE15	Unmanned Aerial Vehicle	3	0	0	3	3
BANE16	Principles of Turbo machinery in Air Breathing Engines	3	0	0	3	3
BANE17	Fatigue and Fracture Mechanics	3	0	0	3	3
BANE18	Space Mechanics	3	0	0	3	3

Options for Elective V:

Code No.	Course Title	L	T	P	TCH	C
BANE19	Total Quality Management	3	0	0	3	3
BANE20	Aircraft Rules and Regulations CAR I and CAR II	3	0	0	3	3
BANE21	Industrial Aerodynamics	3	0	0	3	3
BANE22	Wind Energy	3	0	0	3	3
BANE23	Gas Turbine Combustion	3	0	0	3	3
BANE23	Satellite Technology	3	0	0	3	3

SEMESTER III

BMA301	MATHEMATICS – III	L	T	P	TCH	C
		4	1	0	5	4

OBJECTIVE:
To study the basic concepts and application of Engineering Mathematics

UNIT-I	PARTIAL DIFFERENTIAL EQUATIONS	12

Formation of PDE by eliminating arbitrary constants, functions – Solutions of first order PDE – Standard types-homogeneous linear PDE of second order with constant coefficients - Lagrange's Linear PDE – Method of grouping, multiplier methods

UNIT II	FOURIER SERIES	12

Dirichlet's conditions – General Fourier series – Half-range Sine and Cosine series – Parseval's identity – Harmonic Analysis.

UNIT III	BOUNDARY VALUE PROBLEMS	12

Classifications of second order linear partial differential equation – Solutions of one dimensional wave equation and one-dimensional heat equation.

UNIT IV	LAPLACE TRANSFORMS	12

Laplace transform of simple functions – Transform of elementary functions – Basic properties – initial and final value theorem – Transform of derivatives and integrals – transform of periodic functions – inverse Laplace transforms –Convolution theorem (excluding proof) – Solution of linear ODE of second order with constant coefficients and solutions of simultaneous first order differential equations with constant coefficients using Laplace transformation techniques.

UNIT V	FOURIER TRANSFORMS	12

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

Total Periods : 60

TEXT BOOKS

Grewal, B.S., *Higher Engineering Mathematics*, Khanna Publications, 2007.

REFERENCES

1) Glyn James, *Advance Modern Engineering Mathematics*, Pearson Education, 2007.
2) Kreyszig. E, *Advanced Engineering Mathematics*, (8th edition), John Wiley & Sons, Singapore, 2000.
3) Kandasamy P et al, *Engineering Mathematics, Vol. II & III* (4th revised edition), S. Chand & Co., New Delhi, 2000.
4) Narayanan S., Manicavachagom Pillay T. K., Ramanaiah G., *Advanced Mathematics for Engineering Students, Volume II & III* (2nd edition), S. Viswanathan Printers and Publishers, 1992.
5) Venkataraman M. K., *Engineering Mathematics – Vol. III – A & B* (13th edition), National Publishing Co., Chennai, 1998.
6) Julius S. Bendat and Allan G. Piersol.,*Random Data: Analysis and Measurement Procedures* (4th edition), Wiley Series in Probability and Statistics, 2010.

BAN301	FUNDAMENTALS OF AERONAUTICS AND ASTRONAUTICS	L	T	P	TCH	C
		3	0	0	3	3

OBJECTIVE :

To make the students understand the Basics of Aeronautics and Astronautics.

UNIT I	INTRODUCTION TO FLIGHT	8

Brief history of Aviation-Hot air balloon and heavier than air flying machines-early airplane configurations-Modern Airplanes-Components of airplane and their functions-Rotary wing aircrafts-Space vehicles

UNIT II	FUNDAMENTALS OF AERONAUTICS	11

International Standard Atmosphere-Pressure, Temperature and Density altitude, Basic Aerodynamics - Continuity, Momentum and Energy equations, Bernoulli's equation-Mach number-subsonic, transonic, sonic and supersonic flow regimes, Measurement of pressure and airspeed- IAS,EAS and TAS. Airfoil geometry and nomenclature-infinite and finite wing sections-lift, drag and moment coefficients-angle of attack-aspect ratio-Reynolds number-induced drag and parasite drag-airfoil characteristics, Elements of Aircraft performance, stability and control

UNIT III	AIRCRAFT STRUCTURES AND MATERIALS	8

Structural components of an airplane- monocoque and semi monocoque structure –materials for structural components – composite materials and their significance in Aviation Technology

UNIT IV	AIRCRAFT PROPULSION	10

Propeller Engine – Gas Turbine Engine – Turbo prop, Turbo jet, Turbo fan Engines- specific fuel consumption-variation of thrust and power with speed and altitude – materials for engine components

UNIT V	SPACE VEHICLES AND ASTRONAUTICS	8

Basics of Rocket Technology-escape velocity-re entry vehicles-heat transfer problems of space vehicles-ablative cooling-Satellite technology – Hypersonic vehicles, Elements of Astronautics.

Total Periods:45

TEXT BOOKS:

1. Anderson, J. D., *Introduction to Flight*, Tata McGraw-Hill Higher Education, 6th edition 2010.

REFERENCES:

1. Kermode, A. C, Barnard, R. H and Philpott, D. R, *Mechanics of Flight*, Pearson education, 2012.
2. Shevell, R. C., *Fundamentals of Flight*., Prentice hall (2nd edition), 1989.
3. Steven, A. Brandt, Randall J. Stiles, John J. Bertin and Ray Whitford, *Introduction to Aeronautics: A Design Perspective*, AIAA Education series(2nd edition),2004.
4. Torenbeek, E and Wittenberg, H, *Flight Physics: Essentials of Aeronautical Disciplines and Technology*, with Historical Notes, Springer, 2009

BAN302	FUNDAMENTALS OF FLUID MECHANICS	L	T	P	TCH	C
		4	1	0	5	4

OBJECTIVE :
To make the students understand the Basics of Fluid Mechanics

UNIT I	INTRODUCTION	10

Fluid – definition - Fluid properties - Newton's law of viscosity - Classification of fluids - fluid statics - Hydrostatic forces on submerged surfaces - Stability of floating bodies

UNIT II	FLUID FLOW ANALYSIS AND FLOW MEASUREMENT	14

Ideal and real flow - Concept of continuum - Eulerian and Lagrangian approaches - Velocity field - Pathline, Streakline, Streamline - Stream tube - Fluid acceleration - Continuity, momentum differential equations - Navier Stokes equation - Stream function – Vorticity – Irrotationality - Potential function - Potential flow - Laplace equation - Bernoulli's equation and its applications-Venturi meter - Orifice meter , Flow Rate and Velocity Measurement.

UNIT III	DIMENSIONAL ANALYSIS	10

Buckingham Pi Theorem - Non dimensional numbers and their significance - Flow similarity and model studies.

UNIT IV	FLOW THROUGH PIPES	12

Laminar and turbulent flow - Boundary layer flow – Boundary layer thickness - Reynolds number and its significance - Laminar fully developed pipe flow - Hagen-Poiseuille flow- Coefficient of friction - Head loss – Darcy-Wiesbach equation - Hydraulic gradient - Total energy lines - Moody's diagram - Turbulent flow through pipes.

UNIT V	FLUID MACHINERY	14

Classification of fluid machines - Reciprocating and centrifugal pumps - impulse and reaction turbines - Working principle of Pelton, Francis and Keplan turbines - Velocity triangles - fans and blowers.

Total Periods: 60

TEXT BOOKS:

1. Frank M White, *Fluid Mechanics*, The McGraw Hill companies. 7th edition), 2011.
1. Rathakrishnan, E, *Fundamentals of Fluid Mechanics*, Prentice-Hall (3rd edition), 2012.
2. Yunus A Cengel and John M Cimbala, *Fluid mechanics: Fundamentals and Applications*, Tata McGraw Hill (2nd edition), 2010.

REFERENCES:

1. Irving H Shames, *Mechanics of Fluids*, The McGraw Hill companies (4th edition), 2003.
2. Yuan, S.W, *Foundations of Fluid Mechanics*, Prentice-Hall, 1967.

BAN303	FUNDAMENTALS OF AERO THERMODYNAMICS	L	T	P	TCH	C
		4	1	0	5	4

OBJECTIVE :
To make the students understand the Basics of Aero Thermodynamics.

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 – Reversibility and irreversibility - Concept of Entropy, Clausius inequality, Principle of increase of entropy – Absolute entropy – Availability - Entropy change in non-flow processes.

UNIT II	AIR POWER CYCLE	12

Carnot, Otto, Diesel, Dual, Stirling and Ericsson cycle - Air standard efficiency – Mean effective pressure – Actual and theoretical PV diagram of two stroke and four stroke IC engines.

UNIT III	VAPOUR POWER CYCLE	12

Introduction – Rankine cycle – Means of increase of efficiency of the Rankin cycle – Ideal reheat and regenerative Rankine cycle – Second law analysis of vapour power cycles – Cogeneration.

UNIT IV	REFRIGERATION AND AIR CONDITIONING	10

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

UNIT V	THERMODYNAMICS OF AIRCRAFT PROPULSION CYCLES	10

Isentropic flow through passages – Brayton cycle – Brayton cycle with intercooling, reheat and regeneration – Ideal jet propulsion cycles. Basics of heat transfer.

Total Periods: 60

TEXT BOOKS

1. Rathakrishnan E., *Fundamentals of Engineering Thermodynamics*, Prentice-Hall India, 2012.
2. Nag.P.K., *Engineering Thermodynamics*, Tata McGraw-Hill, New Delhi, 2007.
3. Yunus A Cengel and Michael A Boles., *Thermodynamics- an Engineering approach*, McGraw Hill Education (7th edition), 2012.

REFERENCES

1. Holman.J.P., *Thermodynamics*, McGraw-Hill (3rd edition), 2007.
2. Gordon J. Van Wylen and Richard E. Sonntag and Claus Borgnakke., *Fundamentals of Classical Thermodynamics – Vol 1*, Wiley Eastern, 1994.
3. Arora C.P., *Thermodynamics*, Tata McGraw-Hill, New Delhi, 2003.
4. Merle C Potter and Craig W Somerton., *Thermodynamics for Engineers*, Schaum's Outline Series, Tata McGraw-Hill (2nd edition), 2009.

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BAN304	FUNDAMENTALS OF STRUCTURAL MECHANICS	L	T	P	TCH	C
		4	1	0	5	4

OBJECTIVE :
To make the students understand the Basics of Aircraft Structures

UNIT I	INTRODUCTION TO STRENGTH OF MATERIALS	12

Introduction to mechanics of deformable bodies - Material selection criteria – stress – strain – Stress and strain diagram - Hook's law - Elastic constants – definition of engineering constants: elastic modulus, Poisson's ratios, shear modulus, relation between three modulus Poison's ratio, Young's modulus, shear modulus and bulk modulus. Statically determinate and indeterminate problems in tension and compression – Thermal stress – Impact loading – introduction to composite materials

UNIT II	THEORY OF ELASTICITY	12

Concept of theory of elasticity – basic assumptions – Plane stress – Plane strain – Co-ordinate transformation – Stress tensor – Stress-strain dependence – General hooks law linear elastic and non-linear inelastic - Isotropic medium – Lam's constant – Miller indices – Strain from epitaxy – Introduction to thermal stress analogy.

UNIT III	BEAM THEORY	12

Shear force and bending moment diagrams for simply supported and cantilever beams – stress, strain and deflection in straight beams – flexural and shear stresses -Shear stress variation in beams of symmetric sections – Beams of uniform strength – Methods of evaluation of deflection.

UNIT IV	TORSION	12

Torsion of solid and hollow circular shafts – Shear stress variation – Power transmission in shafts – Open and closed-coiled helical springs – Stresses in helical springs.

UNIT V	BIAXIAL STRESSES	12

Stresses in thin circular and spherical shell under internal pressure – Volumetric strain – Combined loading – Principle stresses and maximum shear stresses – Analytical and graphical methods - Mohr's circle.

Total Periods: 60

TEXT BOOKS:

1. Gere & Timoshenko, *Mechanics of Materials*, McGraw Hill, 1993
2. William Nash, *Strength of Materials*, Tata McGraw Hill, 2004
3. F. P. Beer, E.R. Johnston, and J.T. Dewolf, *Mechanics of Materials*, McGraw-Hill (4^{th} edition), 2006

REFERENCE:

1. Dym,C.L., and Shames,I.H., *Solid Mechanics*, McGraw Hill, Kogakusha, 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.VanNostrand Co. Inc., Princeton, N.J., 1977

BAN305	MECHANICS OF MACHINES	L	T	P	TCH	C
		3	1	0	4	4

OBJECTIVE :
To make the students understand the Basics of Machines and its operating mechanisms

UNIT I	MECHANISMS	12

Machine Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom – Kutzbach criterion - Slider crank and crank rocker mechanisms – Inversions – Applications – Kinematic analysis of simple mechanisms – Determination of velocity and acceleration.

UNIT II	FRICTION	12

Friction in screw and nut – Pivot and collar – Thrust bearing – Plate and disc clutches – Belt (Flat and Vee) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive.

UNIT III	GEARING AND CAMS	9

Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, Compound gear trains and epicylic gear trains - Determination of speed and torque - Cams – Types of cams and followers.

UNIT IV	FORCE ANALYSIS AND BALANCING	15

Introduction to force analysis - Static and dynamic – Inertia force and inertia torque – D'Alembert's principle - Static and dynamic balancing – Single and several masses in different planes –Balancing of reciprocating masses- primary balancing and concepts of secondary balancing – Single and multi cylinder engines (Inline) – Balancing of radial V engine – direct and reverse crank method.

UNIT V	VIBRATION	12

Free, forced and damped vibrations of single degree of freedom systems – Force transmitted to supports – Vibration isolation – Vibration absorption – Torsional vibration of shaft – Single and multi rotor systems – Geared shafts – Critical speed of shaft.

Total Periods: 60

TEXT BOOKS

1. Rattan.S.S., Theory of Machines, Tata McGraw–Hill Publishing Co, New Delhi, 2004.
2. Balaguru. S., Dynamics of Machinery, SciTech publication (2nd edition),2009.

REFERENCES

1. Rao, J.S and Dukkipati, R.V, "Mechanism and Machine Theory", Second Edition, Wiley Eastern Ltd., 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. Shigley, J.E. and Uicker, J.J., "Theory of Machines and Mechanisms", McGraw-Hill, 1980.
Burton Paul, "Kinematics and Dynamic of Planer Machinery", Prentice Hall, 1979.

BAN3L1	FLUID MECHANICS AND MACHINERIES LABORATORY	L	T	P	TLH	C
		0	0	2	0	2

OBJECTIVE :
To make the student understand the principles and fundamentals of fluid mechanics through various experiments

1	Determination of pipe flow losses
2	Calibration of orifice meter and venture meter
3	Flow through notches and weir.
4	Flow through open orifice
5	Buoyancy experiment – Metacentric Height.
6	Verification of Bernoulli's Equation
7	Performance characteristics of centrifugal pump
8	Performance characteristics of submergible pump
9	Performance characteristics of jet pump
10	Performance characteristics of oil gear pump.
11	Characteristics of impulse turbine – Pelton wheel turbine
12	Characteristics of reaction turbine – Francis turbine

Total Periods :44

BAN3L2	STRENGTH OF MATERIALS LAB	L	T	P	TLH	C
		0	0	2	0	2

OBJECTIVE :
To make the student understand the principles and fundamentals of structural mechanics through various experiments

1	Tension test of a mild steel rod.
2	Shear test on mild steel and aluminum rod.
3	Torsion test on mild steel rod
4	Hardness test (a) Brinell & (b) Rockwell.
5	Impact tests (a) Izod (b) Charpy
6	Deflection test on helical spring.
7	Fatigue test: (a) Reverse plate bending (b) Rotating beam
8	Block compression test.

Total Periods :44

BME3L1	MACHINE DRAWING	L	T	P	TLH	C
		0	0	3	0	2

OBJECTIVE :
To make the student understand the principles and fundamentals of Machine Drawing

Indian standard code (BIS) of practice for engineering drawing – general principle of presentation, conventional representation of threaded parts, springs, Gears and common features, Abbreviations and symbols used in technical drawings

Tolerance – Types – Symbols used and representation on the drawing – fit types, selection for different application – Allowance, Interchangeability. Surface finish Relation to the manufacturing processes – Types of representation on the drawing welding symbols.

Preparation of working drawing for given machine components: Bolts, Screws, Studs, Nuts, Keys and Key-ways.

Preparation of simple assembly drawings: Different types of cotter and knuckle joints.

Preparation of simple assembly drawing for following machine with part drawings given: Screw jack, Plummer block, connecting rod, machine vice, tail stock of lath, fuel injection pump for single cylinder engine, stop valve.

TEXT BOOK:

1. Narayanan. K. L. Machine Drawing, New age publisher, 2006.

REFERENCES:

1. Bhatt, N. D.., Machine Drawing, Charotar publishing house, 2000.
2. Gopala Krishnan, Machine Drawing, Subash publishers, 2001.

Total Periods :45

SEMESTER IV

BMA402	NUMERICAL METHODS	L	T	P	TCH	C
		4	1	0	5	4

OBJECTIVE :
To make the students understand the basics of Numerical methods and its importance

UNIT I	SOLUTION OF EQUATIONS AND EIGNE VALUE PROBLEM	12

Iterative method, Newtown-Raphson method for single variable-solutions of linear system by Gaussian, Gauss-Jordan, Jacobian and Gauss-Siedel methods, Inverse of matrix by Gauss-Jordan method , Eigen value of a matrix power and Jacobian methods.

UNIT II	INTERPOLATION (FINITE DIFFERENCES)	12

Newton's Divided difference formula, Lagrange's interpolation-forward and backward difference formula-Stirling's and Bessel's central difference formula

UNIT III	NUMERICAL DIFFERENTIATION AND INTEGRATION	12

Numerical differentiation with interpolation polynomials, Numerical integration by Trapezoid Simpson's 1/3" and 3/8" rule, Double integrals using Trapezoidal and Simpson's rule.

UNIT IV	INTIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS	12

Single step methods, Taylor series, Euler and modified Euler, Runge kutta method of first ar second order differential equations, multiple step methods, Milne and Adam's – Bash for predictor and corrector method.

UNIT V	BOUNDARY VALUE PROBLEMS FOR ODE AND PDE	12

Finite difference for the second order ordinary differential equations, finite difference solutions fo one dimensional heat equations (both implicit and explicit), one dimensional wave equation, Tw dimensional, Laplace and Poisson equation.

Total Periods: 60

TEXT BOOK:

1. Jain. M. K. Iyengar, S. R. K. And Jain, R K., *Numerical Methods for Scientific ar Engineering Computation*, 3rd edition, New age international publication, company, 1993

REFERENCE:

1. Grewal. B. S., *Higher Engineering Mathematics*, Khanna Publishers (36th edition), 2001.
2. M. K. Venkatraman., *Numerical Methods*, NPC, Chennai.
3. Richard W. Hamming., *Numerical Methods for Scientists and Engineers*, Dov Publications (2nd edition), 1987.

BAN401	AIRCRAFT STRUCTURES – I	L	T	P	TCH	C
		4	1	0	5	4

OBJECTIVE :
To make the students understand the basics of Aircraft Structures and its functions

UNIT I	ELEMENTS OF AIRCRAFT STRUCTURES	14

Introduction to basic structural elements in an aircraft – design considerations for aerospace structures - monocoque and semi-monocoque structures – basic loads on airframe, load resistance of ribs, skin, stringer, stiffener, spares, wing box, bulk head. Various structural design approaches

UNIT II	STATICALLY DETERMINATE AND INDETERMINATE STRUCTURES	12

Statically determinate frames - Analysis of plane Truss - Method of joints - 3 D Truss-Plane frames - Composite beam.
Propped Cantilever - Fixed-Fixed beams - Clapeyron's Three Moment Equation – slope deflection and energy 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 South well 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 THEORY	10

Fail safe and safe life structures, factor of safety, Brief introduction of yield material, brittle vs. ductile behavior, Creep and creep rupture, viscoelastic materials - environmental stress, stress potentials, effect of time and temperature - Fatigue and Fracture - Maximum Stress theory – Maximum Strain Theory – Maximum Shear Stress Theory – Distortion Theory – Maximum Strain energy theory – Application to aircraft Structural problems.

Total Periods: 60

TEXT BOOKS:

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. C.T.Sun, *Mechanics of aircraft structures*, John wiley& sons, inc

REFERENCE:

1. Timoshenko, S., *Strength of Materials*, Vol. I and II, Princeton D. Von Nostrand Co, 1990.
2. Peer, D. J., and Azar J. J., *Aircraft Structures*, McGraw – Hill (2nd edition), 1999.
3.Bruhn.E.F., *Analysis and design of flight vehicle structures*, Tri set of offset company, 1973.
4. **Michael C.Y.Niu ,** A**irframe structural design (ISBN No.962-7128-04-X), 1998**
5. Rivello, **T**heory and Analysis of Flight Structures, McGraw-Hill, 1969.
6. Perry, Aircraft Structures, McGraw-Hill, 1950.

BAN402	AERODYNAMICS-I	L	T	P	TCH	C
		4	1	0	5	4

OBJECTIVE :
To make the students understand the basics of Aerodynamics

UNIT I	BASIC AERODYNAMIC PRINCIPLES	12

Models of fluid - 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	FUNDAMENTALS OF INVISCID FLOWS	12

Ideal Flow over a circular cylinder, D'Alembert's Paradox, Magnus effect, KuttaJonkowski Theorem, Starting Vortex, Kutta condition, Real flow over smooth and rough cylinder, Basics of vortex theory, Basics of compressible flow.

UNIT III	AIRFOIL THEORY	12

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	FINITE WING THEORY	12

Vortex Filament, Biot and Savart Law, Bound Vortex and trailing Vortex, Horse Shoe Vortex, Lifting Line Theory and its limitations, induced drag coefficient, elliptic and general lift distribution, Oswald's wing efficiency factor, effect of plan form and aspect ratio

UNIT V	VISCOUS FLOW THEORY	12

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

Total Periods: 60

TEXT BOOKS:

1. Anderson, J.D., *Fundamentals of Aerodynamics*, MaGraw Hill Book Co., 1999
2. Rathakrishnan,E., *Theoretical Aerodynamics*, John Wiley & Sons, Inc., 2013

REFERENCE:

1. Milne Thomson, L.H., *Theoretical Aerodynamics*, Macmillan, 1985
2. John J Bertin., *Aerodynamics for Engineers*, Pearson Education Inc, 5th Edition.
3. Clancy L J., *Aerodynamics*, John Wiley & sons, 1991.

BAN403	AIRCRAFT PROPULSION	L	T	P	TCH	C
		4	1	0	5	4

OBJECTIVE :
To make the students understand the basics of Aircraft Propulsion.

UNIT I	FUNDAMENTALS OF ENGINES	10

History and classifications of Aero engines, Working of gas turbine engine – Thrust equation – Factors affecting thrust – Engine performance parameters – Efficiency, Specific fuel consumption, Range and Endurance, Methods of thrust augmentation – Characteristics of propeller, turboprop, turbofan and turbojet engines

UNIT II	INLETS AND NOZZLES	14

Subsonic inlets – External and internal flow pattern – inlet performance criterion – Boundary layer separation – Supersonic inlets – the starting problem – shock boundary layer problem – external deceleration – flow stability problem – Exhaust nozzles – Theory of flow in isentropic nozzles – Losses in nozzles – Nozzle efficiency — nozzle choking – Over expanded and under expanded nozzles – Ejector and variable area nozzles – Interaction of nozzle flow with adjacent surfaces – Thrust reversal.

UNIT III	COMPRESSORS	14

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.

UNIT IV	COMBUSTION CHAMBERS	12

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 – flame holders

UNIT V	TURBINES	10

Elementary theory of axial flow turbine – Vortex theory – Stator and rotor blades – losses in the blade – choice of blade profile, chord and pitch – stage and overall performance – blade cooling – radial flow turbine

Total Periods: 60

TEXT BOOKS:

1. Hill, P.G. & Peterson, C.R, *Mechanics & Thermodynamics of Propulsion*, Addison – Wesley Longman INC, 1999.
2. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H., *Gas Turbine Theory*, Longman, 1989.

REFERENCES:

1. Ahmed F. El-Sayed, *Aircraft Propulsion and Gas turbine engines*, CRS Press, 2008

2. Saeed Farokhi, *Aircraft Propulsion*, John Wiley & Sons, Inc ., 2009

3. *Rolls Royce Jet Engine* – 5th Edition – 1996.

4. Oates, G.C., *Aero thermodynamics of Aircraft Engine Components*, AIAA Education Series

BAN404	AIRCRAFT SYSTEMS AND INSTRUMENTS	L	T	P	TCH	C
		3	0	0	3	3

OBJECTIVE :
To make the students understand the basics of Aircraft Systems and Instruments.

UNIT I	AIRCRAFT SYSTEMS	12

Hydraulic systems - Study of typical workable system - components – Hydraulic systems controllers - Pneumatic systems - Advantages - Working principles - Typical Air pressure system – Brake system- Typical Pneumatic power system - Components, Landing Gear systems – Classification.

UNIT II	AIRPLANE CONTROL SYSTEMS	10

Conventional Systems - fully powered flight controls - Power actuated systems – Modern control systems - Digital fly by wire systems - Auto pilot system active control Technology.

UNIT III	ENGINE SYSTEMS	8

Fuel systems for Piston and jet engines, - Components of multi engines. Lubricating systems for piston and jet engines - Starting and Ignition systems - Typical examples for piston and jet engines.

UNIT IV	AUXILIARY SYSTEM	8

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

UNIT V	AIRCRAFT INSTRUMENTS	7

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

Total Periods:45

TEXT BOOKS:

1. McKinley, J.L., and Bent, R.D., *Aircraft Maintenance & Repair,* McGraw-Hill, 1993.
2. *General Hand Books of Airframe and Powerplant Mechanics*, U.S. Dept. of Transportation, Federal Aviation Administration, The English Book Store, New Delhi1995.

REFERENCES:

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

BAN405	MANUFACTURING ENGINEERING	L	T	P	TCH	C
		4	0	0	4	4

OBJECTIVE :
To make the students understand the basics of manufacturing Engineering.

UNIT I	METAL WORKING PROCESS	12

Mechanical working of metals – hot and cold working – rolling, extrusion, spinning, wire-drawing, press working. Welding – different types of gas and arc welding process, soldering and brazing. Casting – different types, furnaces, casting defects and inspection.

UNIT II	THEORY OF METAL CUTTING AND MACHINING PROCESSES	12

Introduction, mechanics of metal cutting-chip formation, Merchant's circle theory cutting force calculations, tool materials. Influence of tool angles, tool life, cutting fluids, machining time calculations, Metal cutting economics, problem in merchant circle, tool life, machining time and economics.

Lathe – introduction, types, construction, mechanisms and attachments for various operations, nomenclature of single point cutting tool. Capstan and turret lathes various mechanisms, tool and loading arrangement. Automatic lathes - single spindle and multi spindle mechanisms, CNC lathes.

UNIT III	SHAPER, PLANER AND MILLING PROCESS	12

Shaper, planer and slotter: types, specifications, mechanisms, holding devices, difference between shaper and planer. Milling machine – types and specification, mechanisms, holding devices, milling operations. Milling tool nomenclature, indexing types-simple, compound and differential.

UNIT IV	DRILLING, BORING, BROACHING, SURFACE FINISHING PROCESS	12

Drilling, Boring- Specification, Nomenclature of drilling and reaming tool and its specification. Broaching: Specification, types, mechanisms, nomenclature of broaching tool. Grinding process, Types of grinding machines, Grinding Wheels, Honing, Super finishing, Polishing,, Galvanizing, Electroplating.

UNIT V	NON-TRADITIONAL MACHINING PROCESSES AND HIGH ENERGY RATE FORMING PROCESSES	12

Non-traditional machining techniques, classification, Abrasive jet machining, Electrical Discharge Machining, E. D wire cutting, Electro chemical machining, Electron Beam Machining, Laser Beam Machining, Ultrasonic Machining.

Explosive forming, Electro hydraulic, Electromagnetic forming, Dynapack machine.

Total Periods:60

TEXT BOOKS:

1. P.C. Sharma., *A text book of Production Technology*, S.Chand& Company ltd, 2007.
2. P.N.Rao. *Manufacturing Technology-Foundry Forging and Welding*, TMH publishing co, 2009.

REFERENCE:

1. W.A.J.chapman., *Workshop Technology*. *Vol I,II & III*, 1975, ELBS.
2. Roy A Lindberg, *Process and Material Manufacture*, PHI, 1995.
3. Kalpakjan, *Manufacturing Engineering and Technology*, Addison Wesley, 2005.
4. HajraChowdary S.K, *The fundamentals of work shop technology Vol. I & II*, Media publishers, 1997.

BAN4L1	AIRCRAFT STRUCTURES LABORATORY – I	L	T	P	TLH	C
		0	0	3	0	2

OBJECTIVE :
To make the student understand the principles and fundamentals of aircraft structures through various experiments

1	Determination of Young's modulus of steel using mechanical extensometers.
2	Determination of Young's modulus of aluminum using electrical extensometers
3	Determination of fracture strength and fracture pattern of ductile material
4	Determination of fracture strength and fracture pattern of brittle materials
5	Deflection of beams with various end conditions
6	Verification of Maxwell's theorem and principle of superposition
7	Stress strain curves for various engineering materials
8	Column – Testing.
9	South – Well's Plot.
10	Testing of riveted joints

Total Periods :45

BAN4L2	AERODYNAMICS LABORATORY – I	L	T	P	TLH	C
		0	0	3	0	2

OBJECTIVE :
To make the student understand the principles and fundamentals of aerodynamics through various experiments

1	Calibration of subsonic wind tunnel.
2	Pressure distribution over smooth cylinder
3	Pressure distribution over rough cylinder
4	Flow over a flat plate of different angle of incidence
5	Pressure distribution over symmetric airfoil.
6	Pressure distribution over cambered airfoil.
7	Force measurement using wind tunnel balance
8	Analysis of wake behind a bluff body
9	Flow visualization at subsonic velocity (a) Smoke flow visualization (b) Oil flow visualization.
10	Water flow channel, visualization of flow pattern of different bodies

Total Periods :45

BAN4L3	MANUFACTURING ENGINEERING LABORATORY	L	T	P	TLH	C
		0	0	2	0	2

OBJECTIVE :
To make the student understand the principles and fundamentals of manufacturing engineering through various experiments

1	Study of centre, capstan and automatic lathes and their accessories
2	Exercise on setting the work piece and the tool in the lathe
3	Plane turning and step turning
4	Taper turning and knurling
5	Eccentric Turning
6	Thread cutting and grooving
7	Drilling and reaming
8	Drilling and boring
9	Surface grinding
10	Study of shaper and planer machines
11	Study of milling and grinding machines.

Total Periods :44

SEMESTER V

BAN501	AIRCRAFT STRUCTURES – II	L	T	P	TLH	C
		3	1	0	4	4

OBJECTIVE :
To make the students understand the behaviour of various aircraft structural components.

UNIT I	UNSYMMETRICAL BENDING	12

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

UNIT II	SHEAR FLOW IN OPEN SECTIONS	12

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	12

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 center of closed sections.

UNIT IV	BUCKLING OF PLATES	12

Bending of thin plates – rectangular sheets under compression - local buckling stress of thin walled sections – crippling strength by Needham's and Gerard's methods – thin-walled column strength – load carrying capacity of sheet stiffener panels – effective width – inter-rivet and sheet wrinkling failures - short panel failing strength.

UNIT V	STRESS ANALYSIS OF WING AND FUSELAGE	12

Wing structural arrangements – factors influencing - wing stress analysis methods – determination of shear force and bending moment distribution over fuselage – Numerical problems – Tension field beam – general Wagner equation - Semi-tension field beams.

Total Periods: 60

Text Books:

1.Megson T M G , 'Aircraft Structures for Engineering Students', Fifth Edition, Elsevier Aerospace Engineering Series,2007.

2. Howard D Curtis, 'Fundamentals of Aircraft Structural Analysis', WCB-McGraw Hill, 1997

Reference Books:

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

3. Bruhn. E.H., 'Analysis and Design of Flight Vehicles Structures', Tri-state off-set company, USA, 1985

BAN502	AERODYNAMICS – II	L	T	P	TLH	C
		3	1	0	4	4

OBJECTIVE :

To make the student understand the concepts of compressible flows.

UNIT I	FUNDAMENTAL ASPECTS OF COMPRESSIBLE FLOW	12

Compressibility, Continuity, Momentum and Energy equation for steady one dimensional flow, Compressible Bernoulli's equation, Area – Mach number – Velocity relation, Mach cone, Mach angle, One dimensional Isentropic flow through variable area duct, Isentropic relations - Critical conditions, Characteristic Mach number, Maximum discharge velocity.

UNIT II	SHOCK AND EXPANSION WAVES	12

Normal shock relations, Prandtl's relation, Hugonoit equation, Raleigh Supersonic Pitot tube equation, Moving normal shock waves, Oblique shocks, θ-β-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 convergent and convergent-divergent nozzles.

UNIT III	TWO DIMENSIONAL COMPRESSIBLE FLOW	12

Potential equation for 2-dimensional compressible flow, Linearization of potential equation,Small perturbation theory, Linearized Pressure Coefficient, Linearized subsonic flow, Prandtl-Glauert rule, Linearized supersonic flow, Method of characteristics, Wave drag coefficient.

UNIT IV	HIGH SPEED FLOW OVER AIRFOILS, WINGS AND AIRPLANE CONFIGURATION	12

Critical Mach number, Drag divergence Mach number, Shock Stall, Shock- Boundary layer interaction, 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,Introduction to Hypersonic Flows, Numerical Analysis of one Dimensional flow.

UNIT V	EXPERIMENTAL METHODS	12

Wind tunnels for Subsonic, transonic, Supersonic and hypersonic flows, Various Measurementtechniques, Power requirement, Force and moment measurement, Wind tunnel balance, Wind tunnel corrections,Flow visualizationtechniques, Hot wire technique, Optical methods, Shock tube, Gun tunnels,

Total Periods: 60

Text Books:

1. Anderson, J. D, Modern Compressible Flow, Third Edition, Tata McGraw-Hill & Co., 2012.

2. Rathakrishnan., E, Gas Dynamics, Prentice Hall of India, 2004.

3. Yahya S.M., Fundamentals of Compressible Flows, Third Edition, New Age International Publishers, 2003.

Reference Books:

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.

BAN503	ADVANCED AEROSPACE PROPULSION	L	T	P	TLH	C
		3	1	0	4	4

OBJECTIVE :.
To make the student understand the fundamentals of ramjet, scramjet and rocket propulsion.

UNIT I	RAMJET AND SCRAMJET PROPULSION	14

Operating principle of ramjet engine – Components of ramjet engines and their efficiencies – Combustion in ramjet engine – Critical, subcritical and supercritical modes of operation -Ramjet engine and its performance characteristics – Ramjet design calculations – Flame stability problems in ramjet combustors –Integral ram rockets. - Introduction to hypersonic vehicles and supersonic combustion - problems associated with supersonic combustion– Various types scramjet combustors – Fuel injection schemes in scramjet combustors – one dimensional models for supersonic combustion using method of influence coefficient.

UNIT II	PULSEJET PROPULSION	10

Pulse propulsion – Combustion process in pulse jet engines – inlet charging process – Supercritical charging and subcritical discharging – Subcritical charging and subcritical discharging – Subcritical charging and supercritical discharging.

UNIT III	SOLID PROPELLANT ROCKETS	12

Operating principle – Specific impulse of a rocket – Internal ballistics – Selection criteria of solid propellants – propellant grain design considerations – Progressive, Regressive and neutral burning in solid rockets.

UNIT IV	LIQUID PROPELLANT ROCKETS	12

Liquid propellant rockets – selection of liquid propellants – various feed systems for liquid rockets – cryogenic techniques - Thrust vector control – 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	NON - CONVENTIONAL PROPULSION TECHNIQUES	12

Introduction to nozzleless propulsion and basic concepts - Electric rocket propulsion – Plasma as a fluid- Diffusion in Partially Ionized gases - Ion propulsion – Nuclear rocket – Types – Solar Sail - comparison of performance of these propulsion systems with chemical rocket propulsion systems.

Total Periods: 60

Text Books:

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 8th Edition, 2010.

2. Thomas A Ward, "Aerospace Propulsion Systems", John Wiley & Sons Inc., New York,2010.

Reference Books:

1.J D Mattingly, "Elements of Propulsion - Gas Turbines and Rockets ", AIAA Education Series, 2006.

2.David H. Heiser and David T. Pratt., "Hypersonic Air -breathing Propulsion", AIAA Education Series, 1999.

3. DanM.Goebel, Ira Katz, 'Fundamentals of Electric Propulsion', John Wiley & Sons Inc, New York, 2003.

BAN504	THEORY OF ELASTICITY	L	T	P	TLH	C
		3	1	0	4	4

OBJECTIVE :
To make the student understand theoretical concepts of material behaviour with particular emphasis on their elastic property.

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	TWO DIMENSIONAL FORMULATION	9

Plane Strain – Plane Stress – Generalized Plane Stress- Anti-planeStrain – Airy Stress Function – Polar Co-Ordinate Formulation – Cartesian Co-Ordinate Solution Using Polynomials and Fourier Methods- General Solutions in Polar Co- Ordinates.

UNIT III	TORSION	9

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

UNIT IV	ANISOTROPIC ELASTICITY	9

Neumann Principle – Material Symmetry – Restrictions on Elastic Moduli – Torsion of a Solid Possessing a Plane of Material Symmetry – Plane Deformation Problems – Applications To Fracture Mechanics

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 Periods: 45

Text Books:

1.Timoshenko, S., and Goodier, T.N., Theory of Elasticity, McGraw – Hill Ltd., Tokyo, 1990.

2.MartinH.Sadd, Elasticity Theory, Applications and Numeric, Elesevier, 2005.

Reference Books:

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

4.Ansel C Ugural and Saul K Fenster, 'Advanced Strength and Applied Elasticity', 4th Edition, Prentice Hall, New Jersey, 2003.

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BAN505	AIRCRAFT PERFORMANCE	L	T	P	TLH	C
		3	0	0	3	3

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	AERODYNAMICS OF THE AIRPLANE (Drag Polar)	9

International Standard Atmosphere, TAS, IAS and EAS, , Aerodynamic Lift, Drag and Moments – Lift, Drag and Moment Co-efficient- Aerodynamic Center – NACA airfoil nomenclature – Streamlined and Bluff body – Skin friction Drag, Pressure Drag and Induced Drag – Drag Polar – Various drags of an airplane – Methods of Drag Reduction – Mach Number – Effect on Drag Polar.

UNIT II	AIRCRAFTENGINE PERFORMANCE	9

Piston engines, Thrust and Efficiency – Froud's momentum Theory – Characteristics of Propeller – Factors affecting propeller performance, Prediction of propeller performance, Propeller noise, Propeller selection, Jet engines, Turbojet, Turbopropand Turbofan Engines, Engine performance parameters, Comparative study of different gas turbine engines, Ramjet and rocket engines

UNIT III	STEADY LEVEL FLIGHT	9

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 aircrafts

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

UNIT V	ACCELERATED 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.

Total Periods: 45

Text Books:

1. Anderson, Jr., J.D. Aircraft Performance and Design, McGraw-Hill International Edition, 1999.

2. Houghton,E.L. and Carruthers, N.B. Aerodynamics for engineering students, Edward Amold Publishers, 1988

Reference Books:

1. MiadoSaarlas, Aircraft Performance, John Wiley & Sons, 2007

2. Torenbeek E and Wittenberg H, Flight Physics, Springer, 2009

3. Anderson, Jr., J.D. Introduction to Flight, McGraw-Hill International Edition, 1999 .

4.Pamadi, B.N. Performance, Stability, Dynamics, and Control of Airplanes, AIAA Education Series, 2004

BCE507	ENVIRONMENTAL STUDIES	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :.
To make the student understand the need and control of environmental problems.

UNIT I	NATURAL RESOURCES AND ASSOCIATED PROBLEMS	6

The multidisciplinary nature of environmental studies definition, scope and importance – need for public awareness – Natural Resources – Forest Resources – Water Resources - Mineral Resources – Energy resources – Land Resources – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

UNIT II	ECOSYSTEMS	9

Concept of an ecosystem structure and function of an ecosystem, produces consumers and decomposes, energy flow in the ecosystem, Ecological succession food chains, food webs and ecological pyramids, introduction, types, characteristics features, structure and function of different ecosystem,

UNIT III	BIODIVERSITY AND ENVIRONMENTAL POLLUTION	12

Introduction – definition ;.genetic, species and ecosystem diversity, biogeographically classification of India, value of biodiversity; consumptive use productive use social, ethical aesthetic and option values, biodiversity at global, national and local levels India as a mega-diversity nation, hot spots of biodiversity, threats to biodiversity habitual loss poaching of wild life man, wildlife conflicts, endangered and endemic species of India, conservation of biodiversity in-situ and ex-situ conservation of biodiversity.

ENVIRONMENTAL POLLUTION

Definition,causes, effects and control measure of air pollution, water pollution, soil pollution, marine pollution , noise pollution, thermal pollution, nuclear hazards, solid waste management – causes, effects and its control measure – role of an individual in presentation of pollution and case studies.

UNIT IV	SOCIAL ISSUES AND THE ENVIRONMENT	9

From unsustainable to sustainable development, urban problems related to energy, water conservation, rain water harvesting, watershed management, resettlement and rehabilitation of people its problems and concerns , case studies environmental ethics, issues and possible solution climate change global warming add rain, ozone layer depletion nuclear accident and holocaust case studies waste land reclamation, various environment protection act , issues involved enforcement of environmental legislation public awareness.

UNIT V	HUMAN POPULATION AND THE ENVIRONMENT	9

Population growth variation among nations, population explosion family welfare program environment and human health, human right, value education, HIV/AIDS, women and child welfare role of information technology in environment and human health case studies.

FIELDWORKS

Visit to a local area to document assets river forest/ grass land/ hill mountain, visit to local polluted site rural/industrial / agricultural, study of common plants, insects, birds, study of simple ecosystems = ponds, river hill slopes etc(field work equal to 5 lecture hours)

Total Periods: 45

Text Books:

1. Sharma.B.K. andKaur, Environmental Chemistry, Goel Publishing House, Meerut, 1994.

2. De.A.K., Environmental Chemistry, New Age International (p) lt., New Delhi, 1996.

3. Kurian Joseph and Nagendran.R, Essential of Environmental Studies, Pearson Education, 2004.

Reference Books:

1. Dara S.S., A Text Book of Environmental Chemistry and Pollution Control, S.Chand and company Ltd., New Delhi, 2004.

2. Jeyalakshmi.R, Principles of Environmental Science, First Edition, Devi Publications, Chennai, 2006.

3. Kamaraj.P and Arthanareeswari.M, Environmental Science - Challenges and Changes, first Edition, Sudhandhir Publications, 2007.

BAN5V1	VALUE ADDED PROGRAM - I	L	T	P	TLH	C
		0	0	2	2	1

OBJECTIVE :
To enhance confidence, attitude of students and improve their employability skills.

1	An activity to describe the personal value.
2	An activity to describe the responsibility of students in society.
3	An activity to enhance self-confidence and self-esteem.
4	An activity to make a goal setting.
5	An activity to make a time management chart.
6	An activity to describe the planning process.
7	An activity to enhance the creativity of students.
8	An activity to improve the lateral thinking.
9	An activity to describe the importance of team work.
10	An activity to enhance the interpersonal skills.
11	An activity to enhance the leadership skills.
12	An activity to manage the stressed situation.
13	An activity to describe the decision making.
14	An activity to weighing positives and negatives.
15	An activity to make a SWOT analysis.

BAN5L1	STRUCTURES LABORATORY - II	L	T	P	TLH	C
		0	0	3	3	2

OBJECTIVE :

To experimentally study the unsymmetrical bending of beams, find the location of shear Centre, obtain the stresses in circular discs and beams using photoelastictechniques, calibration of photo – elastic materials and study on vibration of beams.

1	Determination of Shear centre in 'L' open section.
2	Determination of Shear centre in 'C' open section.
3	Determination of Shear centre in 'Z' open section.
4	Determination of Shear centre in 'D' Closed section.
5	Combined bending and Torsion of a Hollow Circular Tube.
6	Constant Strength Beam.
7	Wagner beam – Tension field beam.
8	Free Vibration of a Cantilever Beam.
9	Forced Vibration of Beams.
10	Flexibility matrix for cantilever beam.
11	Calibration of Photoelastic materials.
12	Stresses in circular discs using photo elastic techniques.
13	Stresses in beams using photo elastic techniques.
14	Fabrication of a Composite Laminate.
15	Preparation of Test Specimens.

BAN5L2	AERODYNAMICS LABORATORY – II	L	T	P	TLH	C
		0	0	3	3	2

OBJECTIVE :
To make the student understand the principles and fundamentals of high speed aerodynamics through various experiments.
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1	Pressure distribution over a nose cone model.
2	Determination of base drag of a missile model.
3	Determination of profile drag of bodies by wake survey method.
4	Study of flow field over a backward facing step.
5	Wind effect studies on tall structures.
6	Aerodynamic studies of automotive models.
7	Pressure distribution over a Delta wing
8	Power estimation of Wind Turbine
9	Fanno flow
10	Rayleigh flow
11	Flow visualization (shadowgraph system) in Incompressible jets using low density gases.
12	Flow visualization in supersonic jets using shadowgraph.
13	Study on image processing of shadowgraph image.
14	Calibration of supersonic wind tunnel.
15	Flow visualization studies in supersonic flows by schilren system.

BAN5L3	AERO DESIGN AND MODELLING LABORATORY	L	T	P	TLH	C
		0	0	2	2	1

OBJECTIVE :
To make the student understand the principles and fabrication techniques for making gliders and Remote control aircraft through various experiments.

1	Design and fabrication of gliders using balsa wood.
2	Design and fabrication of catapult.
3	Design and fabrication of power gliders.
4	Design and fabrication of single crank flapping wing mechanism.
5	Design and fabrication of double crank flapping wing mechanism.
6	Design and fabrication of pivoted double crank flapping wing mechanism.
7	Design and fabrication of wing using balsa wood.
8	Design and fabrication of horizontal and vertical stabilizer using balsa wood
9	Design and fabrication of fuselage using hardened polystyrene.
10	Design and fabrication of control surfaces using glass fibers composite.
11	Design and fabrication of fuselage using glass fibers composite.
12	Design and fabrication of fuselage using hardened polystyrene.
13	Estimation the discharge rate of Li-Po battery for different thrust setting.
14	Estimating the propeller thrust for different voltage setting.
15	Assembling of Remote Control Aircraft.

SEMESTER VI

BAN601	AIRCRAFT STABILITY AND CONTROL	L	T	P	TLH	C
		3	1	0	4	4

OBJECTIVE :.
To make the students understand the concept of stable and non-stable configuration of airplanes.

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	12

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	09

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

Total Periods: 60

Text Books:

1. Pamadi, B.N.,"Performance, Stability, Dynamics, and Control of Airplanes", AIAA Education Series, 2004
2. Nelson, R.C." Flight Stability & Automatic Control", McGraw Hill, 1998.

Reference Books:

1. McCormick, B.W. "Aerodynamics, Aeronautics & Flight Mechanics", John Wiley, 1995.
2. Babister, A.W. "Aircraft Stability and response", Pergamon Press, 1996.
3. Etkin, B., "Dynamics of Flight Stability and Control", John Wiley, New York, 1982.
4. Perkins C.D. &Hage R.E. "Airplane performance, stability and control", John Wiley & Sons 1976.

BAN602	AEROSPACE STRUCTURAL MATERIALS & COMPOSITES	L	T	P	TLH	C
		3	1	0	4	4

OBJECTIVE :.

To make the students understand the basic concept, design, analysis and fabrication of composite materials & structures.

UNIT I	INTRODUCTION	12

Atomic structure and bonding in materials-Crystal structure of materials-crystal systems- unit cells and space lattices- determination of structures of simple crystals by x-ray diffraction- miller indices of planes and directions- packing geometry in metallic- ionic and covalent solids-Concept of amorphous-single and polycrystalline structures and their effect on properties of materials-Crystal growth techniques-Imperfections in crystalline solids and their role in influencing various properties.

UNIT II	AEROSPACE MATERIALS	12

Introduction – Physical Metallurgy – Wrought Aluminum Alloys – Cast Aluminum Alloy - Production of Semi Abrogated Forms– Plastics and Rubber – Introduction to FRP, Glass and Carbon Composites– Fibers and Resins – Characteristics and Application– Super Alloys. Emerging Trends in Aerospace Materials.

UNIT III	MECHANICS OF COMPOSITES	12

Micro mechanics – Mechanics of materials approach, elasticity approach to determine material properties – Fiber Volume ratio – Mass fraction – Density of composites-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 IV	LAMINATION THEORY AND FAILURE ANALYSIS	12

Governing differential equation for a unidirectional lamina and general laminate, angle ply and cross ply laminate, Failure criteria for composites--Failure modes of sandwich panels - Bending stress and shear flow in composite beams.

UNIT V	FABRICATION METHODS	12

Various open and closed mould processes, Manufacture of fibers, Types of resins, properties and applications, Netting analysis, Basic design concepts of sandwich construction - Materials used for sandwich construction.

Total Periods: 60

Text Books:

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

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

BAN603	FINITE ELEMENT METHODS	L	T	P	TLH	C
		3	1	0	4	4

OBJECTIVE :.

To make the student understand concepts of finite element method for structural components.

UNIT I	INTRODUCTION	12

Introduction to FEA - historical background - Review of various approximate methods – Raleigh Ritz's, Galerkin and finite difference methods- Governing equation and convergence criteria of finite element method - Examples of Finite Element Modeling

UNIT II	ONE DIMENSIONAL SYSTEMS	12

Direct stiffness method – spring element- Derivation of the stiffness matrix- Example of a spring assemblage-Assembly of global stiffness matrix-Types of boundary conditions- The Potential energy approach –Examples-Prismatic bar under axial loading- bending of beams - Fundamentals of Finite Element Modeling – Element Division - Numbering Scheme- Coordinate and Shape Functions- The Potential Energy Approach- Assembly of Global Stiffness Matrix and Load Vector- Treatment of Boundary Conditions- Temperature Effects- Shear Force and Bending Moment - Examples.

UNIT III	TWO DIMENSIONAL SYSTEMS	12

Plane truss structure-Introduction- Plane Trusses-Coordinate Transformation – Local & Global Coordinate- The Element Stiffness Matrix- Stress Calculations- Temperature Effects –Examples.
Plane stress & strain – Constant Strain Triangle (CST)- Isoparametric Representation- Potential Energy Approach - Element Stiffness; Force Terms Stress Calculations- Temperature Effects- Examples

UNIT IV	THREE DIMENSIONAL SYSTEMS	12

Axisymmetric formulation – Element stiffness matrix and force vector – Galerkin approach – Body forces and temperature effects – Stress calculations – Boundary conditions and Nodal Solution; Mapping and Numerical Integration– Four node quadrilateral for axisymmetric problems –Applications to cylinders under internal or external pressures – Rotating discs

UNIT V	APPLICATIONS OF FEM TO AEROSPACE STRUCTURES	12

Linear static analysis, non-linear static analysis –dynamic analysis-simple harmonic motion-damping consideration-forced vibration- typical issues in contact analysis-contact impact algorithm-Case studies problems using software packages and MATLAB coding.

Total Periods: 60

Text Books:

1. Tirupathi.R. Chandrapatha and Ashok D. Belegundu,"Introduction to Finite Elements in Engineering", Printice Hall India,Fourth Edition, 2011.
2. Rao. S.S., "Finite Element Methods in Engineering", Butterworth and Heinemann, Fourth Edition, 2005.
3. Daryl L. Logan, "A First Course in the Finite Element Method", 5th Edition, PWS Publishing Company, Boston, 2010.

Reference Books:

1. Reddy J.N.,"An Introduction to Finite Element Method ",McGraw Hill , 3rd edition, 2005.
2. Krishnamurthy, C.S., "Finite Element Analysis", Tata McGraw Hill, 2nd 2001.
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", John Wiley and Sons, Inc., Fourth edition, 2001.
5. Larry J Segerlind, "Applied Finite Element Analysis", John Wiley and Sons, Inc.Second Edition, 1984

BAN604	HEAT TRANSFER	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :.

To make the student understand concepts of conduction, convection and radiation heat transfer.

UNIT I	FUNDAMENTALS OF HEAT TRANSFER	9

Modes of heat transfer: Conduction – Convection – Radiation – One dimensional steady state heat conduction: Composite Medium – Critical thickness – Effect of variation of thermal Conductivity – Extended Surfaces.

UNIT II	CONDUCTION HEAT TRANSFER	9

Unsteady state. Heat Conduction: Lumped System Analysis – Heat Transfer in Semi infinite and infinite solids – Use of Transient – Temperature charts – Application of numerical techniques.

UNIT III	CONVECTIVE HEAT TRANSFER	9

Introduction – Free convection in atmosphere - free convection on a vertical flat plate – Empirical relation in free 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, application of numerical techniques in problem solving.

UNIT IV	RADIATIVE HEAT TRANSFER AND HEAT EXCHANGERS	9

RADIATIVE HEAT TRANSFER: 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	9

Heat transfer problems in gas turbine, rocket thrust chambers and Re-entry vehicles –numerical problems using MATLAB.

Total Periods: 45

Text Books:

1. Sachdeva, S.C. "Fundamentals of Engineering, Heat and Mass Transfer, Wiley Eastern Ltd. Fourth Edition, New Delhi, 2012.
2. Holman, J.P., "Heat Transfer ", McGraw Hill Book Co., Inc., New York, Tenth Edition., 2009.
3.Rathakrishnan. E., "Elements of Heat Transfer", CRC Press,2012.

Reference Books:

1. Sutton, G.P., "Rocket Propulsion Elements ", John Wiley and Sons, 8th Edition.2010.
2. Lienhard J. H., "A Heat Transfer Text Book", Phlogiston Press, U.S.A., 2008.
3. OzisikM.N.,"Heat Transfer A Basic Approach", The McGraw-Hill Company, reprint 1995.

BAN605	BASICS OF AIRCRAFT MAINTENANCE AND REPAIR	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :.

To make the student understand concepts of aircraft general engineering and maintenance practices.

UNIT I	FUNDAMENTAL ASPECTS OF AIRCRAFT MAINTENANCE AND REPAIR	9

Importance of aircraft maintenance and repair – CAR stipulations- Hazardous materials and safety practices- Earlier aircrafts with wood structures – Maintenance of fabric covered airplanes – Aircraft painting and markings

UNIT II	MAINTANENACE AND REPAIR OF AIRCRAFT STRUCTURES	9

Aircraft tubing repair – Special welding repairs – Soldering and brazing – Sheet metal inspection and repair – Repair practices – Rivet – Repair design – Maintenance and repair of Plastic materials – Composite materials – Inspection and repair of composite material.

UNIT III	MAINTENANCE OF PRIMARY AIRCRAFT SYSTEM	9

Importance of various aircraft system – Hydraulic system maintenance practices – Service, flushing and inspection –Trouble shooting and maintenance of Hydraulic and Pneumatic System – Inspection and maintenance of Control system – Inspection and maintenance of landing gear.

UNIT IV	MAINTENANCE OF ENGINE AND FUEL SYSTEM	9

Aircraft engine maintenance – Fuel system inspection – Inspection and repair of fuel tank – Trouble shooting.

UNIT V	MAINTENANCE OF AUXILIARY SYSTEM AND INSTRUMENTS	9

Oxygen system, service and maintenance – Installation and maintenance of instruments – Testing instruments and systems – checking of a typical vacuum system.

Total Periods: 45

Text Books:

1. Kroes Watkins Delp," Aircraft Maintenance and Repair", McGraw Hill, 7th edition,New York, 2013.

Reference Books:

1. A&P Mechanics, "Aircraft Hand Book", F A A Himalayan Book House, New Delhi,1996.
2. A&P Mechanics, "General Hand Book", F A A Himalayan Book House, New Delhi, 1996.

BANE01	AIRFRAME MAINTENANCE AND REPAIR	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :.

To make the student understand study the maintenance aspect of airframe systems and rectification of snags

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 Inspection of damage – Classification – Repair or replacement – Sheet metal inspection – N.D.T. Testing – Riveted repair design, Damage investigation – reverse technology.

UNIT II	PLASTICS AND COMPOSITES IN AIRCRAFT	9

Review of types of plastics used in airplanes – Maintenance and repair of plastic components – Repair of cracks, holes etc., various repair schemes – Inspection and Repair of composite components – 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	9

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	9

Hazardous materials storage and handling, Aircraft furnishing practices – Equipments. Trouble shooting - Theory and practices.

Total Periods: 45

Text Books:

1.Kroes Watkins Delp, “Aircraft Maintenance and Repair”, McGraw Hill, 7th edition,New York, 2013.

Reference Books:

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

BANE02	AN INTRODUCTION TO COMBUSTION	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :.

To make the student understand the basics in the area of combustion in various engines.

UNIT I	INTRODUCTION TO COMBUSTION	9

Thermochemical 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	9

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 ENGINES	9

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	COMBUSTION IN SCRAMJET ENGINES	9

Introduction to supersonic combustion – need for supersonic combustion for hypersonic air-breathing 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 ROCKET ENGINES	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

Total Periods: 45

Text Books:

1. Stephen R turns, ”An Introduction to Combustion”, Tata Mc. Graw Hill Publishing Co., Ltd., New Delhi, Reprint 2013.
2. Lefebvre AG and Dilip R ballal, “Gas Turbine Combustion”, CRC press ,Third Edition, 2010.

Reference Books:

1.Warnatz J, Maas U and Dibble RW,”Combustion”,Springer, Fourth Edition,2006.
2. Beer, J.M., and Chiger, N.A. “Combustion Aerodynamics”, Applied Science Publishers Ltd., London, 1981.
3. Sharma, S.P., and Chandra Mohan, “Fuels and Combustion”, Tata Mc. Graw Hill Publishing Co., Ltd., New Delhi, 1987

BANE03	EXPERIMENTAL STRESS ANALYSIS	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :.

To make the student understand on experimental method of finding the response of the structure to different types of load.

UNIT I	MEASUREMENTS AND EXTENSOMETERS	9

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	9

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

UNIT III	PHOTOELASTICITY	9

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	9

Introduction to Moiré techniques, Brittle coating methods and Holography

UNIT V	NON – DESTRUCTIVE TESTING	9

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

Total Periods: 45

Text Books:

1. Dally, J.W., and Riley, W.F., "Experimental Stress Analysis", McGraw Hill Inc., New York, Fourth Edition 2005.
2. James F. Doyle ,"Modern Experimental Stress Analysis ",John Wiley & Sons, 2004.
3. Ramesh, K., " Experimental Stress Analysis", Indian Institute of Technology Madras, India,E-book,2009.

Reference Books:

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
5. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., "Experimental Stress Analysis", Tata McGraw Hill, New Delhi, 1984.

BANE04	EXPERIMENTAL AERODYNAMICS	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :
To make the student understand the measurement techniques involved in aerodynamic testing.

UNIT I	WIND TUNNEL TESTING	9

Low speed wind tunnels-estimation of energy ratio and power required supersonic wind tunnels-calculation of running time and storage tank requirements.

UNIT II	EXPERIMENTS IN SUBSONIC WIND TUNNELS	9

Estimation of flow angularity and turbulence factor-calculation of CL and CD on aero foils from pressure distribution- CD from wake survey-Test section average velocity using traversing rakes-span wise load distribution for different taper ratios of wing

UNIT III	EXPERIMENTS IN HIGH SPEED TUNNELS	9

Mach number estimation in test section by pressure measurement and using a wedge – preliminary estimates of blowing and running pressures, nozzle area ratios, mass flow for a given test section size and Mach number-starting problem and starting loads.

UNIT IV	MEASUREMENT TECHNIQUES	9

Hot wire anemometer and laser Doppler anemometer for turbulence and velocity measurements-Use of thermocouples and pyrometers for measurement of static and total temperatures-Use of pressure transducers, Rotameters and ultrasonic flow meters.

UNIT V	SPECIAL PROBLEMS	9

Pitot-static tube correction for subsonic and supersonic Mach numbers-boundary layer velocity profile on a flat plate by momentum-integral method -Calculation of CD from wall shear stress-Heating requirements in hypersonic wind tunnels-Re-entry problems.

Total Periods: 45

Text Books:

1. Rathakrishnan. E “Instrumentation, Measurement and Experiments in Fluids”, CRC Press, London, 2007

Reference Books:

1. Rae W.H and Pope. A “Low speed wind tunnel testing” John Wiley Publication, 1999
2. Pope. A and Goin. L “High speed wind tunnel testing” John Wiley, 1985

BAN6V1	VALUE ADDED PROGRAM - II	L	T	P	TLH	C
		0	0	2	2	1
OBJECTIVE : To enhance confidence, attitude of students and improve their employability skills.						
1	A business letter to a company asking for Quotation.					
2	A cover letter for applying a Job.					
3	A sample Email communication for the given situation.					
4	A model Technical report writing.					
5	An activity to analysis the audience.					
6	An activity to practice the body language.					
7	An activity to practice the voice modulation.					
8	An activity to present a self introduction.					
9	An activity to present a technical seminar.					
10	An activity to write a proper resume.					
11	A mock interview and group discussion.					
12	Problems on critical reasoning and sentence correction.					
13	Problems on number, Simple interest and compound interest.					
14	Problems on Analytical and Logical Reasoning.					
15	Problems on probability, permutation and combination.					

BAN6L1	AIRCRAFT SYSTEM LABORATORY	L	T	P	TLH	C
		0	0	3	3	2
OBJECTIVE : To train the students "ON HAND" experience in maintenance of various systems in aircraft.						
1.	Aircraft systems observations during Ground run.					
2.	Aircraft "Mooring" procedure.					
3.	Aircraft "Levelling" procedure					
4.	Control System "Rigging check" procedure					
5.	Aircraft "Symmetry Check" procedure					
6.	Procedure to find the centre of gravity of Aircraft					
7.	"Flow test" to assess of filter element clogging					
8.	"Pressure Test" To assess hydraulic External/Internal Leakage					
9.	"Functional Test" to adjust operating pressure					
10.	"Pressure Test" procedure on aircraft fuel system components					
11.	"Brake Torque Load Test" on wheel brake units					
12.	Maintenance and rectification of snags in hydraulic systems.					
13.	Rectification of snags in aircraft fuel systems.					
14.	Tyre pressure checking and Oleo leg pressure procedure.					
15.	Landing gear strut wheel dismantling and assembly procedure.					

BAN6L2	PROPULSION LABORATORY	L	T	P	TLH	C
		0	0	3	3	2

OBJECTIVE :
To understand the basic concepts and carryout experiments in Aerospace Propulsion.

1.	Estimation of spread rate in incompressible circular jets.
2.	Estimation of spread rate in incompressible non- circular jets.
3.	Estimation of centre line velocity decay in supersonic circular jets.
4.	Estimation of centre line velocity decay in supersonic non-circular jets.
5.	Determination of Wall jet velocity profile.
6.	Determination of Impingement jet velocity profile.
7.	Study of free convective heat transfer over a flat plate.
8.	Study of forced convective heat transfer over a flat plate.
9.	Study of conduction heat transfer in a flat plate.
10.	Operation of a subsonic Ramjet engine.
11.	Flame stabilization studies using conical flame holders.
12.	Velocity and pressure measurements of Co-axial jets.
13.	Effect of swirl on diffusion flame.
14.	Studies liquid fuel atomizers.
15.	Studies on pre-mixed flame.

BAN6L3	AIRCRAFT DESIGN PROJECT - I	L	T	P	TLH	C
		0	0	3	3	2

OBJECTIVE :

To introduce and develop the basic concept in aircraft design.

1.	Comparative configuration study of different types of airplanes
2.	Comparative study on specification and performance details of aircraft
3.	Preparation of comparative data sheets
4.	Work sheet layout procedures
5.	Comparative graphs preparation.
6.	selection of main parameters for the design
7.	Preliminary weight estimations.
8.	Selection of main parameters,
9.	Power plant selection.
10.	Aerofoil selection,
11.	Wing and stabilizers selection.
12.	Control surfaces designing.
13.	Drag estimation
14.	Detailed performance calculations and stability estimates
15.	Preparation of layouts of balance diagram and three view drawings

SEMESTER VII

BAN701	COMPUTATIONAL FLUID DYNAMICS	L	T	P	TLH	C
		3	1	0	4	4

OBJECTIVE :.

To study the flow of dynamic fluids by computational methods

UNIT I	INTRODUCTION	12

Basic Equations of fluid dynamics and their classification – Boundary Conditions – Incompressible inviscid flows – source, vortex and doublet panel method – Discretization of Partial Differential Equation – Truncation error, stability consistency, accuracy and convergence of numerical schemes.

UNIT II	GOVERNING EQUATIONS	12

Conservation Equations- Direct numerical Simulation – Large Eddy Simulation – Time-Averaged Equations for Turbulent flow – Reynolds Stress Equations – Turbulence modeling

UNIT III	WALL EFFECTS	12

The Role of Walls – Wall functions – Renormalization Group k- Models – Low-Reynolds number k-Models

UNIT IV	NUMERICAL METHODS	12

Finite Volume Method – SIMPLE Algorithm – Advanced Discretization Methods and Numerical Schemes – Solution Procedure – Differencing Scheme, Numerical Diffusion, Relaxation Factors and convergence

UNIT V	APPLICATIONS	12

Large Scale problems in CFD – Iterative Solvers – Preconditioning Techniques – Vector and Parallel Computing – Post Processing for Visualisation.

Total Periods: 60

Text Books:

1. Jiyuan Tu, Guan, Heng Yeoh, Chaoqun Liu, "Computational Fluid Dynamics A Practical Approach" Springer Verlag,2012.
2. J. D.Anderson, "Computational Fluid Dynamics", McGraw Hill International, 2012.

Reference Books:

1. H.K. Versteeg and W. Malalsekera "An Introduction to Computational Fluid Dynamics, The Finite Volume Method", Longman Scientific & Technical, 2007.
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.

BAN702	AVIONICS	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :.

To introduce the basic concepts of navigation & communication systems of aircraft.

UNIT I	INTRODUCTION TO AVIONICS	9

Need for avionics in civil and military aircraft and space systems – Integrated avionics and weapon systems – Typical avionics subsystems - Design approaches and recent advances - Application Technologies.

UNIT II	PRINCIPLE OF DIGITAL SYSTEMS	9

Digital computer – Digital number system- number systems and codes-Fundamentals of logic and combinational logic circuits –Digital arithmetic – interfacing with analogue systems - Microprocessors – Memories.

UNIT III	DIGITAL AVIONICS ARCHITECTURE	9

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

UNIT IV	FLIGHT DECKS AND COCKPITS	9

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	9

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

Total Periods:45

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.

Reference Books:

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,Prentice Hall, 2002..

BAN703	CONTROL ENGINEERING	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :.

To understand the basic concepts of flight control system.

UNIT I	INTRODUCTION	9

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	9

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

UNIT III	CHARACTERISTIC EQUATION AND FUNCTIONS	9

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	9

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

UNIT V	SAMPLED DATA SYSTEMS	9

Sampled data control systems - functional elements-sampling process - z-transforms- properties - inverse z transforms- response between samples-modified z-transforms - ZOH and First order Hold process- mapping between s and z planes - pulse transfer functions - step response - stability analysis-Jury's stability test - Introduction to digital control system, Digital Controllers and Digital PID controllers.

Total Periods: 45

Text Books:

1. OGATO, Modern Control Engineering, Fifth Edition, Prentice-Hall of India Pvt.Ltd., New Delhi, 2010.
2. Azzo, J.J.D. and C.H. Houpis, Feed back control system analysis and synthesis, McGraw-Hill international 3rs Edition, 1998.

Reference Books:

1. Kuo, B.C. Automatic control systems, Prentice-Hall of India Pvt.Lted., New Delhi, 2009.
2. Houpis, C.H. and Lamont, G.B. Digital control Systems, McGraw Hill Book co., New York, U.S.A. 1995.
3. Naresh K Sinha, Control Systems, New Age International Publishers, New Delhi,1998.

BBA704	PRINCIPLES OF MANAGEMENT AND PROFESSIONAL ETHICS	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :

To bring awareness of management skills and needs of professional ethics.

UNIT I	MANAGEMENT FUNCTIONS & STRUCTURE	9

Management – Definition – Basic Function – Contribution of Taylor & Fayol. Types of structure – Line, staff, Functional, Committee, Project & Matrix – Structures. Departmentalization – Centralization – Decentralization – span of control. Management By Objectives –Management By Exception.

UNIT II	MANAGEMENT OF ORGINASATION	9

Forms of Business / Industrial Ownership – Sole Trader, Partnership, Company, Performance Appraisal – Basic Principles – Pitfalls – Methods to Overcome. Industrial Safety – Causes of Accidents – Cost of Accident – How to minimize Accidents. Plant Layout & Maintenance – Need, Types & Managerial Aspects.

UNIT III	ORGANIZATIONAL BEHAVIOUR	9

OB – Definition – Nature & Scope – Contributing Disciplines – Importance of OB to Managers. Personality – Definition – Theories – Factors Influencing Personality. Motivation – Definition – Theories. Theory X & Y – Transactional Analysis. Morale & Job Satisfaction – Factors Influencing Job Satisfaction.

UNIT IV	GROUP DYNAMICS	9

Group – Definition – Types – Determinants of Group Cohesiveness – Communication – Process – Barriers – Effective Communication. Leadership Theories – Factors Contributing to Effective Leadership – Role of Trade Union in Organizations – Functions of Trade Union – Why Trade Union is required? – Types of Trade Union.

UNIT V	PROFESSIONAL ETHICS	9

Ethics in Workplace – Formulation of Ethics – Managerial Ethics – Managing Ethical Behaviour – Codes of Ethics – Encouraging Ethical Behaviour – Social Responsibility – Spirituality.

Total Periods: 45

Text Books:

1. Gupta C.B., Management Theory and Practice, 14th Edition, Sultan Chand & Sons, 2009.
2. Dr. Prasad L.M., Principle & Practice of Management, 7th Edition, Sultan Chand & Sons, 2008.

Reference Books:

1. Aswathappa, Organisational Behaviour, 8th Edition, Himalaya Publishing House, 2010.
2. Dr. Prasad L.M., Organisational Behaviour, 4th Edition, Sultan Chand & Sons, 2008.
3. Harold Koontz, Principles of Management, 1st Edition, Tata McGraw Hill, 2004.

ELECTIVE II -MAINTENANCE STREAM

BANE05	AIRCRAFT ENGINE REPAIR AND MAINTENANCE	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :

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

UNIT I	INSPECTIONS AND TROUBLE SHOOTING OF PISTON ENGINES	9

Need for Inspection, maintenance and trouble shooting in Piston engine – Inspection of all 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 – Details of carburetion and injection systems for small and large engines – Ignition system components – Spark plug – Maintenance and inspection check to be carried out.

UNIT II	INSPECTION AND TROUBLE SHOOTING OF PROPELLER	9

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

UNIT III	OVERHAULING OF PISTON ENGINES	9

Symptoms of failure - Fault diagnostics - Case studies of different piston 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	INSPECTION AND TROUBLE SHOOTING OF GAS TURBINE ENGINE	9

Gas turbine engine inspection & checks – Use of instruments for online maintenance – Maintenance procedures of gas turbine engines – Trouble shooting and rectification procedures – Component maintenance procedures – Systems maintenance procedures. Special inspection procedures : Foreign Object Damage – Blade damage – etc. Gas turbine testing procedures – test schedule preparation – Storage of Engines – Preservation and de-preservation procedures.

UNIT V	OVERHAULING OF GAS TURBINE ENGINES	9

Gas turbine Engine Overhaul procedures – Inspections and cleaning of components – Repairs schedules for overhaul – Balancing of Gas turbine components. Trouble Shooting - Procedures for rectification – Condition monitoring of the engine on ground and at altitude – engine health monitoring and corrective methods.

Total Periods: 45

Text Books:

KROES & WILD, “Aircraft Power plants”, 7th Edition – McGraw Hill, New York, 1994.

Reference Books:

1. TURBOMECA, "Gas Turbine Engines", The English Book Store, New Delhi, 1995.
2. UNITED TECHNOLOGIES PRATT & WHITNEY, "The Aircraft Gas turbine Engine and its Operation", The English Book Store, New Delhi.

ELECTIVE II -DESIGN STREAM

BANE06	HELICOPTER AERODYNAMICS	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :.

To introduce the concepts of ideal rotor theory and ground effect machines.

UNIT I	INTRODUCTION TO ROTATING WING CONCEPT	9

Evolution of helicopter-Helicopter configurations - 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	HOVERING FLIGHT DYNAMICS	9

Actuator disc theory-Blade Element Theory-ideal twist Induced & profile power-Figure of merit-Thrust and power coefficients-calculation of drag, torque, power-Ground effect in hover-Estimation of hover ceiling.

UNIT III	FORWARD FLIGHT DYNAMICS	9

Forward flight performance-Parasite drag and Power-Stall limitations-flapping-cyclic Pitch - Autorotation in hover and in forward flight-Dead man's curve.

UNIT IV	CLIMB AND DESCENT PERFORMANCE	9

Vertical flight-flow patterns surrounding the rotor-Power required in climb and descent-Descent speed calculations-Take-off techniques.

UNIT V	GROUND EFFECT MACHINES	9

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.

Total Periods: 45

Text Books:

1. Gupta. L "Helicopter Engineering", Himalayan Books, 1996
2. Seddon. J "Basic Helicopter Aerodynamics" AIAA education series, 1990.

Reference Books:

1. Gessow A & Myers G.C "Aerodynamics of Helicopter" Mac Millan & Co, 1987
2. Saunders "Dynamics of Helicopter flight", John Wiley, 1975
3. Newman. S "Foundation of Helicopter Flight" Halsted Press, 1994

ELECTIVE II -DESIGN STREAM

BANE07	THEORY OF VIBRATIONS	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :.

To teach the students about the basic concepts of vibration..

UNIT I	SINGLE DEGREE OF FREEDOM SYSTEMS	09

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	09

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 AND APPROXIMATE METHODS	09

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

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

UNIT IV	ELEMENTS OF AEROELASTICITY	09

Concepts – Coupling – Aero elastic instabilities and their prevention – Basic ideas on wing divergence, loss and reversal of aileron control – aileron efficiency-semi rigid theory and successive approximations- Lift distribution – rigid and elastic wings. Tail efficiency. Effect of elastic deformation on static longitudinal stability.

UNIT V	FLUTTER PHENOMENON	09

Physical interpretation of the classical Flutter – Non-dimensional parameters – stiffness criteria – Dynamic mass balancing – Dimensional similarity - Flutter analysis- Calculation of the flutter speed via P-Method – concept of dummy structural damping , violent flutter, moderate flutter and mild flutter and prevention of flutter.

Total Periods: 45

Text Books:

1. Y.C. Fung, "An Introduction to the Theory of Aeroelasticity", John Wiley & Sons Inc., New York, 2008.

2. Thomson W T, 'Theory of Vibration with Application' - CBS Publishers, 1990.

Reference Books:
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 Tork, 1983.
3. R.H. Scanlan and R.Rosenbaum, "Introduction to the study of Aircraft Vibration and Flutter", Macmillan Co., New York, 1981.
4. R.D.Blevins, "Flow Induced Vibrations", Krieger Pub Co., 2001

ELECTIVE II -DESIGN STREAM

BANE08	BOUNDARY LAYER THEORY	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :

To make the student understand the importance of viscosity and boundary layer in fluid flow.

UNIT I	FUNDAMENTAL EQUATIONS OF VICOUS FLOW	9

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, Non-dimensionalising the basic equations and boundary conditions, vorticity considerations, creeping flow, boundary layer flow

UNIT II	SOLUTIONS OF VICOUS FLOW EQUATIONS	9

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	9

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 EQUATIONS	9

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 EQUATIONS	9

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

	Total Periods: 45
Text Books: 1. White, F. M., Viscous Fluid Flow, McGraw-Hill & Co., Inc., New York., 2005.	
Reference Books: 1. Schlicting, H., Boundary Layer Theory, McGraw-Hill, New York, 2000. 2. Reynolds, A, J., Turbulent Flows Engineering, John Wiley and Sons, 1980.	

ELECTIVE II -DESIGN STREAM

BANE09	**THEORY OF TURBULENT FLOWS**	**L**	**T**	**P**	**TLH**	**C**
		3	**0**	**0**	**3**	**3**

OBJECTIVE :

To make the student understand the importance of Turbulent flow.

UNIT I	**INTRODUCTION**	**9**
Definition of turbulence; Features of turbulence – irregularity, diffusivity, high Reynolds number, rotational, dissipative, continuum phenomenon; Characterisation of turbulent flows – statistical averages, moments, probability density function, correlation, spectrum, scales, intermittency, quadrant analysis.		
UNIT II	**EQUATIONS GOVERNING TURBULENT FLOW**	**9**
Reynolds averaged Navier – Stokes Equations;Equations for Reynolds stresses,mean and turbulent kinetic energy ;Energy transfer in turbulent flows ; Closureproblem ;Boundary layer equations for turbulent flows ;Momentum integral equation for turbulent boundary layer ;Reynolds averaged and mass weighted equations for compressible flows.		
UNIT III	**TURBULENCE MODELLING**	**9**
Outline of approaches to prediction of turbulent flows – statistical theory ofturbulence; integral methods for thin shear flows; Direct numerical simulation (DNS);Modelling of turbulent stresses and numerical solution of resulting equations.Need for models of turbulence ; zero -, one -, half - , and two- equation models ofturbulence; Reynolds stress model ; three-equation model; Modelling for compressibleflows; Role of DNS data in turbulence modelling.		
UNIT IV	**NUMERICAL SCHEME FOR PREDICTING SEPARATED FLOWS**	**9**
Reynolds average Navier – Stokes equations ; Finite volume discretization;Solution procedure ; Inlet, exit and wall boundary conditions;Modification to models of turbulence for flow with separation and swirl; Examples of computation of separated flows		
UNIT V	**EXPERIMENTAL TECHNIQUES**	**9**
Need for special techniques; Hot-wire anemometry ; LASER Doppler Velocimetry ;Particle Image Velocimetry.		
		Total Periods: 45

Text Books:

1. Wilcox, D.C."Turbulence modeling for CFD", DCW Industries, La Canada, CA, 3rd edition 2006.
2. Lesieur, M."Turbulence in fluids" Kluwer, Dordrecht, 4th edition, 2008.

Reference Books:

Tennekes, H. and Lumley,J.L."A first course on turbulence" MIT Press, Cambridge Mass., 1972.
2. Pope S.B."Turbulence" Cambridge University Press, Cambridge, U.K., 2000.
3. Biswas, G. and Eswaran,V. C."Turbulent flows" Narosa Publishing House New Delhi, India, 2002.
4. Davidson P.A,"Turbulence" Oxford University Press, Oxford, U.K, 2004.

ELECTIVE III -MAINTENANCE STREAM

BANE10	HELICOPTER MAINTENANCE	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :.
To present the basics in the area of Helicopter maintenance.

UNIT I	**HELICOPTER FUNDAMENTAL**	**9**
Basic directions – Ground handling, bearing – Gears.		
UNIT II	**INSPECTION AND MAINTENANCE OF MAIN ROTOR SYSTEM**	**9**
Head maintenance – blade alignment – Static main rotor balance – Vibration – Tracking – Span wise dynamic balance – Blade sweeping –Electronic balancing – Dampener maintenance – Counter weight adjustment – Auto rotation adjustments – Mast & Flight Control Rotor - Mast – Stabilizer, dampeners – Swash plate flight control systems collective – Cyclic – Push pull tubes – Torque tubes – Bell cranks – Mixer box – Gradient unit control boosts – Maintenance & Inspection control rigging.		
UNIT III	**INSPECTION AND MAINTENANCE OF MAIN ROTOR TRANSMISSION**	**9**
Engine transmission coupling – Drive shaft – Maintenance clutch – Free wheeling units – Spray clutch – Roller unit – Torque meter – Rotor brake – Maintenance of these components – vibrations – Mounting systems – Transmissions.		
UNIT IV	**INSPECTION AND MAINTENANCE OF POWER PLANT & TAIL ROTOR**	**9**
Fixed wing power plant modifications – Installation – Different type of power plant maintenance. Tail rotor system – Servicing tail rotor track – System rigging.		
UNIT V	**AIRFRAMES AND RELATED SYSTEMS**	**9**
Fuselage maintenance – Airframe Systems – Special purpose equipment.		
		Total Periods: 45

Text Books:
1. JEPPESEN, "Helicopter Maintenance", Jeppesons and Sons Inc., 2000.

Reference Books:
1. "Civil Aircraft Inspection Procedures", Part I and II, CAA, English Book House, New Delhi, 1998.
2. LARRY REITHMIER, "Aircraft Repair Manual", Palamar Books Marquette, 1992.

ELECTIVE III -DESIGN STREAM

BANE11	THEORY OF PLATES AND SHELLS	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :.
To study the behavior of the plates and shells with different geometry under various types of loads.

UNIT I	**CLASSICAL PLATE THEORY**	**9**
Classical Plate Theory – Assumptions – Differential Equations – Boundary Conditions – Axi-Symmetric Loading.		
UNIT II	**PLATES OF VARIOUS SHADES**	**9**
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**	**9**
Stability and Free Vibration Analysis of Rectangular Plates.		
UNIT IV	**APPROXIMATE METHODS**	**9**
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 Periods: 45

Text Books:
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

Reference Books:

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

ELECTIVE III -DESIGN STREAM

BANE12	HYPERSONIC AERODYNAMICS	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :.

To present the fundamentals of hypersonic flow and the associated problem areas.

UNIT I	FUNDAMENTALS OF HYPERSONIC AERODYNAMICS	9

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

UNIT II	SIMPLE SOLUTION METHODS FOR HYPERSONIC IN VISCID FLOWS	9

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

UNIT III	VISCOUS HYPERSONIC FLOW THEORY	9

Boundary layer equation 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.

Total Periods: 45

Text Books:

1. John. D. Anderson. Jr., "Hypersonic and High Temperature Gas Dynamics", AIAA Series, New York, 2006.

Reference Books:

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.

ELECTIVE III -DESIGN STREAM

BANE13	NANO SCIENCE AND TECHNOLOGY	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :.

To Impart the basic knowledge on nanoscience and technology.

UNIT I	INTRODUCTION	9

Introduction to nanoscale materials - atomic & molecular size. Scientific revolutions-nanotechnology applicationarea. Scope of nanoscience and technology

UNIT II	NANOSTRUCTURES AND DIMENSIONS	9

Classification of nanostructures-zero, one, two and three dimensional nanostructures. Size Dependency inNanostructures-quantum size effects in nanostructures. Chemistry of tailored nano shapes.

UNIT III	NANOMATERIAL SYNTHESIS	9

Synthesis of nanomaterials-top down and bottom up approach. Method of nanomaterials preparation – wetchemical synthesis-mechanical grinding-gas phase synthesis.

UNIT IV	NANOMATERIAL PROPERTIES	9

Surface to volume ratio. Surface properties of nanoparticles. Mechanical, optical, electronic, magnetic, thermaland chemical properties of nanomaterials. Size dependent properties-size dependent absorption spectra.Shape impact.

UNIT V	PHYSICAL PROPERTIES OF NANOSTRUCTURED MATERIALS	9

Quantum dots-optical properties and applications. Carbon nano tubes-physical properties and applications.Magnetic behavior of nanomaterials. Electronic transport in quantum wires. Surface chemistry of tailoredmonolayer.

Total Periods: 45

Text Books:

1. T. Pradeep, " Nano the Essential Nanoscience and Nanotechnology", Tata McGraw hill, 2007.
2. Mick Wilson, Kamali Kannargare., Geoff Smith, "Nano technology: Basic Science and Emergingtechnologies", Overseas Press, 2005.

Reference Books:
1. Charles P. Poole, Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2003.
2. Mark A. Ratner, Daniel Ratner, "Nanotechnology: A gentle introduction to the next Big Idea", Prentice Hall
P7R:1st Edition, 2002.
3. J. Dutta, H. Hoffmann, "Nanomaterials", Topnano-21, 2003.

BAN7L1	AIRFRAME AND AIRCRAFT POWERPLANT REPAIR LABORATORY	L	T	P	TLH	C
		0	0	3	3	2

OBJECTIVE :
To introduce the knowledge of the maintenance and repair of both Airframe and Aircraft powerplant.

1.	Dismantling and reassembling a piston engine
2.	Piston Engine - cleaning, visual inspection, NDT checks.
3.	Piston Engine Components - dimensional checks.
4.	Study of carburetor, fuel pump, spark plug and ignition system.
5.	Dismantling and reassembling a jet engine
6.	Jet Engine – identification of components & defects.
7.	Jet Engine – NDT checks and dimensional checks
8.	Engine starting procedures.
9.	Aircraft wood gluing by single scarf and double scarf joint point.
10.	Welded single & double V-joints using MIG, TIG & PLASMA welding.
11.	Fabric and Riveted patch repairs.
12.	Tube bending and flaring
13.	Sheet metal forming.
14.	Repairing of Acrylic sheets.
15.	Repairing the composite panels.

BAN7L2	AVIONICS LABORATORY	L	T	P	TLH	C
		0	0	3	3	2

OBJECTIVE :
To learn about basic digitalelectronics circuits, programming with microprocessors, design and implementation ofdata buses in avionics with MIL – Std.

1.	Addition/Subtraction of binary numbers.
2.	Multiplexer/Demultiplexer Circuits.
3.	Encoder/Decoder Circuits.

4.	Timer Circuits, Shift Registers, Binary Comparator Circuits.
5.	Addition and Subtraction of 8-bit and 16-bit numbers.
6.	Sorting of Data in Ascending & Descending order.
7.	Sum of a given series with and without carry.
8.	Greatest in a given series & Multi-byte addition in BCD mode.
9.	Interface programming with 4 digit 7 segment Display & Switches & LED's.
10.	Channel Analog to Digital Converter & Generation of Ramp, Square, Triangular waveby Digital to Analog Converter.
11.	Study of Different Avionics Data Buses.
12.	MIL-Std – 1553 Data Buses Configuration with Message transfer.
13.	MIL-Std – 1553 Remote Terminal Configuration.

BAN7L3	**AIRCRAFT DESIGN PROJECT – II**	**L**	**T**	**P**	**TLH**	**C**
		0	**0**	**3**	**3**	**2**

OBJECTIVE :
To enhance the knowledge in continuation of the design given in project–I andthefollowing assignments are to be carried out.

1.	V-n diagram for the design study
2.	Gust and maneuverability envelopes
3.	Critical loading performance and final V-n graph calculation
4.	Structural design study – Theory approach
5.	Load estimation of wings
6.	Load estimation of fuselage.
7.	Balancing and Maneuvering loads on tail plane, Aileron and Rudder loads.
8.	Detailed structural layouts.
9.	Design of some components of wings, fuselage
10.	Preparation of a detailed design report with drawings.
11.	Preparation of model using computer aided design packages.
12.	Preparation of structural analysis report for wing.
13.	Preparation of structural analysis report for Fuselage.
14.	Preparation of flow analysis report for wing.
15.	Preparation of flow analysis report for fuselage.

BAN7L4	FLIGHT TRAINING LABORATORY	L	T	P	TLH	C
		0	0	2	2	1

OBJECTIVE :

To demonstrate the real time experience ofmaneuver.

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.

BAN7P1	PROJECT WORK	L	T	P	TLH	C
		0	0	4	4	1

OBJECTIVE :

The objective of the project work is to enable the students in convenient groups of not more than 4 members on a project involving theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Each student shall finally produce a comprehensive report covering background information,3 literature survey and problem statement, This final report shall be in typewritten form as specified in the guidelines.

SEMESTER VIII

BAN801	ROCKETS AND MISSILES	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :

To learn about the aerodynamics and stability of Rockets and Missiles.

UNIT I	ROCKET SYSTEMS	9

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	9

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	9

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	9

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.

Total Periods: 45

Text Books:

1.Martin J L Turner, Rocket and Spacecraft Propulsion, Springer-Praxis Publishing, 2001

2.Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 7th Edition, 2001

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Reference Books:

1. J.D.Mattingly, Elements of Propulsion - Gas Turbines and Rockets, AIAA Education series,2006,.

2. Mathur, M.L., and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion",Standard Publishers and Distributors, Delhi, 1988.

ELECTIVE IV -MAINTENANCE STREAM

BANE14	AIRPORT MANAGEMENT	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :

To study the concepts of air transportation and the maintenance management of aircraft.

UNIT I	INTRODUCTION	9

Development of air transportation, comparison with other modes of transport – Role of IATA, ICAO – The general aviation industry airline – Factors affecting general aviation, use of aircraft, airport: airline management and organization – levels of management, functions of management, Principles of organization planning the organization – chart, staff departments & line departments.

UNIT II	AIRLINE ECONOMICS	9

Forecasting – Fleet size, Fleet planning, the aircraft selection process, operating cost, passenger capacity, load factor etc. – Passenger fare and tariffs – Influence of geographical, economic & political factors on routes and route selection.

Fleet Planning: The aircraft selection process – Fleet commonality, factors affecting choice of fleet, route selection and Capitol acquisition – Valuation & Depreciation – Budgeting, Cost planning – Aircrew evaluation – Route analysis – Aircraft evaluation.

UNIT III	PRINCIPLES OF AIRLINES SCHEDULING	9

Equipment maintenance, Flight operations and crew scheduling, Ground operations and facility limitations, equipments and types of schedule – hub & spoke scheduling, advantages / disadvantages & preparing flight plans – Aircraft scheduling in line with aircraft maintenance practices.

UNIT IV	AIRCRAFT RELIABILITY	9

Aircraft reliability – The maintenance schedule & its determinations – Condition monitoring maintenance – Extended range operations (EROPS) & ETOPS – Ageing aircraft maintenance production.

UNIT V	TECHNOLOGY IN AIRCRAFT MAINTENANCE	9

Airlines scheduling (with reference to engineering) – Product support and spares – Maintenance sharing – Equipments and tools for aircraft maintenance – Aircraft weight control – Budgetary control.

On board maintenance systems – Engine monitoring – Turbine engine oil maintenance – Turbine engine vibration monitoring in aircraft – Life usage monitoring – Current capabilities of NDT – Helicopter maintenance – Future of aircraft maintenance.

Total Periods: 45

Text Books:

1. FEDRIC J.H., "Airport Management", 2000.
2. C.H. FRIEND, "Aircraft Maintenance Management", 2000.

Reference Books:

1. Gene Kropf, "Airline Procedures".
2. Wilson & Bryon, "Air Transportation".
3. Philip Locklin D, "Economics Of Transportation".
4. " Indian Aircraft Manual" – Dgca Pub.
5. Alexander T Wells, "Air Transportation", Wadsworth Publishing Company, California, 1993

ELECTIVE IV -DESIGN STREAM

BANE15	UNMANNED AERIAL VEHICLE	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :

To make the student understand the importance parameters in designing of UAV.

UNIT I	INTRODUCTION TO UNMANNED AIRCRAFT SYSTEMS	9

The Systemic Basis of UAS-System Composition- Conceptual Phase-Preliminary Design-Selection of the System- Some Applications of UAS

UNIT II	AERODYNAMICS AND AIRFRAME CONFIGURATIONS	9

Lift-induced Drag - Parasitic Drag - Rotary-wing Aerodynamics - Response to Air Turbulence - Airframe Configurations Scale Effects - Packaging Density – Aerodynamics - Structures and Mechanisms - Selection of power-plants - Modular Construction - Ancillary Equipment

UNIT III	CHARACTERISTICS OF AIRCRAFT TYPES	9

Long-endurance, Long-range Role Aircraft – Medium-range, Tactical Aircraft - Close-range/Battlefield Aircraft - MUAV Types - MAV and NAV Types - UCAV - Novel Hybrid Aircraft Configurations - Research UAV

UNIT IV	COMMUNICATIONS NAVIGATION	9

Communication Media - Radio Communication - Mid-air Collision (MAC) Avoidance - Communications Data Rate and Bandwidth Usage - Antenna Types NAVSTAR Global Positioning System (GPS) - TACAN - LORAN C - Inertial Navigation - Radio Tracking - Way-point Navigation

UNIT V	CONTROL AND STABILITY	9

HTOL Aircraft - Helicopters - OTE/OTE/SPH - Convertible Rotor Aircraft - Payload Control - Sensors –culmon filter- Autonomy

Total Periods: 45

Text Books:

1. Reg Austin., Unmanned Aircraft Systems, John Wiley and Sons., 2010

Reference Books:

1.Milman&Halkias, "Integrated Electronics", McGraw Hill, 1999.
2. Malvino& Leach, "Digital Principles & Applications", McGraw Hill, 1986
3. Collinson R.P.G, „Introduction to Avionics", Chapman and Hall, India, 1996
4.BernadEtikin,"Dynamic of flight stability and control", John Wiley, 1972

ELECTIVE IV - DESIGN STREAM

BANE16	PRINCIPLES OF TURBOMACHINERY IN AIRBREATHING ENGINES	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :
To understand the theoretical concepts of turbomachinery.

UNIT I	INTRODUCTION TO TURBOMACHINERIES	5

Introduction - Blades and flow - Work input and output - Dynamic scaling – Losses and Efficiency

UNIT II	AXIAL FLOW COMPRESSORS AND FANS	13

Radial Equilibrium Equation; Design of compressor blades; 2-D blade section design : Airfoil Data; Axial Flow Track Design; Axial compressor characteristics; Multi-staging of compressor characteristics; Transonic Compressors; Shock Structure Models in Transonic Blades; Transonic Compressor Characteristics; 3-D Blade shapes of Rotors and Stators; Instability in Axial Compressors; Loss of Pressure Rise; Loss of Stability Margin; Noise problem in Axial Compressors and Fans

UNIT III	AXIAL FLOW TURBINES	9

Turbine Blade 2-D (cascade) analysis Work Done; Degree of Reaction; Losses and Efficiency; Flow Passage; Subsonic, transonic and supersonic turbines, Multi-staging of Turbine; Exit flow conditions; Turbine Cooling; Turbine Blade design – Turbine Profiles : Airfoil Data and Profile construction

UNIT IV	CENTRIFUGAL COMPRESSORS:	9

Elements of centrifugal compressor/ fan; Inlet Duct Impeller; Slip factor; Concept of Rothalpy; Modified work done; Incidence and lag angles; Diffuser ; Centrifugal Compressor Characteristics; Surging; Chocking; Rotating stall; Design

UNIT V	RADIAL TURBINE:	9

Thermodynamics and Aerodynamics of radial turbines; Radial Turbine Characteristics; Losses and efficiency; Design of radial turbine

Total Periods: 45

Text Books:

1. Nicholas Cumpsty, Compressor Aerodynamics, 2004, Kreiger Publications, USA.
2. Johnson I.A., Bullock R.O. NASA-SP-36, Axial Flow Compressors, 2002 (re-release), NTIS.
3. Ahmed F. El-Sayed; Aircraft Propulsion and Gas Turbine Engines; CRC press, 2008

Reference Books:

1. El-Wakil, M M; Powerplant Technology, 1984, McGraw-Hill Pub.
2. NASA-SP-290, Axial Flow turbines, 2002 (re-release), NTIS, USA.
3. J H Horlock, Axial flow compressors, Butterworths, 1958, UK.
4. J H Horlock, Axial Flow Turbines, Butterworths, 1965, UK.
5. B Lakshminarayana; Fluid Mechanics and Heat Transfer in turbomachineries,Â 1995, USA.

ELECTIVE IV - DESIGN STREAM

BANE17	FATIGUE AND FRACTURE MECHANICS	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :.

To become skilled in the concepts of estimation of the endurance and failure mechanism of Components

UNIT I	FATIGUE OF STRUCTURES	9

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	9

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	9

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

UNIT IV	FRACTURE MECHANICS	9

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 ANDTESTINIG	9

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

Total Periods: 45

Text Books:

1. Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw Hill, New Delhi, India, 2009.
2.. T.L. Anderson, Fracture Mechanics - Fundamentals and Applications, 3rd Edition, Taylor and Francis Group, 2005

Reference Books:

1. K. R.Y. Simha, Fracture Mechanics for Modern Engineering Design, Universities Press (India) Limited, 2001
2. D. Broek, Elementary Engineering Fracture Mechanics, Kluwer Academic Publishers, Dordrecht, 1986.
3. Barrois W, Ripely, E.L., "Fatigue of aircraft structure," _ Pergamon press. Oxford, 1983

ELECTIVE IV - DESIGN STREAM

BANE18	SPACE MECHANICS	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :

To study the basic concepts of orbital Mechanics with particular emphasis on interplanetary trajectories

UNIT I	BASIC CONCEPTS AND THE GENERAL N- BODY PROBLEM	9

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	9

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	9

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	9

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.

Total Periods: 45

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.

Reference Books:

1.Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 7th Edition, 2001.

ELECTIVE V - MAINTENANCE STREAM

BANE19	TOTAL QUALITY MANAGEMENT	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :
To understand the Total Quality Management concept and principles and the various tools available to achieve Total Quality Management.

UNIT I	INTRODUCTION	9

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs – Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNIT II	TQM PRINCIPLES	9

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

UNIT III	STATISTICAL PROCESS CONTROL (SPC)	9

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

UNIT IV	TQM TOOLS	9

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

UNIT V	QUALITY SYSTEMS	9

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, TS16949, ISO 14000 – Concept, Requirements and Benefits.

Total Periods: 45

Text Books:

1. Dale H.Besterfiled, et al., "Total Quality Management", Pearson Education, Inc.2003. (Indian reprint 2004). ISBN 81-297-0260-6.

Reference Books:

1. Evans. J. R. & Lindsay. W,M "The Management and Control of Quality", (5th Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
2. Feigenbaum.A.V. "Total Quality Management", McGraw-Hill, 1991.
3. Oakland.J.S. "Total Quality Management", Butterworth Hcinemann Ltd., Oxford, 1989.
4. Narayana V. and Sreenivasan, N.S. "Quality Management – Concepts and Tasks", New Age International 1996.
5. Zeiri. "Total Quality Management for Engineers", Wood Head Publishers, 1991.

ELECTIVE V - MAINTENANCE STREAM

BANE20	AIRCRAFT RULES AND REGULATIONS CAR I AND II	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :

To impart knowledge regarding CAR in India (DGCA) in par with FAA & JAA

UNIT I	C.A.R. SERIES "A " & " B "	9

C.A.R series 'A' - procedure for civil air worthiness Requirements and responsibility operators vis-a-vis Air Worthiness directorate - 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 operations.

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 check list.

UNIT II	C.A.R. SERIES "C " & " D "	9

C.A.R. series 'C' - defect recording, monitoring, investigation and reporting - 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'-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 " & " F "	9

C.A.R. series 'E' - approval of organizations - 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 " & " M "	9

C.A.R. series 'L' - aircraft maintenance engineer – licensing - Issue of AME Licence, its classification and experience requirements, Complete Series 'L'.

C.A.R. series 'M' Mandatory Modifications / Inspections.

UNIT V	C.A.R. SERIES "T " & " X "	9

C.A.R. series 'T' - flight testing of aircraft - 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 Periods: 45

Text Books:

1. " Aircraft Manual (India) ", The English Book Store, 17-1, Connaught Circus, New Delhi.

Reference Books:

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

ELECTIVE V - DESIGN STREAM

BANE21	INDUSTRIAL AERODYNAMICS	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :

To familiarize the learner with non-aeronautical uses of aerodynamics such as road vehicle, building aerodynamics and problems of flow induced vibrations.

UNIT I	**ATMOSPHERIC BOUNDARY LAYER**	**9**

Atmospheric circulation-Local winds-Terrain types-Mean velocity profiles-Power law and logarithm law- wind speeds-Turbulence profiles-Roughness parameters-simulation techniques in wind tunnels

UNIT II	**BLUFF BODY AERODYNAMICS**	**9**

Boundary layers and separation-Two dimensional wake and vortex formation-Strouhal and Reynolds numbers-Separation and reattachments-Power requirements and drag coefficients of automobiles-Effects of cut back angle-aerodynamics of trains.

UNIT III	**WIND ENERGY COLLECTORS**	**9**

Horizontal and vertical axis machines-energy density of different rotors-Power coefficient-Betz coefficient by momentum theory.

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-ventilation and architectural aerodynamics

UNIT V	**FLOW INDUCED VIBRATIONS**	**9**

Vortex shedding, lock & effects of Reynolds number on wake formation in turbulent flows - across wind galloping-wake galloping-along wind galloping of circular cables-oscillation of tall structures and launch vehicles under wind loads-stall flutter.

Total Periods: 45

Text Books:

1. Blevins R.D "Flow Induced Vibrations", Van Nostrand, 1990
2. Sovran, M(ed) "Aerodynamic drag mechanism of bluff bodies and road vehicles", Plenum Press, N.Y, 1990

Reference Books:

1. Sachs P "Wind Forces in Engineering", Pergamon Press, 1988
2. Scorer R.S "Environmental Aerodynamics", Ellis Harwood Ltd, England, 1978
3. Calvert N.G "Wind Power Principles", Charles Griffin & Co London, 1979.

ELECTIVE V - DESIGN STREAM

BANE22	WIND ENERGY	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :

To understand the fundamentals of wind energy and its conversion techniques for electrical energy applications.

UNIT I	WIND ENERGY FUNDAMENTALS & WIND MEASUREMENTS	9

Wind Energy Basics, Wind Speeds and scales, Terrain, Roughness, Wind Mechanics, Power Content, Class of wind turbines, Atmospheric Boundary Layers, Turbulence. Instrumentation for wind measurements, Wind data analysis, tabulation, Wind resource estimation, Betz's Limit, Turbulence Analysis

UNIT II	AERODYNAMICS THEORY & WIND TURBINE TYPES	9

Airfoil terminology, Blade element theory, Blade design, Rotor performance and dynamics, Balancing technique (Rotor & Blade), Types of loads; Sources of loads Vertical Axis Type, Horizontal Axis, Constant Speed Constant Frequency, Variable speed Variable Frequency, Up Wind, Down Wind, Stall Control , Pitch Control, Gear Coupled Generator type, Direct Generator Drive /PMG/Rotor Excited Sync Generator

UNIT III	GEAR COUPLED GENERATOR WIND TURBINE COMPONENTS AND THEIR CONSTRUCTION	9

Electronics Sensors /Encoder /Resolvers, Wind Measurement : Anemometer & Wind Vane, GridSynchronisation System, Soft Starter, Switchgear [ACB/VCB], Transformer, Cables and assembly,Compensation Panel, Programmable Logic Control, UPS, Yaw & Pitch System : AC Drives, SafetyChain Circuits, Generator Rotor Resistor controller (Flexi Slip), Differential Protection Relay forGenerator, Battery/Super Capacitor Charger & Batteries/ Super Capacitor for Pitch System, TransientSuppressor / Lightning Arrestors, Oscillation & Vibration sensing

UNIT IV	DIRECT ROTOR COUPLED GENERATOR	9

Excited Rotor Synch.Generator / PMG Generator, Control Rectifier, Capacitor Banks, Step Up / Boost
Converter (DC-DC Step Up), Grid Tied Inverter, Power Management, Grid Monitoring Unit (Voltage
and Current), Transformer, Safety Chain Circuits

UNIT V	MODERN WIND TURBINE CONTROL & MONITORING SYSTEM	9

Details of Pitch System & Control Algorithms, Protections used & Safety Consideration in Wind turbines, Wind Turbine Monitoring with Error codes, SCADA & Databases: Remote Monitoring and Generation Reports, Operation & Maintenance for Product Life Cycle, Balancing technique (Rotor & Blade), FACTS control & LVRT & New trends for new Grid Codes.

Total Periods: 45

Text Books:

1. Kaldellis J.K, Standalone and Hybrid Wind Energy Systems, CRC Press, 2010
2. Mario Garcia –Sanz, Constantine H. Houpis, Wind Energy Systems,CRC Press 2012

Reference Books:

1. Freris, L.L., Wind Energy Conversion Systems, Prentice Hall, 1990
2. Spera, D.A., Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering, ASME Press, 1994.
3. Duffie, A and Beckmann, W. A., Solar Engineering of Thermal Processes, John Wiley, 1991.
4. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press,1996.

ELECTIVE V - DESIGN STREAM

BANE23	GAS TURBINE COMBUSTION	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :.

To present the basics in the area of combustion in gas turbine engine.

UNIT I	INTRODUCTION TO COMBUSTION	9

Introduction -Deflagration - Detonation - Classification of Flames -Flammability Limits -Global Reaction-Rate Theory- Laminar Premixed Flames - Laminar Diffusion Flames - Turbulent Premixed Flames - Flame Propagation in Heterogeneous Mixtures of Fuel Drops, Fuel Vapor, and Air - Droplet and Spray Evaporation - Ignition Theory - Spontaneous Ignition - Flashback - Stoichiometry

UNIT II	COMBUSTION PERFORMANCE	9

The Combustion Process - Reaction-Controlled Systems - Mixing-Controlled Systems - Reaction- and Evaporation-Controlled Systems- Flame Stabilization - Bluff-Body Flameholders - Mechanisms of Flame Stabilization - Flame Stabilization in Combustion Chambers-Factors Influencing Ignition Performance Methods of Improving Ignition Performance.

UNIT III	FUEL INJECTION	9

Basic Processes in Atomization - Classical Mechanism of Jet and Sheet Breakup - Prompt Atomization -

Drop-Size Distributions - Atomizer Requirements-Pressure Atomizers- Rotary Atomizers - Air-Assist Atomizers - Airblast Atomizers – Vaporizers - Fuel Nozzle Coking - Gas Injection.

UNIT IV	COMBUSTION NOISE	9

Direct Combustion Noise - Combustion Instabilities - Control of Combustion Instabilities - Modeling of Combustion Instabilities

UNIT V	HEAT TRANSFER	9

Heat-Transfer Processes- Internal Radiation - Radiation from Nonluminous Gases - External Radiation

Internal Convection - External Convection - Calculation of Uncooled Liner Temperature - Film Cooling

Correlation of Film-Cooling Data - Practical Applications of Transpiration Cooling

Total Periods: 45

Text Books:

1. AG Lefebvre and Dilip R ballal, "Gas Turbine Combustion", CRC Press third edition,2010.
2. Stephen R tuns, " An Introduction to Combustion", Mc Graw Hill, third edition,2011.

Reference Books:

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.

ELECTIVE V - DESIGN STREAM

BANE24	SATELLITE TECHNOLOGY	L	T	P	TLH	C
		3	0	0	3	3

OBJECTIVE :

To study the fundamentals of the spacecraft and satellite systems design.

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.

Total Periods: 45

Text Books:

1 Spacecraft Thermal Control, Hand Book, Aerospace Press, 2002.
2.Introduction Space Flight, Francis J. Hale Prentice Hall, 1994.
5.Space Vehicle Design, Michael D. Griffin and James R. French, AIAAEducation Series, 1991.

Reference 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 .Space Communications Systems, Richard.F, Filipowsky Eugen I MuehllorfPrinctice Hall, 1995.

BAN8P2	PROJECT WORK PHASE II	L	T	P	TLH	C
		0	0	15	15	6

OBJECTIVE :

The objective of the project work is to enable the students in convenient groups of not more than 4 members on a project involving theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. This final report shall be in typewritten form as specified in the guidelines.