Syllabus
II Year-III Semester
B. TECH. : AERONAUTICAL ENGINEERING

3AN2-01 : Advanced Engineering Mathematics-I		
Credit: 3		**Max. Marks: 120(IA:30, ETE:120)**
		End Term Exam: 3 Hours
SN	**Contents**	**Hours**
1	**Numerical Methods – 1:** Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Gauss's forward and backward interpolation formulae. Stirling's Formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange'sformulae. Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.	**10**
2	**Numerical Methods – 2:** Numerical solution of ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge- Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. Solution of polynomial and transcendental equations-Bisection method, Newton-Raphson method and Regula-Falsi method.	**08**
3	**Laplace Transform:** Definition and existence of Laplace transform, Properties of Laplace Transform and formulae, Unit Step function, Dirac Delta function, Heaviside function, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs by Laplace transforms method.	**10**
4	**Fourier Transform:** Fourier Complex, Sine and Cosine transform, properties and formulae, inverse Fourier transforms, Convolution theorem, application of Fourier transforms to partial ordinary differential equation (One dimensional heat and wave equations only).	**7**
5	**Z-Transform:** Definition, properties and formulae, Convolution theorem, inverse Z-transform, application of Z-transform to difference equation.	**5**
	Total	**40**

3AN1-02/4AN1-02 :Technical Communication	
Credit: 2	**Max. Marks: 100(IA:20, ETE:80)**

	End Term Exam: 2 Hours	
SN	**Contents**	**Hours**
1	**Vocabulary Building.** Concept of Word Formation. Affixes. Synonyms and Antonyms.	**5**
2	**Grammar** Words and Sentences. Verbs and Tenses. Questions and Question Tags. The Infinitive and the '...ing' form.	**5**
3	**Grammar** Nouns and Articles. Determiners. Adjectives and Adverbs. Relative clauses.	**5**
4	**Identifying Common Errors in Writing** Subject-Verb Agreement. Noun-Pronoun Agreement. Articles. Prepositions.	**5**
5	**Composition** Précis Writing. Essay Writing. Comprehension of Passage.	**5**
	Total	**25**

3AN1-03/ 4AN1-03 : Managerial Economics and Financial Accounting		
Credit: 2	**Max. Marks: 100(IA:20, ETE:80)**	
	End Term Exam: 2 Hours	
SN	**Contents**	**Hours**
1	**Basic economic concepts-** Meaning, nature and scope of economics, deductive vs inductive methods, static and dynamics, Economic problems: scarcity and choice, circular flow of economic activity, national income-concepts and measurement.	**5**
2	**Demand and Supply analysis-** Demand-types of demand, determinants of demand, demand function, elasticity of demand, demand forecasting –purpose, determinants and methods, Supply-determinants of supply, supply function, elasticity of supply.	**5**
3	**Production and Cost analysis-** Theory of production- production function, law of variable proportions, laws of returns to scale, production optimization, least cost combination of inputs, isoquants. Cost concepts-explicit and implicit cost, fixed and variable cost, opportunity cost, sunk costs, cost function, cost curves, cost and output decisions, cost estimation.	**5**
4	**Market structure and pricing theory**- Perfect competition, Monopoly, Monopolistic competition, Oligopoly.	**5**
5	**Financial statement analysis-** Balance sheet and related concepts, profit and loss statement and related concepts, financial ratio analysis, cash-flow analysis, funds-flow analysis, comparative financial statement, analysis and interpretation of financial statements, capital budgeting techniques.	**5**
	Total	**25**

3AE3-04 : Engineering Thermodynamics		
Credit: 3		**Max. Marks: 150 (IA:30, ETE:120)**
		End Term Exam: 3 Hours
SN	**Contents**	**Hours**
1	**Fundamentals**: System &control volume; Property, state &process; Exact &inexact differentials; Thermodynamic definition of work, displacement work, electrical, magnetic, gravitational, spring and shaft work.	**5**
2	**Zeroth and First Law of Thermodynamics:** Definition of thermal equilibrium and Zeroth law, temperature scales; Definition of heat; Concept of total energy; First law for cyclic & non-cyclic processes; Internal energy and Enthalpy.	**7**
3	**Pure substances**: Ideal gases and ideal gas mixtures, Real gases and real gas mixtures; Properties of two phase systems; Constant temperature and constant pressure heating of water, definitions of saturated states, use of steam tables, R134a tables, saturation tables, superheated tables; Identification of states & determination of properties, Mollier's chart.	**8**
4	**First Law for Flow Processes**: Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes.	**5**
5	**Second law**: Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.	**5**
6	**Entropy and Exergy:** Clausius inequality; Definition of entropy; Determination of entropy from steam tables; Principle of increase of entropy; Definition of Isentropic efficiency for compressors, turbines and nozzles, irreversibility and availability, availability function for systems and control volumes undergoing different processes; Second law analysis for control volume; Exergy balance equation and exergy analysis.	**7**
7	**Thermodynamic cycles**: Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle.	**3**
	Total	**40**

3AE4-05 : Incompressible Fluid Mechanics		
Credit: 4		**Max. Marks: 200 (IA:40, ETE:160)**
		End Term Exam: 3 Hours
SN	**Contents**	**Hours**
1	**Fluid Properties:** Concept of fluid and flow, ideal and real fluids, continuum concept; Pressure, density, specific gravity, viscosity, compressibility, specific heats, capillarity and surface tension; Newtonian and non-Newtonian fluids.	**6**
2	**Fluid Statics**: Pascal's law; Hydrostatic equation; Hydrostatic forces on plane and curved surfaces; Buoyancy.	**4**
3	**Fluid Kinematics**: Eulerian and Lagrangian description of fluid flow; System and control volume concept; Stream, streak and path line, equation of streamline, types of flows; Conservation of mass in a control volume, differential equation of continuity; Fluid element rotation and vorticity	**5**
4	**Fluid Dynamics**: Linear and angular momentum conservation equation in integral form; Euler's equation; Bernoulli's equation; Conservation of energy, applications through various examples including flow measuring devices – orificemeter, venturimeter, pitot tube.	**5**
5	**Viscous Flow**: Flow regimes and Reynolds number; Relationship between shear stress and strain rate; Navier-Stokes equation, unidirectional flow between stationary and moving parallel plates, flow through pipes, Hagen-Poiseuille flow.	**5**
6	**Introduction to Turbulent Flow**: Reynolds experiment, laminar to turbulent transition; Reynolds decomposition; Shear stress in turbulent flow, eddy viscosity; Prandtl mixing length hypothesis; Flow in hydraulically smooth and rough pipes.	**5**
7	**Boundary Layer**: Boundary layer concept; Displacement, momentum and energy thickness; vonKarman momentum integral equation; Laminar and turbulent boundary layer flows, drag on a flat plate; Boundary layer separation and control, streamlined and bluff bodies, lift and drag on cylinder.	**6**
8	**Dimensional Analysis**: Fundamental and derived units and dimensions; Dimensional homogeneity; Dimensional analysis using Rayleigh method & Buckingham-Π theorem; Significance of dimensionless group; Geometric, kinematic and dynamic similarity, model testing; Derivations and applications of important dimensionless numbers.	**4**
	Total	**40**

3AE4-06 : Introduction to Aeronautics		
Credit: 2		**Max. Marks: 80 (IA:20, ETE:80)**
		End Term Exam: 2 Hours
SN	**Contents**	**Hours**
1	**History of aviation:** Brief history of flight vehicle development with emphasis on key ideas; Indian aerospace activities; Aerospace applications.	**3**
2	**Aircraft configurations:** Classification of aircraft and space vehicles; Functions of major components of airplane; Different types of flight vehicles; V/STOL configurations; Basic flight instruments	**4**
3	**Standard Atmosphere:** Physical properties and structure of atmosphere; Geometric and geopotential altitude; Hydrostatic equation; Definition of standard atmosphere; Pressure, density& temperature altitudes.	**5**
4	**Basic Aerodynamics:** Introduction to principle of flight; Generation of lift, drag & moment, non-dimensional coefficients; Airfoil, airfoil geometry, NACA airfoil series; Centre of pressure and aerodynamic centre; Wings, wing planform and orientation, flow over finite wing; Propagation of sound, different flight regimes, shocks, wave drag, critical & drag divergence Mach number; Swept and delta wings; Types of drag, methods to reduce drag.	**8**
5	**Aerospace structures:** Basic function of aircraft structure; Aircraft configuration and principle types of construction; Details of constructional features of conventional aircraft; Use of metallic, non-metallic and composite materials; Introduction to landing gears.	**3**
6	**Aerospace Propulsion:** Fundamental gas turbine cycle and propulsion techniques; Mechanism of thrust production in propellers and jet engines, comparative merits; Different types of aircraft engines; Principles of operation of rocket.	**4**
7	**Basic Flight Mechanics:** Forces and moments on airplane; Significance of L/D ratio; Aircraft Drag Polar; High lift devices; Concepts of stability & control; Primary and secondary control surfaces; Basic maneuvers.	**3**
	Total	**30**

3AE4-07 : Mechanics of Solids		
Credit: 3		**Max. Marks: 150 (IA:30, ETE:120)**
		End Term Exam: 3 Hours
SN	**Contents**	**Hours**
1	**Introduction:** Concept of Stress, stress components under axial loading; Concept of strain, normal strain under axial loading; Stress-strain diagrams; Hooke's law for 2D and 3D cases; Modulus of elasticity, Poisson's ratio, bulk modulus, modulus of rigidity, shearing strain; Thermal stresses.	**7**
2	**Transformation of Stress and Strain:** Principal stresses, maximum shearing stress; Mohr's circle for stress and strain; Stresses in thick and thin-walled pressure vessels.	**5**
3	**Stresses in Beams:** Shear force and bending moment diagrams for simply supported and cantilever beams with concentrated, uniformly distributed and variable loads; Theory of pure bending; Bending stress variation in cross-section; Transverse shear stress and its distribution in different sections; Composite beam.	**8**
4	**Deflection of Beams:** Deflection in simply supported beams and cantilever with concentrated loads, uniformly distributed loads and their combination.	**5**
5	**Columns:** Buckling of columns, differential equation approach, energy approach, approximate techniques; Euler's formula for pin-ended columns and its extension to columns with other end conditions, concept of equivalent length; Rankine formula and other empirical relations.	**8**
6	**Torsion:** Deformation in a circular shaft, angle of twist; Stresses due to torsion; Torsion in composite shafts; Saint-Venant's theorem.	**7**
	Total	**40**

3AE4-21: Incompressible Fluid Mechanics Lab		
Credit: 1		**Max. Marks:50 (IA:30, ETE:20)**
		End Term Exam: 2 Hours
SN	**Contents**	**Hours**
1	Determination of meta-centric height of a given body	
2	Determination of C_d, C_v& C_c for given orifice	
3	Calibration of contracted Rectangular Notch and Triangular Notch and determination of flow rate	
4	Determination of velocity of water by Pitot tube	
5	Verification of Bernoulli's theorem	
6	Calibration and flow rate determination using venturimeter and orificemeter	
7	Determination of head loss in given length of pipe	
8	Determination of the Reynolds number for laminar, turbulent and transient flow in pipe	
9	Determination of coefficient for minor losses in pipes	
10	To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile	
11	To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness	
12	Study of flow pattern using Hele-Shaw apparatus.	

3AE4-22 : Introduction to Aeronautics Lab		
Credit: 1		**Max. Marks:50 (IA:30, ETE:20)**
		End Term Exam: 2 Hours
SN	**Contents**	**Hours**
1	Smoke visualization over cylinder and airfoil section to show boundary layer separation.	
2	To acquaint with aircraft fuselage constructional details and types.	
3	Study of fuselage structure i.e. Longerons, bulk head stringes etc.	
4	To acquaint with aircraft wing constructional details and types.	
5	To acquaint with aircraft primary control surfaces along with their locations on aircraft.	
6	To acquaint with aircraft secondary flight control surfaces along with their locations on aircraft	
7	Study of Piston engine and its components like; cylinder block, piston, camshaft, crank- shaft, piston rod, valves etc.	
8	Study of Jet Engine and its components like inlet, compressors, combustion chambers, turbine exhaust cone etc.	
9	To acquaint with different types of Jet Engine; Turbojet, turboprop, turboshaft etc.	

3AE4-23 : Mechanics of Solids Lab		
Credit: 1		**Max. Marks:50 (IA:30, ETE:20)**
		End Term Exam: 2 Hours
SN	**Contents**	**Hours**
1	Introduction to Universal Testing Machine	
2	Use of Izod Impact Tester to measure impact loads	
3	Testing torsion load using Torsion Tester	
4	Compression Calculation of hardness using Rockwell Hardness Tester	
5	Calculation of hardness using Brinell hardness Tester	
6	Calculation of hardness using Vickers Hardness Tester VM-50	
7	Column testing for buckling	
8	Tensile test	
9	Testing	
10	Shear testing.	

3AE4-24 : Object Oriented Programming Lab		
Credit: 1.5	**Max. Marks: 75 (IA: 45, ETE:30)**	
	End Term Exam: 3 Hours	
SN	**Contents**	**Hours**
1	Use of functions, arrays, strings etc.	
2	Use of nested loops in applications	
3	Brief introduction to pointers and referencing	
4	Defining class and objects; use of objects as function parameters; friend functions	
5	Different types of inheritance	
6	Constructors and destructors	
7	Function and operator overloading	
8	Introduction to algorithms such as searching algorithms (linear search and binary search) and sorting algorithms	

3AE4-25 : CAD Lab		
Credit: 1.5		**Max. Marks: 75 (IA: 45, ETE:30)**
		End Term Exam: 3 Hours
SN	**Contents**	**Hours**
1	Introduction and different features of the CAD Software (AutoDesk Inventor/ Solid Works/ CATIA)	
2	2-D Drafting	
3	3-D Modeling	
4	Assembly Modeling	
5	Feature Modification and Manipulation	
6	Detailing	
7	Surface Modeling