3AN1: MECHANICS OF SOLIDS

(Common with Mechanical 3ME1A, Automobile 3AE1A, Prod. & Indl. Engg 3PI1A)

B.Tech. (Aeronautical) 3rd semester **Max. Marks: 100**
3L+1T **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Simple Stress and Strain: Tension, compression, shearing stress and strain, Linear elasticity, Poisson's ratio, Hooke's law for linear elastic isotropic material, Equations of static equilibrium, Concept of free body diagram, Composite bars, Thermal stresses, Stresses on inclined planes, Generalised Hooke's law for 2D and 3D cases.	5
	Strain Energy in axial loads, Stress-strain curves: Behavior of common materials in simple tension and compression test, Concept of factor of safety and permissible stress, Introduction to plasticity, viscoelasticity, anisotropy and orthotropy.	3
II	Principal Stress and Strain: Combined loading, Plane stress and Plane strain, Stress and strain Transformation, Principal stress and maximum shear stress, and their planes.	3
	Concept of equivalent bending and equivalent twisting moments, Mohr's circle of stress and strain. Theories of Elastic Failures: The necessity for a theory, Different theories and their applications.	5
III	Members Subjected to Flexural Loads: Theory of simple bending, bending moment and shear force diagrams for different types of static loading and support conditions on beams.	5
	Moving loads, Relation between load, shear force and bending moment.	3
IV	Bending and Shear Stresses in Beam: Bending formula, Section modulus, Distribution of bending stresses. Transverse shear stress and its distribution in circular, hollow circular, rectangular, Box, I, wide flange, T sections etc.	6
	Strain energy in bending, Combined axial and lateral loads. Thin-walled Pressure Vessels: Stresses in cylindrical and spherical vessels.	2
V	Torsion: Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity, Strain energy in torsion, Stresses in members subjected to combined axial, bending and torsional loads.	4
	Columns and struts: Equilibrium, buckling and stability, Short, long and intermediate columns, Euler's formula for crippling load for columns, different end conditions, equivalent length, Eccentric loading Rankine formula and other empirical relations.	4
	TOTAL	**40**

TEXT BOOK

1.Mechanics of Materials, James M. Gere, Cengage Learning (Brooks\Cole).
2.Mechanics of Materials, Beer, Johnston, Dewolf and Mazurek, Tata mcgraw Hill.
3.Strength of Materials, Sadhu Singh, Khanna Publishers.
4.Mechanics of Material, Punmia, Jain and Jain, Laxmi Publications.

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	An Introduction to the Mechanics of Solids, Crandall, Dahl and Lardner, Tata mcgraw Hill.	2008
2	Strength of Materials, Ryder G.H., Macmillan India.	1969

3AN2: MATERIAL SCIENCE AND ENGINEERING

B.Tech. (Aeronautical) 3rd semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Atomic structure of Metals: Crystal structure, crystal lattice of (i) Body centred cubic (ii) Face centred cubic (iii) Closed packed hexagonal, crystallographic	5
	Notation of atomic planes and Directions (Miller Indices),polymorphism and allotropy, Crystal imperfection.	3
II	Theories of plastic deformation. Phenomenon of slip, twinning and dislocation.Identification of crystallographic possible slip planes and direction in FCC, BCC, HCP.	5
	Recovery and recrystallization, preferred orientation causes and effects on the property of metals.	3
III	Classification of engineering materials. Solidification of metals and of some typical alloys: Mechanism of crystallisation (I) nuclear formation (ii) crystal growth.	2
	General principles of phase transformation in alloys, phase rule and equilibrium diagrams, Equilibrium diagram of binary system having complete mutual solubility in liquid state and limited solubility in solid state, Binary isomorphous alloy system.	3
	Hume-Rothery rule, Binary system with limited solid solubility of terminal phase and in which solubility decreases with temperature and also alloy with a peritectic transformation. Equilibrium diagram of a system whose components are subject to allotropic change. Iron carbon Equilibrium diagram, phase transformation in the iron carbon diagram (I) Formation of Austenite (ii) Transformation of Austenite into pearlite (iii) Martensite transformation in steel, TTT curves.	3
IV	Engineering properties and their measurements.Principles and applications of annealing, normalising, hardening, tempering.Recovery and recrystallization.	2
	Hardenability -its measures, variables, effecting Hardenability, methods, for determination of Hardenability. Over-heated and Burnt steel, its causes and remedies. Temper brittleness -its causes and remedies.	2
	Basic principles involved in heat treatment of plain carbon steel, alloy steels, cast iron	2

	and Non-ferrous metals and their alloys.	
	Chemical Heat treatment of steels: Physical principles involved in chemical heat treatment procedure for carburizing, Nitriding, Cyaniding, carbo-nitriding of steel.	**2**
V	Effects produced by Alloying element on the structures and properties of steel Distribution of alloying elements (Si, Mn, Ni, Cr, Mo, Co, W, Ti, Al) in steel, structural classes of steel.	**4**
	Classification of steels, BIS Standards.Fibre reinforced plastic composites: Various fibres and matrix materials, basic composite manufacturing methods, applications of composite materials.	**4**
	TOTAL	**40**

TEXT BOOK

1.An Introduction to Material Scince and Engineering, William D.Callister, John Wiley and Sons.
2. Material Science, Raghvan V., Prentice Hall India.
3. Principles of Material Science and Engineering, William F.Smith, McGraw-Hill Publications.
4. Engineering Physical Metallurgy, Lakhtin Y., Mir Publisher.

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Heat Treatment – Principles and Techniques, Rajan T.V., Sharma and Sharma, Prentice Hall of India	**1994**
2	The Structure, Properties and Heat treatment of Metals, Davies D.J. and Oelmann L.A., Pitman Books, London.	**1983**

3AN3 : ENGINEERING THERMODYNAMICS

B.Tech. (Aeronautical) 3rd semester **Max. Marks: 100**
3L+1T **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Basic Concepts of Thermodynamics : Thermodynamics system, control volume, Properties, state, processes and cycle, equality of temperature, Zeroth Law of thermodynamics, temperature scale.	**5**
	Laws of perfect gas, Pure substances, vapour-Liquid -solid-phase equibrium in a pure substances, thermodynamic surfaces	**3**
II	Work and heat, Law of conservation of mass and energy, First law of thermodynamics, steady state Processes.	**4**
	Second law of thermodynamics, Heat engine, Carnot cycle, thermodynamic temperature scale, entropy, change of entropy for different processes, equivalence of Kelvin plank and clausius statements, clausius inequality.	**4**
III	Available and unavailable energy, availability of a non flow and steady flow system, Helmbeltz and Gibb's functions.	**5**
	Thermodynamic Relations: Important mathematical relations, Maxwell relations, Tds Relations, Joule-Thomson coefficient, Clayperon relation.	**3**

IV	Air - standard power cycle, Brayton cycle, Otto cycle, diesel cycle, Dual cycle, Stirling cycle, Ericssion cycle and Atkinson cycle, Mean effective pressure and efficiencies.	6
	Four stroke petrol and diesel engine, Two stroke Petrol and diesel engine.	2
V	Properties of steam, phase change process, use of steam table & molier chart.	2
	Rankine cycle, Reheat cycle, Regenerative cycle, cogeneration vapour compression refrigeration cycle.	6
	TOTAL	**40**

TEXT BOOK

1. Engineering Thermodynamics, Chottopadhyay P., Oxford University Press.
2. Thermal Science & Engineering, Kumar D.S., S.K.Kataria & Sons
3. Engineering Thermodynamics, Nag P.K., Tata McGraw-Hill, New Delhi

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Fundamentals of Classical Thermodynamics, Gordan J Van Wylen, Willey Eastern Ltd.	2006
2	Engineering Thermodynamics, Cengel & Boles, Tata McGraw-Hill, New Delhi.	2003

3AN4 : MANUFACUTRING PROCESSES

B.Tech. (Aeronautical) 3rd semester **Max. Marks: 100**

3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Importance of manufacturing, economic and technological definition of manufacturing, survey of manufacturing processes. Foundry Technology: Patterns practices: Types of patterns, allowances and material used for patterns, moulding materials, moulding sands, Moulding sands; properties and sand testing; grain fineness; moisture content, clay content and permeability test,	2
	core materials and core making,coreprint; core boxes, chaplets, gating system design. Moulding practices: Green, dry and loam sand moulding, pit and floor moulding; shell moulding; permanent moulding; carbon dioxide moulding.	2
	Casting practices: Fundamental of metal casting, sand casting, Shell-Mould casting, mold casting (plaster and ceramic), investment casting, vacuum casting, Permanent mould casting, slush casting, pressure casting, die casting, centrifugal casting, continuous casting, squeeze casting.	2
	casting alloys, casting defects, design of casting, gating system design, and riser design. Melting furnaces-rotary, pit electric, tilting and cupola.	2
II	Metal Joining Processes: Principle of welding, soldering, brazing and adhesive bonding. Survey of welding and allied processes. Arc welding: power sources and consumables.	3
	Gas welding and cutting: Processes and equipments. Resistance welding: principle	2

	and equipments. Spot, projection and seam welding process.	
	Atomic hydrogen, ultrasonic, plasma and laser beamwelding, electron beam welding, and special welding processes e.g. TIG, MIG, friction and explosive welding, welding of C.I. and Al, welding defects. Electrodes and Electrode Coatings	**3**
III	Forming and Shaping Processes: Metal working, elastic and plastic deformation, concept of strain hardening, hot and cold working, rolling, principle and operations, roll pass sequence, forging, forging operations, extrusion, wire and tube drawing processes.	**4**
	Forging: Method of forging, forging hammers and presses, principle of forging tool design, cold working processes-Shearing, drawing, squeezing, blanking, piercing, deep drawing, coining and embossing, metal working defects, cold heading, riveting, thread rolling bending and forming operation.	**4**
IV	Powder Metallurgy: Powder manufacturing, mechanical pulverization, sintering, Electrolytic Process, chemical reduction, atomization, properties of metal powders, compacting of powders sintering, advantages and applications of P/M.	**5**
	Rapid Prototyping Operations: Introduction, subtractive processes, additive processes, Virtual Prototyping and applications.	**3**
V	Plastic Technology: Introduction, Classification of Plastics, Ingredients of Moulding compounds.	**2**
	General Properties of Plastics, Plastic part manufacturing processes such as compression moulding, transfer moulding, injection moulding, extrusion moulding, blow moulding, calendaring, thermoforming, slush moulding, laminating.	**6**
	TOTAL	**40**

TEXT BOOK

1. Manufacturing Technology, Rao P.N., Tata McGraw-Hill, New Delhi.
2. Manufacturing Engineering and Technology, Kalpkajin, Addison Wesley Publishing Company.
3. Processes and Materials of Manufacture, Lindberg R. A., Prentice Hall of India.

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Principles of Manufacturing Materials and Processes, Campbell J.S., McGraw Hill	1961

3AN5 : OBJECT ORIENTED PROGRAMMING IN C++

(Common with Mechanical 3ME5A, Automobile 3AE5A)

B.Tech. (Aeronautical) 3rd semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Introduction to Object Oriented Programming: Basic concepts: Class, Object, Method, Message passing, Inheritance, Encapsulation, Abstraction, Polymorphism.	**8**
II	Basics of C++ Environment: Variables; Operators; Functions; user defined,	**5**

	passing by reference, passing an array to the function, inline function, scope, overloading; Pointers: objects and lvalue, arrays and pointers, the new and delete operators.	
	Dynamic arrays, arrays of pointers and pointers to arrays, pointers to pointers and functions; Strings: String I/O, character functions in ctype.h, string functions in string.h.	**3**
III	Object oriented concepts using C++: Classes: Member functions, Friend functions, Constructors, Access functions, Private member functions, class destructor, static data and function members; Overloading: inline functions, this operator, overloading various types of operators.	**4**
	Conversion operators; the stringclass; Composition and Inheritance: Hierarchy and types of inheritance, protected class members, private versus protected access, virtual functions and polymorphism, virtual destructors, abstract base classes.	**4**
IV	Templates and Iterators: function and class templates, container classes, subclass templates, iterator classes; Libraries: standard C++ library, contents of a standard C headers.	**5**
	String streams, file processing: Files and streams classes, text files, binary files, classification of files, the standard template library.	**3**
V	Data Structures Using C++: Linked lists - Singly linked list, Doubly linked lists, Circular lists, Stacks and Queues priority Queues, Stacks, Queues.	**8**
	TOTAL	**40**

TEXT BOOK

1. Object Oriented Programming in C++, Robert Lafore, Pearson Education.
2. Programming with C++, John Hubbard Schaum's Outlines, Tata McGraw Hill.
3. Object Oriented Programming with C++, Balagurduswamy, Tata McGraw Hill
4. C++ Program Design, Cohoon and Davidson, Tata McGraw Hill.
5. C++ How to Program,Dietal and Dietel, Prentice Hall of India.
6. C++ Complete Reference, Herbert Schild, Tata McGraw Hill.
7. Let Us C++, Y.Kanitkar, BPB Publisher.

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Data Structures using C++; Tanenbaum, Prentice Hall International.	2013
2	Data Structure through C++, Y.Kanitkar, BPB Publisher.	2005

3AN6 : ADVANCED ENGINEERING MATHEMATICS

B.Tech. (Aeronautical) 3rd semester **Max. Marks: 100**

3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Fourier Series and method of separation of variables (Boundary value problems) Expansion of simple functions in Fourier series, half range series, change of interval, Harmonic analysis.	4
	Application to the solution of wave equation and diffusion equation in one dimension and Laplace's equation in two dimensions by method of separation of variable.	4
II	Laplace Transform : Laplace Transform with its simple properties . Inverse Laplace transform convolution Theorem (withoutproof) solution of ordinary differential equation with constant coefficient .	8
III	Special functions : Bessel's function of first kind, simple recurrence relations, orthogonal property.	5
	Legendre's function of first kind simple recurrence relations, orthogonal property, Rodrigue's formula.	3
IV	Numerical Analysis : Finite differences , Difference operators, forward, Backward, central & average operators. Newton's forward and backward interpolation formula,	3
	Stirling's central difference formula Lagrange's interpolation formula for unequal interval. Solution of non linear equations in one variable by Newton Raphson's and Regulafalsi's method .	5
V	Numerical Analysis : Numerical solution of simultaneous algebric equation by Gauss elimination and Gauss seidel method. Numerical differentiation , Numerical integration trapezoidal rule, Simpson's one third and three eight rule.	4
	Numerical solution of ordinary differential equation of first order: Picards method, Euler's, and modified Euler's method, Milne's methods and runga kutta fourth order method.	4
	TOTAL	**40**

TEXT BOOK

1. Advanced Engineering Mathematics, Kreyszig E., Wiley Eastern.
2. Advance Mathematics for Engineers, Chandrika Prasad, Prasad Mudranalaya, Allahabad.
3. Advanced Engineering Mathematics, Potter, Goldhers and Aboufadel, Wiley Eastern.

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REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Numerical Methods for Scientist And Engineers, Jain and Jain, Iyengar S.R.K., Wiley Eastern	1987
2	A First Course in Numerical Analysis, Ralston A., Rabinowitz P., McGraw Hill	1978

3AN7: STRENGTH OF MATERIALS LAB

B.Tech. (Aeronautical) 3rd semester **Max. Marks: 75**
2P **Exam Hours: 2**

UNIT	CONTENTS	CONTACT HOURS
	1.Izod Impact testing. 2.Rockwell Hardness Testing. 3.Spring Testing 4.Column Testing for buckling 5.Torsion Testing 6.Tensile Testing 7.Compression Testing 8.Shear Testing 9.Brinell Hardness Testing 10. Bending Test on UTM. 11.Study of Fatigue Testing Machine.	

3AN8: MATERIAL SCIENCE LAB

B.Tech. (Aeronautical) 3rd semester **Max. Marks: 75**
2P **Exam Hours: 2**

UNIT	CONTENTS	CONTACT HOURS
	1.Study of Engineering Materials and crystals structures. Study of models BCC, FCC, HCP and stacking sequence, tetrahedral and octahedral voids. 2.To calculate the effective number of atoms, co-ordination number, packing factors, c/a ratio for HCP structure. 3.Study of brittle and ductile fracture. 4.To prepare metallic samples for metallographic examination and to study the principle and construction of the Metallurgical Microscope. 5.Study of the following Micro structures: Hypo, Hyper and Eutectoid Steel, Grey, White, Nodular and Malleable Cast Iron. 6.Annealing of Steel -Effect of annealing temperatures and time on hardness. 7.Study of Microstructure and hardness of steel at different rates of cooling. Microstructure examination of white cast iron. 8.Hardening of steel, effect of quenching medium on hardness. 9.Effect of Carbon percentage on the hardness of Steel. 10. Study of various crystal structures and dislocations through models. 11. Study of Iron-Carbon Equilibrium Diagram and sketch the various structures present at room temperature.	

3AN9 : PRODUCTION PRACTICE Lab

B.Tech. (Aeronautical) 3rd semester **Max. Marks: 100**
3P **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
	1. Study of lathe machine, lathe tools, cutting speed, feed and depth of cut. 2. To perform step turning, knurling and chamfering on lathe machine as per drawing. 3. Taper turning by tailstock offset method as per drawing. 4. To cut metric thread as per drawing. 5. To perform square threading, drilling and taper turning by compound rest as per drawing. 6. To study shaper machine, its mechanism and calculate quick return ratio. 7. To prepare mould of a given pattern requiring core and to cast it in aluminum. 8. Moisture test and clay content test. 9. Strength Test (compressive, Tensile, Shear Transverse etc. In green and dry conditions) 10. Hardness Test (Mould and Core). 11. Permeability Test. 12. A.F.S. Sieve analysis Test.	

3AN10: COMPUTER PROGRAMMING LAB

B.Tech. (Aeronautical) 3rd semester **Max. Marks: 100**
3P **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
	List of programs in C: 1. Program for revising control statements, arrays and functions. 2. Program using string handling and various functions described in string.h, ctype.h. 3. Program using structures and sorting algorithm (Insertion, Selection, Quick, Heap sort) And functions described in math.h. 4. Program using file handling and related functions defined in stdio.h, io.h. 5. Program using pointers, array and pointers, pointers to structures, dynamic memory Allocation. List of Programs in C++ 6. Program using basic I/O and control statements. 7. Program using class, objects, objects as function parameters. 8. Program using functions and passing reference to a function, inline functions. Program using Inheritance and virtual base class.	

	9. Program using pointers, arrays, dynamic arrays. Program using functions defined in c type.h and string.h. 10. Program using constructors, destructors. Program using function and operator over Loading. List of program in C++ implementing Data Structures 11. Creating and managing (add, delete, print, insert) nodes of a Linked list. 12. Creating and managing (create, pop, push etc.) Stacks and queues. Note: Students should submit and present a minor project at the end of the lab.	

4AN1: INTRODUCTION TO AERONAUTICS

B.Tech. (Aeronautical) 4th semester **Max. Marks: 100**

3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Introduction: Mankind's desire to fly, various efforts in Pre-Wright Brothersera-briefhistori- calsketch,Wrightflyer, Earlier types off lying machines, Development of aeronautic alsci- encein America and Europe.Progress in Aircraft design, aerospace applications.	5
	Current Status:Different types of heavier than air vehicles, along with prominent features. Airplane, Helicopter, Hovercraft,V/stolmachines, modern developments	3
II	Airplane Aerodynamics: Nomenclature used in Aerodynamics, different parts of airplane. Wing as lifting surface, Types of wingplan forms, Aerodynamic features like Aerofoil pressure distribution,	4
	Aerodynamic forces and moments, Lift and Drag. Dragpolar, L/Dratio, high lift devices, Airplane performance like Thrust/Power available, climb and glide, maximum range and endurance,take off and landings.Illustrations through sketches/plots.	4
III	Airplane Stability and Control: Airplane axis system, forces and moments about longitudinal, latheral and vertical axes, equilibrium of forces developed on wing and horizontal tail,	6
	Centre of gravity, its importance in stability and control. Control surfaces elevator sailer on sand rudder.	2
IV	Airplane Propulsion: Requirement of power: various means of producing power. Brief description of thermodynamics of engines. Piston engines, Jet engines. Engine airframe com- binations of various types, their performance. Detailed functioning of components of a Piston-Propengine. Use of propellers as means of producing forward thrust.	4
	Functioning of Jet engine, turbo-prop, turbo-fan, turbo-shaft, Prop-fan, Possible locations of power plant on air- plane, Rocket Propulsion, Classification of rockets like liquid and solid propellant rockets.	4
V	Airplane Structure, Materials and Production: Structural arrangement of earlier airplane, developments leading to all metal aircraft. Strengtht to weight ratio-choice of aircraft materials for different parts.	4
	Detailed description of wing, tail and fuselage joints. Stress-Strain diagrams, Plane and Space, Trusses, loads on airplane components, V-n diagram. Mechanical properties of materials.Materials for different components, use of composites. Aircraft production methods and equipment.	4
	TOTAL	**40**

TEXT BOOK

1. R S Shevell,Fundamentals of Flight, prenticehall
2. John Anderson Jr.,Introduction to Flight, mcgrawhill.

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	E W somersetmaugham, Jet Engine Manual, bippublications	1916
2	Fundamentals of Flight; By Dr.O.P.Sharma and Lalit Gupta.	2006

4AN2: INSTRUMENTATION AND CONTROL ENGINEERING

B.Tech. (Aeronautical) 4th semester **Max. Marks: 100**
3L+1T **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Electronic & Electrical Measuring Instruments: Accuracy & precision, Repeatability, Limits of errors, Systematic & random errors, standard deviation, Gaussian error analysis, Combination of errors. Theory and working principle of galvanometer, Analog Voltmeter, ammeter and Multimeters, Digital Voltmeter,	5
	Component Measuring Instruments, Q meter, Vector Impedance meter, Measurement of RF Power ,frequency & Voltage. Introduction to shielding, grounding and interference.	3
II	OSCILLOSCOPES, SIGNAL GENERATION and TRANSDUCERS -: CRT Construction, Basic CRO circuits, CRO Probes, Oscilloscope Techniques of Measurement of frequency, Phase Angle and Time Delay, Multibeam, multi trace, storage & sampling Oscilloscopes. Curve tracers.	3
	Sine wave generators, Frequency synthesized signal generators, Sweep frequency generators. Signal Analysis - Measurement Technique, Wave Analyzers, Frequency - selective wave analyser, Heterodyne wave analyser, Harmonic distortion analyzer, Spectrum analyzer., Construction, Working Principles,	3
	Application of following Transducers- RTD, Thermocouples, Thermistors, LVDT, RVDT, Strain Gauges, Bourdon Tubes, Bellows. Diaphragms, Seismic Accelerometers, Tachogenerators, Load Cell, Piezoelectric Transducers, Ultrasonic Flow Meters.	2
III	CONTROL SYSTEMS ANALYSIS AND COMPONENTS: open loop and close loop control systems. Block diagram algebra and transfer function. Differential equations, Determination of transfer function by block diagram reduction technique & signal flow graph method.	5
	Mason gain formula and calculation of transfer function. Basic component of electrical control system, Armature and field control methods for Speed control. Brief idea of multivariable control system and digital control systems.	3
IV	TIME DOMAIN ANALYSIS OF FIRST ORDER & SECOND ORDER SYSTEMS: Transient and steady state response analysis. Steady state error & error constants. Dynamic error and dynamic error coefficient, Performance Indices.,	4
	Effects of pole and zero addition on transient and steady state response.	4

	Absolute stability and relative stability. Routh's and Hurwitz criterion of stability. Root locus method of analysis. Polar plots	
V	FREQUENCY DOMAIN ANALYSIS. Root locus method of analysis. Polar plots, Bode plot, Design specification in frequency domain and gain and phase margin.	5
	Nyquist stability criterion. M and N loci, Nicholas charts. Concepts of state, state variable and state model, controllability and observability.	3
	TOTAL	**40**

TEXT BOOK

1. Mechanical Measurement, Beckwith, Pearson Education.
2. Experimental Methods for Engineers, Holman, McGraw Hill Publication.
3. Mechanical Engineering Measurement, Sahwney A.R., Dhanpat Rai and Sons.

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Modern Control Engineering, Ogata, Pearson Education India.	
2	Control System, Gopal M., Tata McGraw Hill New Delhi.	
3	Mechanical Measurement and Instrumentation, Rajput R.K., S.K.Kataria and Sons.	

4AN3: FLUID MECHANICS

(Common with Mechanical Engg 4ME2A and Automobile Engg 4AE2A)

B.Tech. (Aeronautical) 4th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Basic Concepts and Properties- Fluid – definition, distinction between solid and fluid Modules and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension.	4
	Fluid statics concept of fluid static pressure, absolute and gauge pressures – pressure measurements by manometers and pressure gauges. Hydrostatic forces on submerged surfaces, centre of pressure, Stability of floating bodies.	4
II	Fluid Kinematics and Fluid Dynamics- Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- Equation of streamline - stream function - velocity potential function - circulation - flow net.	5
	Fluid dynamics - equations of motion - Euler's equation along a streamline Bernoulli's equation, applications-Venturi meter, Orifice meter, Pitot tube. Orifices, mouthpieces, Notches and Weirs, Momentum theorem.	3
III	Dimensional Analysis: Buckingham variables, Model Similitude, Force ratio, Reynolds,Froude's, Mach, Weber and Euler numbers and their applications.	3

	Undistorted model distorted model scale effect.	
	Incompressible Fluid Flow- Viscous flow - Navier - Stoke's equation (Statement only) Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes. (Hagen Poiseulle's equation).	**5**
IV	Turbulent Flow: Variation of friction factor with Reynold's number Moody's diagram, Shear stress in turbulent flow, Prandt Mixing length theory, velocity distribution in smooth pipes and rough pipes, Resistance of smooth and rough pipe.	**4**
	Flow Through Pipes: Minor and major losses, Darcy-Weisbach Formula, , Hydraulic and Energy Grade lines, Flow through pipes in series and in parallel, power transmission, water hammer in pipes.	**4**
V	The Boundary Layer: Description of the boundary layer. Boundary Layer thickness, Von- Karman momentum integral equation, Coefficient of drag, boundary layer separation and control.	**5**
	Flow around a body, Drag and lift, Drag on sphere and cylinder, Development of lift on a circular cylinder, Development of lift on an airfoil.	**3**
	TOTAL	**40**

TEXT BOOK

1. Potter, Mechanics of Fluids, Cengage Learning.
2. Frank M. White, Fluid Mechanics, Tata mcgraw Hill.
3. John F. Douglas, Fluid Mechanics, Pearson Education.
4. Modi and Seth, Fluid Mechanics and Hydraulic Machinery, Standard Book House.
5. Som, S. K., & Biswas, G. Introduction to fluid mechanics and fluid machines: Tata mcgraw-Hill.
6. Munson, B. R., Young, D. F., & Okiishi, T. H. Fundamentals of Fluid Mechanics, Wiley

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Yunus A. Cengel and Cimbala, Fluid Mechanics, Tata mcgrawhill	**2013**
2	Streeter V.L., K.W. Bedford and E.B.Wylie , Fluid Mechanics , Tata mcgraw Hill	**2001**
3	Robert W. Fox and Alan T. Mcdonald, Introduction to Fluid Mechanics, John Wiley &Sons.	**2011**

4AN4: THEORY OF MACHINES

B.Tech. (Aeronautical) 4th semester **Max. Marks: 100**
3L+1T **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Kinematics: Elements, pairs, mechanisms, four bar chain and its inversions, velocity and acceleration, Klein's construction, coriolis component,	**4**
	Instantaneous center method, synthesis of mechanisms, pantograph, scott-Russel, Tchbeicheff straight line, indicator diagram mechanisms.	**4**

II	Friction: Laws of static, dynamic and rolling friction, dry and viscous friction, inclined plane and screw jack, pivots and clutches. Brakes: Band, block and band & block brakes, braking action.	4
	Dynamometers: Absorption and transmission type dynamometers, prony, rope and hydraulic dynamometers.	4
III	Gears: Laws of gearing, gears terminology; tooth form; interference, undercutting and minimum number of teeth on pinion in contact with gear.	6
	Spur, helical, bevel gear, rack and pinion.	2
IV	Gear trains: Simple, compound, reverted and epicyclic gear trains, analytical and tabular methods for velocity ratio. Gear boxes- sliding and constant mesh.	4
	Gyroscope: Principle of gyroscopic couple, effect of gyroscopic couple and centrifugal force on airplanes taking a turn.	4
V	Balancing: Balancing of rotating masses, balancing of reciprocating masses,	4
	Balancing of inline engines and V-engines.	4
	TOTAL	**40**

TEXT BOOK

1. Theory of Machines, Rattan S.S., Tata McGraw Hill.
2. Theory of Machines, Thomas Bevan, Pearson Education.
3. Theory of Machines and Mechanisms, Uicker, Pennocle and Shigley, Oxford University Press.
4. Mechanism and Machine Theory, Ambekar A. G., Prentice-hall Of India
5. Theory of Mechanisms and Machines, Sharma and Purohit, Prentice-hall Of India

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Theory of Mechanisms and Machines, Ghosh A., Affiliated East West Press.	1988
2	Theory of Machines, Abdulla Shariff, Dhanpat Rai Publication	1984

4AN5: AIRCRAFT MATERIALS

B.Tech. (Aeronautical) 4th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Broad classification of aircraft materials.Ferrous materials,nonferrous materials and alloys,	4
	Ceramic materials and fibre reinforced composite materials, polymers,metal matrix particulate.	4
II	MATERIALS IN AIRCRAFT CONSTRUCTION-I Aluminum and its alloys: Types and identification. Properties–Castings–Heat treatment processes–Surface treatments. Magnesium and its alloys: Cast and Wrought alloys–Aircraft application, features specification, fabrication problems,	6
	Special treatments. Titanium and its alloys: Applications, machining, forming,	2

	welding and heat treatment.	
III	MATERIALS IN AIRCRAFT CONSTRUCTION- II Steels: Plain and low carbon steels, various low alloy steels, aircraft steel specifications corrosion and heat resistant steels, structural applications. **Maraging Steels**: Properties and Applications	6
	Copper Alloys–Monel, kmonel **Super Alloys**: Use–Nickel base–Cobalt base–Iron base–Forging and Casting of Super alloys–Welding, Heat treatment.	2
IV	ADHESIVE AND SEALANTS FOR AIRCRAFT Advantages of Bonded structure in airframes–Crack arresting–Weight saving–Technology of adhesive Bonding Structural adhesive materials–Test for bonding structure.	5
	Typical bonded joints & non destructive tests for bonded joint. Bonded Sandwich structures-Materials–Methods of construction of honeycombs	3
V	Corrosion, its detection and prevention. Protective finishes. Testing: Destructive and non- destructive testing techniques.	3
	Crack detection, inspection of parts by hot oil and chalk, dye- penetrant, fluorescent and magnetic particles, X-ray, ultrasonic, eddy current and acoustic emission methods.	5
	TOTAL	**40**

TEXT BOOK

1. S K Hajra Chowdhary, Materials,Science and Engineering Processes, Media Promoters
2. M L Begman,Manufacturing Processes, Asia Publishing House, Bombay.
3 Aircraft General Engineering by Lalith Gupta,Himalaya Book House, newdelhi.

4. Balram Gupta, Aerospace Materials, S Chand

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	George E.F. Titterton,Aircraft Materials, English Book Stores, Delhi	2008
2	King and Butler,Principles of Engineering Inspection,Clever Humes Press.	2008
3	C G K Nair, aircraftmaterials, Interline	1997

4AN6: MACHINE DESIGN

B.Tech. (Aeronautical) 4th semester **Max. Marks: 100**
3L+1T **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Design for strength: Allowable stresses, detailed discussion on factor of safety (factor of ignorance). Introduction of various design considerations like strength, stiffness, weight, cost, space etc.	4
	Design of machine elements subjected to direct stress, Pin, cotter and keyed joints. Design of screw fastening. Pre loading of bolts; effect of initial tension & applied loads.	4
II	Design of members in Bending: Beams and levers.	4
	Design of members in torsion: Shafts and shaft couplings.	4

III	Design of shafts under combined stresses, Calculation of transverse & torsional deflections.	6
	Brackets and screw fasteners subjected to eccentric loading.	2
IV	Fatigue Considerations in Design: Variable load, loading pattern, Endurance stresses, influence of size, surface finish, notch sensitivity & stress concentration. Goodman line, Soderberg criteria	4
	Design of machine members subjected to combined, steady and alternating Stresses. Design for finite life. Design of Shafts under Variable Stresses.	4
V	Design of journal bearing; method of lubrication, hydrodynamic, hydrostatic, boundary etc. Minimum film thickness and thermal equilibrium.	5
	Selection of anti-friction bearings for different loads and load cycles. Mounting of the bearings. Method of lubrication, selection of oil seals.	3
	TOTAL	**40**

TEXT BOOK

1. Mechanical Machine Design, Bahl and Goel, Standard Publishers Distributors.
2. Design of Machine Elements, Bhandari V.B, Tata McGraw-Hill, New Delhi.
3. Machine Design, Sharma and Aggarwal, S.K.Kataria and Sons, Delhi.
4. Design of Machine Elements, Sharma and Purohit, Prentice Hall India.
5. Machine Design, Kulkarni S. G., Tata McGraw Hill
6. A Text Book of Machine Design, Karwa A., Laxmi Publications. 2002

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Mechanical Engg Design, Shigley, Mischke, Budynas and Nisbett, Tata McGraw-Hill.	

4AN7: MACHINE DESIGN SESSIONAL

B.Tech. (Aeronautical) 4th semester **Max. Marks: 100**

3P **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
	Problems on 1. Knuckle & Cotter joints 2. Torque: Keyed joints & shaft couplings 3. Design of screw fastening 4. Bending: Beams, Levers etc. 5. Combined stresses: Shafts, brackets, eccentric loading. 6. Fatigue loading 7. Preloaded bolts and bolts subjected to variable stresses 8. Sliding contact bearing design 9. Anti-friction bearing selection	

4AN8: INSTRUMENTATION LAB

B.Tech. (Aeronautical) 4th semester **Max. Marks: 75**
2P **Exam Hours: 2**

UNIT	CONTENTS	CONTACT HOURS
	1. Study of various electronic components, their Identification ,symbols & Testing: study of Resistances, Capacitors, Inductors, Diodes, Transistors, scrs, ics, Photo diode, Photo transistor ,LED, LDR, CRO demonstration kit and Potentiometers. 2 Plot V-I characteristics & measure open circuit voltage & short circuit current of a solar panel. 3. Measure unknown inductance capacitance resistance using following bridges (a) Anderson Bridge (b) Maxwell Bridge. 4 To study and perform experiment- Compound logic functions and various combinational circuitsbased on AND/NAND and OR/NOR Logic blocks. 5. Measurement of the distance with the help of ultrasonic transmitter & receiver. 6. Measurement of displacement with the help of LVDT. 7. Draw the characteristics of the following temperature transducers: (a) RTD (Pt-100) (b) Thermistors (c) Thermocouple 8. Draw the characteristics between temperature & voltage of a K type thermocouple. 10. Measurement of strain/ force with the help of strain gauge load cell. 11. To study and perform experiment - (a) Astable (b) Monostable (c) Bistable Multivibrators and the frequency variation with different parameters, observe voltage waveforms at different points of transistor.	

4AN9: FLUID MECHANICS LAB.

B.Tech. (Aeronautical) 4th semester **Max. Marks: 75**
2P **Exam Hours: 2**

UNIT	CONTENTS	CONTACT HOURS
	1. Determine Meta centric height of a given body. 2. Determine Cd, Cv & Cc for given orifice. 3. Determine flow rate of water by V-notch. 4. Determine velocity of water by pitot tube. 5. Verify Bernoulli's theorem. 6. Determine flow rate of air by Venturimeter 7. Determine flow rate of air by orificemeter 8. Determine flow rate of air by nozzlemeter. 9. Determine head loss of given length of pipe. 10 Determination of the Reynold's number for laminar, turbulent and transient flow in pipe.	

	11 Determination of Coefficient for minor losses in pipes. 12 To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.	

4AN10 : INTRODUCTION TO AERONAUTICS LAB.

B.Tech. (Aeronautical) 4th semester **Max. Marks: 100**
3P **Exam Hours: 3**

UNIT	CONTENTS	CONTACT 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 off uselage structure i.e. Longerons, bulkheadstringes 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 e.g. Turbojet, turboprop, turboshaft etc.	

5AN1: VIBRATION ENGINEERING

B.Tech. (Aeronautical) 5th semester **Max. Marks: 100**
3L+1T **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Basics of Vibration: Scope of Vibration, Important terminology and classification, Degrees of freedom, Harmonic motion, vectorial representation, complex number representation. Single Degree of Freedom System:	3
	Derivation of equation of motion for one dimensional longitudinal, transverse and torsional vibrations without damping using Newton's second law, D' Alembert's principle and Principle of conservation of energy, Compound pendulum and centre of percussion.	3
	Damped vibrations of single degree of freedom system: Viscous damping, underdamped, critically damped and overdamped systems, Logarithmic decrement, Vibration characteristics of Coulomb damped and Hysteretic damped systems.	2

II	Forced Vibrations of Single Degree of Freedom System: Forced vibration with constant harmonic excitation, Steady state and transient parts, Frequency response curves and phase angle plot,	4
	Forced vibration due to excitation of support. Vibration Isolation and Transmissibility: Force transmissibility, Motion transmissibility, Forced vibration with rotating and reciprocating unbalance, Materials used in vibration isolation.	4
III	System with Two Degree of Freedom: Principle mode of vibration, Mode shapes, Undamped forced vibrations of two degrees of freedom system with harmonic excitation,	5
	Vibration Absorber, Undamped dynamic vibration absorber and centrifugal pendulum absorber.	3
IV	Many Degree of Freedom Systems: Exact analysis (Undamped free vibration),	6
	Approximate methods, Rayleigh's, Dunkerley's, Stodola's and Holzer's methods	2
V	Vibrations of continuous systems: Transverse vibration of a string, Longitudinal vibration of a bar,	4
	Torsional vibration of a shaft and flexural vibrations of a beam.	4
	TOTAL	**40**

TEXT BOOK

1. Mechanical Vibrations, Rao S.S., Pearson Education.
2. Mechanical Vibrations and Noise Engineering, Ambekar A.G., Prentice Hall India.
3. Mechanical Vibrations, Grover G.K., Nem Chand and Brothers.
4. Theory of Vibrations with Applicaion, Thomson and Dahleh, Pearson Education

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Elements of Vibration Analysis, Leonard Meirovitch, Tata mcgraw-Hill, New Delhi.	1986
2	Principles of Vibration, Benson H.Tongue, Oxford Publcation.	2002

5AN2: HEAT TRANSFER

B.Tech. (Aeronautical) 5th semester **Max. Marks: 100**
3L+1T **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Introduction to Heat Transfer Processes: Conduction and radiation, Fourier's law of heat conduction, thermal conductivity, thermal conductivity of solids, liquids and gases, effect of temperature on thermal conductivity, Newton's law of cooling, definition of overall heat transfer coefficient, general parameters influence on the value of heat transfer coefficient.	4
	Conduction : General 3-Dimensoinal conduction equation in Cartesian, cylindrical	4

	and spherical coordinates, different kinds of boundary conditions, nature of differential equations, one dimensional heat conduction with and without heat generation, electrical analogy, heat conduction through composite walls, critical thickness of insulation.	
II	Heat Transfer from Finned Surfaces: fin efficiency and effectiveness, two dimensional steady state heat conduction using analytical and numerical methods, periodic heat conduction.	**4**
	Convection: Review of Navier–Stokes and energy equation, hydrodynamic and thermal boundary layers, laminar boundary layer equations, forced convection appropriate non dimensional members, effect of prandtl number, empirical relations for flow over a flat plate and flow through pipes.	**4**
III	Natural Convection: Dimensional analysis, Grashoff number, boundary layers in external flows (flow over a flat plate only), boundary layer equations and their solutions, heat transfer correlations.	**4**
	Heat Transfer with Change of Phase: Nature of vaporization phenomena, different regimes of boiling heat transfer, correlations for saturated liquid vaporization, condensation on flat plates, correlation of experimental results, drop wise condensation.	**4**
IV	Heat Exchanger: Different types of heat exchangers, arithmetic and logarithmic mean temperature differences, heat transfer coefficient for parallel, counter and cross flow type heat exchanger	**6**
	Effectiveness of heat exchanger, N.T.U. method, fouling factor, constructional and manufacturing aspects of Heat Exchangers.	**2**
V	Thermal Radiation: Plank distribution law, Kirchhoff's law, radiation properties, diffuse radiations, Lambert's law, radiation intensity, heat exchange between two black bodies,	**4**
	Heat exchanger between gray bodies, shape factor, electrical analogy, reradiating surfaces heat transfer in presence of reradiating surfaces.	**4**
	TOTAL	**40**

TEXT BOOK

1. Heat and Mass Transfer, Kumar D.S., Kataria and Sons.
2. Heat Transfer, Sharma and Lal, Vardhan Publisher Jaipur.
3. Heat and Mass Transfer, Nag P.K., Tata mcgraw-Hill, New Delhi.
4. Heat Transfer, Rajput R.K., S. Chand Publication.

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REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Fundamental of Heat and Mass Transfer, Thirumaleshwar M., Pearson Education.	**2009**
2	Heat and Mass Transfer, Cengel, Tata mcgraw-Hill, New Delhi.	**2007**
3	Heat Transfer, Holman J.P., Tata mcgraw-Hill, New Delhi.	**2008**

5AN3: AIRCRAFT SYSTEMS

B.Tech. (Aeronautical) 5th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	AIRPLANE CONTROL SYSTEMS Conventional Systems - Power assisted and fully powered flight controls - Power actuated systems – Engine control systems - Push pull rod system, flexible push pull rod system - Components- Modern control systems - Digital fly by wire systems - Auto pilot system active control Technology,	6
	Introduction to Communication and Navigation systems Instrument, landing systems, VOR - CCV case studies.	2
II	AIRCRAFT SYSTEMS Hydraulic systems - Study of typical workable system - components - Hydraulic system controllers - Modes of operation - Pneumatic systems - Advantages - Working principles - Typical Air pressure system – Brake system - Typical Pneumatic power system - Components,	5
	Landing Gear systems - Classification – Shock absorbers - Retractive mechanism. Anti skid system, wheels and brake, steering systems, indications.	3
III	FUEL SYSTEMS Types of fuels, their properties and testing, color codes, fuel requirements, pumps, fuel transfer systems, fuel tanks, plumbing, valves, indications and warnings	8
IV	AUXILIARY SYSTEM Various types systems, components and operation of air-conditioning System, Pressurization System, Oxygen Systems, Fire Protection Systems, Deicing and Anti Icing systems,	4
	Seat Safety System: Ejection seats, survival packs, parachutes, pilots's personal equipment, life rafts, doors, windows, emergency exits and seat belts.	4
	GENERAL MAINTENANCE PRACTICES Jacking, levelling and mooring, refuelling and defuelling of aircraft, safety precautions. Hydraulic and fluid systems precautions against contamination.	6
	Identification color coding, symbols and other markings to identify the fluid systems.	2
	TOTAL	**40**

TEXT BOOK

1. Aircraft systems - Ian Moir and Allan Seabridge, John Wiley & Sons
2. Aircraft instruments – E H J Pallet, Pearson
3. Aviation Maintenance Technician Hand Book (General) (AC 65-9A) – Himalayan Books
4. Civil aircraft inspection procedure, English books store Delhi (CAIP – CAA)
5. Aircraft Oxygen System – Scheppler Robert : Himalayan Books.

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	A & P Technician Airframe Text Book – Jeppeson	1992
2	A & P Technician General Test Book - Jeppeson	1992

5AN4: AIRCRAFT STRUCTURE-I

B.Tech. (Aeronautical) 5th semester **Max. Marks: 100**

3L+1T **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Analysis of structure for slope and deflection by double integration method, Maclauy's method, Area moment theorm.	8
II	**Statically Determinate Structures:** Analysis of plane truss – Method of joints, Method of sections,	5
	Graphical methods, 3 D Truss Tension coefficient methods.	3
III	**Statically Indeterminate Structures:** Fixed beam, continous beam analysis - Clapeyron's Three Moment Equation	5
	Moment Distribution Method, Plane frame analysis using moment distribution method.	3
IV	**Energy Methods:** Strain Energy due to axial, bending and torsional loads - Castigliano's theorem – Principal of virtual work-Principal of virtual displacement-Maxwell's Reciprocal theorem,	6
	Unit load method - application to beams, trusses, frames, rings, etc.	2
V	Influence line diagram,	4
	Muller breslau principle	4
	TOTAL	40

TEXT BOOK

1. Schaum's Outline Series, Theory and Problems of Strength of Materials 3/ed Willian A Nash – mcgraw Hill Internatinal Edition.
2. Strength of Material by S. Ramamurtham & R. Narayan. , Dhanpat Rai Publishing Co.
3. Strength of Material by R.S. Khurmi., S Chand & Co.

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication

1	Donaldson, B.K., "Analysis of Aircraft Structures – An Introduction", mcgraw-Hill	1993
2	Timoshenko, S., "Strength of Materials", Vol. I and II, Princeton D. Von Nostrand Co	1990

Max. Marks: 100

5AN5: PROPULSION

B.Tech. (Aeronautical) 5th semester

3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**Steady 1-D Gas Dynamics** Basics, Simple flows; Nozzle flow, nozzle design, nozzle operating characteristics for isentropic flow, nozzle flow and shock waves. Nozzle characteristics of some operational Engines. Rayleigh flow and Fanno flow. Inlet: design, sizing and performance for various flow regimes.	3
	Nozzle C-D Nozzle performance - Effects of back pressure, exit area ratio and mass flow Combustion Systems: Basics of combustion chamber, Ignition system, Flame stability and after burners.	2
	Parametric Cycle Analysis of Ideal Engines Engine cycle analysis and basic assumptions. Applications to (i) Ramjet, (ii) Turbojet with and without after burner, (iii) Turbo fan engine, optimum by pass ratio (iv) Turbo-prop Engine Cycle analysis of real engines.	3
II	**Axial Flow Compressor** Euler's Turbo-machinery equations. Axial Flow Compressor analysis, cascade action, flow field. Velocity diagrams, flow annulus area stage parameters. Degree of reaction, cascade airfoil nomenclature and loss coefficient, diffusion facto, stage loading and flow coefficient, stage pressure ratio, Blade Mach no., Repeating-stage, Repeating-row, Meanline design. Flow path dimensions, number of blades per stage, Radial variation, Design Process, Performance.	4
	Axial Flow Turbine Introduction to turbine analysis, mean-radius stage calculations, Stage parameters, stage loading and flow coefficients, degree or reaction, Stage temperature ratio and pressure ratio, Blade spacing, Radial Variation, Velocity ratio, Axial Flow Turbine stage Flow path dimension, stage analysis, Multistage design steps of design single stage and two stage. Turbine Performance. Blade Cooling.	4
III	FUNDAMENTALS & ENGINE PERFORMANCE **Piston Engine** Mechanical, thermal and volumetric efficiencies; Operating principles—2 stroke, 4 stroke, Otto and Diesel; Piston displacement and compression ratio; Engine configuration and firing order. Power calculation and measurement; Factors affecting engine power; Mixtures/leaning, preignition.	3
	Propellers Blade element theory; High/low blade angle, reverse angle, angle of attack, rotational speed; Propeller slip; Aerodynamic, centrifugal, and thrust forces; Torque; Relative airflow on blade angle of attack; Vibration and resonance.	2
	Jet Engine	3

	Potential energy, kinetic energy, Newton's laws of motion, Brayton cycle; The relationship between force, work, power, energy, velocity, acceleration; Constructional arrangement and operation of turbojet, turbofan, turboshaft, turboprop. Gross thrust, net thrust, choked nozzle thrust, thrust distribution, resultant thrust, thrust horsepower, equivalent shaft horsepower, specific fuel consumption; Engine efficiencies; Bypass ratio and engine pressure ratio; Pressure, temperature and velocity of the gas flow; Engine ratings, static thrust, influence of speed, altitude and hot climate, flat rating, limitations.	
IV	**ENGINE COMPONENTS** **Piston Engine** Crank case, crank shaft, cam shafts, sumps; Accessory gearbox; Cylinder and piston assemblies; Connecting rods, inlet and exhaust manifolds; Valve mechanisms; Propeller reduction gearboxes.	**2**
	Jet Engine Air Inlet: Compressor inlet ducts, Effects of various inlet configurations; Ice protection of Air inlet. Compressors: Axial and centrifugal types; Constructional features and operating principles and applications; Fan balancing;	**2**
	Operation: Causes and effects of compressor stall and surge; Methods of air flow control: bleed valves, variable inlet guide vanes, variable stator vanes, rotating stator blades; Compressor ratio. Combustion Section: Constructional features and principles of operation. Turbine Section: Operation and characteristics of different turbine blade types; Blade to disk attachment. Nozzle guide vanes: Causes and effects of turbine blade stress and creep. Exhaust: Constructional features and principles of operation; Convergent, divergent and variable area nozzles; Engine noise reduction; Thrust reversers.	**4**
V	**Fundamentals of Rocket Propulsion** Operating principle - Specific impulse of a rocket - Rocket nozzle classification - Rocket performance considerations - Numerical Problems.Chemical Rockets	**2**
	Solid propellant rockets - Selection criteria of solid propellants - Important hardware components of solid rockets - Propellant grain design considerations - Liquid propellant rockets - Selection of liquid propellants - Thrust control in liquid rockets - Cooling in liquid rockets - Limitations of hybrid rockets - Relative advantages of liquid rockets over solid rockets - Numerical Problems. Advanced Propulsion Techniques	**4**
	Electric rocket propulsion - Ion propulsion techniques - Nuclear rocket - Types - Solar sail-Preliminary Concepts in nozzle less propulsion.	**2**
	TOTAL	**40**

TEXT BOOK

1. Aero Engines – LNVM Society
2. A & P Technician Powerplant Text Book – Jeppeson.
3. Gas Turbine Theory: Cohen, Rogers and Saravanamuttu, Pearson Education
4. Elements of Gas Turbine Propulsion: J.D. Mattingly,mcgraw Hill
5. Rocket Propulsion Elements: George P. Sutton, Oscar Biblarz, John Wiley & Sons.
6. Aircraft Power Plant – Kroes & Wild
7. CAIP – CAA

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Rolls-Royce, " Jet engine ", 3rd edition	1983
2	Mechanics and Thermodynamics of Propulsion: P.G.Hill & Peterson, Addison-Wesley	1970

5AN6.1: Space Dynamics

B.Tech. (Aeronautical) 5th semester **Max. Marks: 100**

3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**BASICS** Glossary of spherical geometry, Solar systems, equatorial plane, polar plane, gyroscopic motion,	5
	Stabilized platforms, inertial navigation, ballistic trajectories.	3
II	**MULTY BODY PROBLEMS** Basics of partial dynamics, two-body problem, satellite orbits, , satellite tracking,	4
	Circular restricted three body problem, orbital elements, Relative motion in the N-body problem	4
III	**SATTELITE DYNAMICS** Satellite injection parameters, Orbit transfer, Injection errors and its effects, attitude dynamics and control, effects of flexibility of satellites, general perturbation approach.	8
IV	**ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD:** One Dimensional and Two Dimensional rocket Motions in Free Space and Homogeneous Gravitational Fields – description of Vertical, Inclined and Gravity Turn Trajectories –	5
	Determination of range and Altitude Simple approximations to Burnout Velocity.	3
V	**STAGING AND CONTROL OF ROCKETS AND MISSILES** Need for staging, Multistaging of rockets – Vehicle Optimization – Stage Separation Dynamics – Separation Techniques Rocket Thrust Vector Control Methods.	8
	TOTAL	40

TEXT BOOK

1. Comelisse, J.W "Rocket Propulsion and Space Dynamics", Freeman & Co. Ltd., London, 1982
2. Griffin M.D and French, J.R "Space Vehicle Design," 2nd ed., AIAA Edu. Series 2004
3. William Tyrrell Thomson," Introduction to Space Dynamics" John Wiley & sons Inc., New York, 1993,

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Sutton, G.P., et al, "Rocket Propulsion Elements, John Wiley & sons Inc., New York,	1993
2	Mathur M., and Sharma, R.P " Gas Turbines and Jet and Rocket Propulsion", Standard Publishers, New Delhi	1998

3	Anderson J.D, "Aircraft Design", mcgraw-Hill	1999

5AN6.2: FATIGUE AND FRACTURE

B.Tech. (Aeronautical) 5th semester **Max. Marks: 100**

3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Elements of solid mechanics: The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation	5
	Airy's function- field equation for stress intensity factor.	3
II	Stationary crack under loading: Two dimensional elastic field- Analytical solutions yielding near a crack front-	4
	Irwin's approximation- plastic zone size- Dugdaale model- determination of J integral and its relation to crack opening displacement.	4
III	Energy balance and crack growth: Griffith analysis- stable and unstable crack growth-	3
	Dynamic energy balance- crack arrest mechanism- K1c test methods- R curves- determination of collapse load.	5
IV	Fatigue crack growth curve: Empirical relation describing crack growth law-life calculations for a given load amplitude, effects of changing the load spectrum.	4
	Introduction to factors affecting fatigue crack propagation. Introduction to crack propagation in composite materials.	4
V	Detection of cracks: NDT methods. Experimental determination of GIC, KIC, J-Integral and CTOD.	8
	TOTAL	**40**

TEXT BOOK

1. Basic fracture mechanics, including an introduction to fatigue,R N L Smith, Butterworth-Heinemann, 1991
2. Fatigue and fracture mechanics, Alfred Martin Freudenthal, Institute for the Study of Fatigue, Fracture and Structural Reliability, George Washington Univ

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Fatigue and Fracture: Understanding the Basics edited by F. C. Campbell, ASM International	2012
2	Fracture Mechanics: An Introduction, E.E. Gdouto,Springer	2005

5AN6.3 AIRCRAFT RULES & REGULATIONS – I

Max. Marks: 100

B.Tech. (Aeronautical) 5th semester

3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Knowledge of Aircraft Rules as far as they relate to airworthiness and safety of aircraft.	4
	Knowledge of Privileges and responsibilities of the various categories of AME Licence and approved persons.	4
II	Knowledge of "Civil Airworthiness Requirements", "Aeronautical Information Circulars (relating to airworthiness)", "Advisory Circulars" and ame Notices issued by DGCA.	5
	Knowledge of various mandatory documents like Certificate of Registration, Certificate of Airworthiness, Flight Manual, Export Certificate of Airworthiness.	3
III	Method of identifying approved material on Aircraft. Knowledge of various documents/certificates issued to establish airworthiness of Aircraft parts. Various logbooks required to be maintained for Aircraft.	5
	Method of maintaining the logbook. Procedure for making entries in logbooks; Journey logbook, Technical logbook etc. Use of schedules, its certification, preservation.	3
IV	Stores : Bonded and Quarantine stores, storage of various aeronautical products including rubber goods, various fluids.	4
	Knowledge of various terms such as Certificate of Flight Release, Certificate of Maintenance, Approved Certificates.	4
V	Condition under which Aircraft is required to be test flown; Certificate to be issued by AME for test flight.	5
	Circumstances under which C of A is suspended. Ferry Flight, MEL, CDL.	3
	TOTAL	40

TEXT BOOK

1. Civil Aviation Requirements, Section-II by DGCA, Published by English Book Store.
2. Aircraft Manual, The Aircraft Act, 1934.
3. Aeronautical Information Circular, DGCA.

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Airworthiness Advisory Circular.	2014
2	Aircraft Maintenance Engineers Notices.	2005

5 AN 7: THERMAL ENGINEERING LAB

B.Tech. (Aeronautical) 5th semester **Max. Marks: 100**
3P **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
	Experiments to be Performed (Minimum 10 Numbers) 1. To Determine Thermal Conductivity of Insulating Powders. 2. To Determine Thermal Conductivity of a Good Conductor of Heat (Metal Rod). 3. To Measure the thermal Conductivity of Liquid. 4. To determine the heat transfer Rate and Temperature Distribution for a Pin Fin. 5. To Measure the Emissivity of the Test plate Surface. 6. To Determine Stefan Boltzmann Constant of Radiation Heat Transfer. 7. To Determine the Surface Heat Transfer Coefficient For Heated Vertical Cylinder in Natural Convection. 8. Determination of Heat Transfer Coefficient in Drop Wise and Film Wise condensation. 9. To Determine Critical Heat Flux in Saturated Pool Boiling. 10. To Study Performance of Simple Heat Pipes. 11. To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers. 12. To Find the Heat transfer Coefficient in Forced Convection in a tube. 13. To determine the total thermal conductivity and thermal resistance of the given compound resistance in series. 14. To find out the thermal conductivity of given slab material. 15. To determine the individual thermal conductivity of different lagging in a lagged pipe. 16. To study the rates of heat transfer for different materials and geometries 17. To understand the importance and validity of engineering assumptions through the lumped heat capacity method. 18. Testing and performance of different heat insulators.	

5 AN 8: AIRCRAFT STRUCTURE LAB

B.Tech. (Aeronautical) 5th semester **Max. Marks: 75**
2P **Exam Hours: 2**

UNIT	CONTENTS	CONTACT HOURS
	LIST OF EXPERIMENTS (PERFORM ANY 8 EXPERIMENTS) 1. Determination of Young's modulus of aluminum using electrical extensometers 2. Determination of fracture strength and fracture pattern of ductile & brittle materials. 3. Deflection of beams with various end conditions for different load. 4. Verification of Maxwell's Reciprocal theorem & principle of superposition.	

	5. Compression tests on long and short columns, Critical buckling loads, South well plot. 6. Wagner beam – Tension field beam. 7. Shear centre location for open sections. 8. Shear centre location for closed sections. 9. Flexibility matrix for cantilever beam. 10. Beam with combined loading. 11. Experiment on Photo- elastic bench.	

5 AN 9: AIRCRAFT SYSTEM LAB.

B.Tech. (Aeronautical) 5th semester **Max. Marks: 100**
3P **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
	LIST OF EXPERIMENTS (Perform any 8 experiments) 1. Aircraft "Jacking Up" procedure 2. Aircraft "Levelling" procedure 3. Control System "Rigging check" procedure 4. Aircraft "Symmetry Check" procedure 5. "Flow test" to assess of filter element clogging 6. "Pressure Test" To assess hydraulic External/Internal Leakage 7. "Functional Test" of Hydraulic Actuator for its proper operation, leakage and load test. 8. "Pressure Test" procedure on fuel system components 9. "Brake Torque Load Test" on wheel brake units 10. Maintenance and rectification of snags in pneumatic, hydraulic and fuel systems components and on Aircraft. 11. Functional Test of Fire detection system on aircraft. 12. Functional Test of Aircraft Pressurization System on aircraft. 13. Functional Test of aircraft landing gear retraction system and its relevant indications in the cockpit. 14. Identification of various components, pipelines with color coding on aircraft. 15. Study of combustion chambers of various engines 16. Study of hydraulic systems of various aircraft 17. Study of pneumatic systems of various aircraft 18. Study of brake systems of various aircraft	

5 AN 10: PROPULSION LAB

B.Tech. (Aeronautical) 5th semester **Max. Marks: 75**
2P **Exam Hours: 2**

UNIT	CONTENTS	CONTACT HOURS
	1. Calculate the cylinder area, sweep area and compression ratio. 2. Test the engine on piston engine test rig to determine: A) Specific fuel consumption B) Break horse power C) Indicated horse power D) Break thermal efficiency E) Mechanical efficiency F) Heat balance sheet G) Air consumption H) Volumetric efficiency for four stroke petrol engine. 3. Study of an aircraft jet engine - assembly of sub systems, 4. Study of an aircraft jet engine - various components, their functions and operating principles 5. To study the functioning of aircraft gas turbine engines.	

6AN1: DIGITAL TECHNIQUES

B.Tech. (Aeronautical) 6th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	NUMBER SYSTEMS, BASIC LOGIC GATES & BOOLEAN ALGEBRA: Binary Arithmetic & Radix representation of different numbers. Sign & magnitude representation, Fixed point representation, complement notation, various codes & arithmetic in different codes & their inter conversion.	**3**
	Features of logic algebra, postulates of Boolean algebra. Theorems of Boolean algebra. Boolean function. Derived logic gates: Exclusive-OR, NAND, NOR gates, their block diagrams and truth tables. Logic diagrams from Boolean expressions and vica-versa. Converting logic diagrams to universal logic. Positive, negative and mixed logic. Logic gate conversion.	**5**
II	DIGITAL LOGIC GATE CHARACTERISTICS: TTL logic gate characteristics.Theory & operation of TTL NAND gate circuitry. Open collector TTL. Three state output logic. TTL subfamilies. MOS & CMOS logic families.	**5**
	Realization of logic gates in RTL, DTL, ECL, C-MOS & MOSFET. Interfacing logic families to one another.	**3**
III	MINIMIZATION TECHNIQUES: Minterm, Maxterm, Karnaugh Map, K map upto 4 variables. Simplification of	**4**

	logic functions with K-map, conversion of truth tables in POS and SOP form.	
	Incomplete specified functions. Variable mapping. Quinn-Mc Klusky minimization techniques.	**4**
IV	COMBINATIONAL SYSTEMS: Combinational logic circuit design, half and full adder, subtractor. Binary serial and parallel adders. BCD adder. Binary multiplier. Decoder: Binary to Graydecoder, BCD to decimal, BCD to 7-segment decoder.	**4**
	Multiplexer, demultiplexer, encoder. Octal to binary, BCD to excess-3 encoder. Diode switching matrix. Design of logic circuits by multiplexers, encoders, decoders and demultiplexers.	**4**
V	SEQUENTIAL SYSTEMS: Latches, flip-flops, R-S, D, J-K, Master Slave flip flops. Conversions of flip-flops. Counters: Asynchronous (ripple), synchronous and synchronous decade counter	**5**
	Modulus counter, skipping state counter, counter design. Ring counter. Counter applications. Registers: buffer register, shift register.	**3**
	TOTAL	**40**

TEXT BOOK

1. Digital Circuit & Logic Design, Samuel C.Lee, Eee
2. Modern Digital Electronics, R.P. Jain, TMH
3. Digital Principles And Applications (Special Indian Edition), Leach & Malvino, TMH
4. 2000 Solved Problems In Digital Electronics (Sigma Series), Bali, TMH
5. Digital Fundamental, Floyd & Jain, Pearson
6. Digital Logic And Computer Design, Mano, Pearson
7. Digital Systems: Principles And Applications, Tocci, Pearson
8. Digital Design, M.Morris Mano, Pearson

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Digital Electronics Principal & Intigrated Ckt, Maini, Wiley	**2007**
2	Digital Logic Design Principals, Palbanian, Wiley	**2007**
3	Digital Electronics, Kharate, Oxford	**2012**

6AN2 : MECHANICS OF COMPOSITE MATERIALS

B.Tech. (Aeronautical) 6th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	INTRODUCTION TO COMPOSITE MATERIALS Classification of composites, particulate composites, fibrous composites. Use of fiber reinforced composites; Fibers, matrices and manufacture of composites; properties of various type of fibers like glass, Kevlar, Carbon and Graphite,	**5**
	Methods of manufacture, surface treatment of fibers, various forms of fibers,	**3**

	matrix materials, polymers: Thermosetting and thermoplastic polymers, properties of polymers like epoxies, phenolics, polyester peek etc.	
II	Manufacture of Composites : Hand lay up technique, pressure bag and vacuum bag moulding techniques, puftrusion, resin-transfer moulding, injection moulding,	4
	Bulk moulding compound, sheet moulding compound. Application of composites in Aircraft Industry.	4
III	Behavior of Unidirectional Composites : Volume traction, weight traction, density of composites, Micromechanics approach, longitudinal strength and stiffness factors affecting longitudinal strength and stiffness,	4
	Transverse strength and stiffness, shear modulus and strength, Poisson's ratio, effect of fiber dimension and distribution on strength and stiffness, Halpin-Tsai equations.	4
IV	Analysis and Strength of An Orthotropic Lamina : Strain relations and engineering constants, relation between engineering constants and stiffness coefficients, strength of an orthotropic lamina, failure theories,	3
	Analysis of laminated composites, laminate orientation code, stress and strain variation in a laminate, properties of symmetric, cross ply angle-ply and quasi isotropic analysis of laminate after initial failure, hygrothermal behaviour of laminates. Thermal and moisture expansion coefficients, transports properties, mass diffusion.	3
	Short fiber composites: approximate analysis of stress transfer, average fiber stress, modules and strength of short composites. **Experimental Characterization of Composites :** Uniaxial portion and compression test, inplane shear test, flexural test, determination of intralaminar shear strength and fracture toughness.	2
V	Maintenance of Composites : Assessment and Repair – Classification of damage, Inspection Methodology, Repair operation, Repair procedures. Types of Repairs – Repair failures, Typical repair procedures,	4
	Delaminations, Damage to laminate structures, Repair to sandwich structures, Repair to Honycomb structures, lightning protection, painting the composite part, Quality control.	4
	TOTAL	**40**

TEXT BOOK

1. R.M. Jones, Mechanics of Composite Materials, Technomic Publication.
2. B.D. Agarwal and L.J. Broutman, Analysis and Performance of Fiber Composites, John Wiley & Sons.

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	R.F. Gibson, Principles of Composite Material Mechanics, Mc Graw Hill International Edition.	2004
2	Lalit Gupta, Advance Composite Materials, Himalyans Books, New Delhi	1998
3	Advance Composites by Joppesen	2002

6AN3 : AERODYNAMICS - I

B.Tech. (Aeronautical) 6th semester **Max. Marks: 100**
3L+1T **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	The standard Atmosphere : International standard atmosphere, geopotential and geometric altitude, pressure, temperature and density altitude. Viscous Flow :	4
	Introduction to turbulence, transition, structure of a turbulent boundary layer, momentum equation for turbulent boundary layer.	4
II	Airfoil and Wing Theory: Joukowski, Karman – Trefftz, Profiles – Thin aerofoil theory and its applications. Vortex line, Horse shoe vortex, Biot and Savart law, Lifting line theory and its limitations,	6
	Wing theory, induced drag, qualitative treatment of low aspect ratio wings.	2
III	Generation of Lift: Kutta Joukowski's theorem. Kutta condition. Blasius theorem.	8
IV	Wind Tunnel Design: Test section, diffuser, fan section, fan design, return passage, cooling,	5
	The breather-vibration, test section flow quality, effuse design, wind tunnel construction, energy ratio, final form.	3
V	Instrumentation and calibration of test section: Measurement of pressure, velocity, turbulence, flow angularity, hot wire anemometry, laser velocimeter, data acquisition, flow visualization techniques, wind tunnel calibration.	4
	Model forces, Moment and pressure measurement Wind tunnel balances – internal and external balances, design of wind tunnel balances, wake survey method.	4
	TOTAL	**40**

TEXT BOOK

1. Anderson, J.D., "Fundamentals of Aerodynamics", mcgraw Hill Book Co., New York, 1998.
2. Houghton, E.L., and Carruthers, N.B., "Aerodynamics for Engineering students", Edward Arnold Publishers Ltd., London, 1989.
3. Introduction to Aeronautics by SOA.

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Milne Thomson, L.H., "Theoretical aerodynamics", Macmillan,	1985
3	Clancey, L.J., "Aerodynamics", Pitman,	1986

6AN4: AIRCRAFT STRUCTURES – II

B.Tech. (Aeronautical) 6th semester **Max. Marks: 100**
3L+1T **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	UNSYMMETRICAL BENDING: General, Principal axis and neutral axis methods- bending stresses in beams of symmetric sections with skew loads-	5
	Bending stresses in beams of unsymmetrical sections.	3
II	SHEAR FLOW IN OPEN SECTIONS: Thin walled beams, Concept of shear flow, shear centre,	4
	Elastic axis with one axis of symmetry, with wall effective and ineffective in bending, unsymmetrical beam sections.	4
III	SHEAR FLOW IN CLOSED SECTIONS: Bredt – Batho formula, Single and multi – cell structures.- Shear flow in single & multicell structures under torsion.	5
	Shear flow in single and multicell under bending with walls effective and ineffective.	3
IV	BUCKLING OF PLATES: Rectangular sheets under compression, local buckling stress of thin walled section-Crippling stresses by Needham's and Gerard's methods,	5
	Thin walled column strength-sheet stiffener panels-Effective width. Thermal post buckling of aircraft wing.	3
V	STRESS ANALYSIS IN WING AND FUSELAGE: Shear resistant web beams-Tension field web beams(Wagner's) – Shear and bending moment distribution for cantilever and semi-cantilever types of beams-	5
	Loads on aircraft –lift distribution-V-n diagram-Gust loads	3
	TOTAL	**40**

TEXT BOOK

1. Peery, D.J., and Azar, J.J., "Aircraft Structures", 2nd edition, mcgraw–Hill, N.Y., 2007.
2. Megson, T.M.G., "Aircraft Structures for Engineering Students", Edward Arnold, 2007.

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Analysis of A/C Structure by Bruce K. Donaldson (Cambridge Aerospace Series)	2006
2	'Analysis of Design of Flight Vehicles Structures', by Bruhn E.H., Tri-state offset company, USA	1973
3	'Theory & Analysis of Flight Structure' by Rivello, R.M., mcgraw Hill	1968

6AN5 : AIRCRAFT DESIGN

B.Tech. (Aeronautical) 6th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Preliminaries: Aircraft Design Requirements, specifications, role of users. Aerodynamic and Structural Consideration, Importance of weight. Airworthiness requirements and standards. Classifications of airplanes. Special features of modern airplane.	4
	Air Loads in Flight: Symmetrical measuring loads in flight, Basic flight loading conditions, Load factor, Velocity - Load factor diagram, gust load and its estimation, Structural limits.	4
II	Airplane Weight Estimation: Weight estimation based on type of airplane, trends in wing loading, weight-estimation based on mission requirements, iterative approach.	3
	Basic Wing Design: Selection of airfoil selection, influencing factors. Span wise load distribution and planform shapes of airplane wing. Stalling take off and landing considerations. Wing drag estimation. High lift devices.	2
	Structural Design: Cockpit and aircraft passenger cabin layout for different categories, types of associated structure, features of light airplanes using advanced composite materials. Structural aspects of design of airplane, Bending moment and shear force diagram. Design principles of all metal stressed skin wing for civil and military applications.	3
III	Landing Gears: Different kinds of landing gears, and associated arrangement for civil and military airplanes.	4
	Preliminary calculations for locating main and nose landing gears.	4
IV	Integration of Structure and Power Plant: Estimation of Horizontal and Vertical tail volume ratios. Choice of power plant and various options of locations, considerations of appropriate air-intakes.	5
	Integration of wing, fuselage, empennage and power plant. Estimation of centre of gravity.	3
V	Introduction of advanced concepts: Supercritical Wings, relaxed static Stability, controlled configured vehicles, V/STOL aircraft and rotary wing vehicles.	5
	Design and layout of flying controls and engine controls.	3
	TOTAL	**40**

TEXT BOOK

1. Daniel P Raymer, Aircraft Design: A conceptual approach, AIAA Series, 1992
2. D Stinton, The Design of Airplane, GRANADA, UK 1983
3. John D Anderson (Jr.), Airplane Performance and Design, mcgraw Hill 1999

4. E Torenbeek Synthesis of Airplane Design

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	L M Nicholal, Fundamentals of airplane Design, Univ. Of Dayton DHIO,	1975
2	Aircraft Design K.D.Wood, Johnson Publishing Company,	1968

6AN6.1 HEAT TRANSFER IN SPACE APPLICATIONS

B.Tech. (Aeronautical) 6th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**SPACE CRAFT THERMAL ENVIRONMENTS:** Launch and ascent environments – environment of earth orbit – environments of interplanetary missions.	8
II	**THERMAL CONTROL TECHNIQUES:** Passive thermal control techniques: thermal coating materials, thermal insulation, heat sinks, phase change materials – Active thermal control techniques: electrical heaters, thermal louvers, HPR fluid systems, heat pipes, space borne cooling systems.	4
	Insulation-Blanket Design: materials-attachment – high temperature blankets – insulation for in-atmosphere applications.	4
III	**PHASE CHANGE MATERIALS :** When to use a PCM -- PCM design. Heat Pipes-Types-Analysis-Testing-heat pipe applications and performances.	8
IV	**THERMAL CONTACT RESISTANCE AND ITS CALCULATION:** Parameters influencing thermal joint resistance – effect of oxidation and interstitial effects.	8
V	**ABLATIVE HEAT TRANSFER:** Physical process and calculation of ablation rates – hypersonic ablation of graphite – heat transfer at high velocities – heat transfer in rarefied gases-transpiration and film cooling.	8
	TOTAL	40

TEXT BOOK

1. Gilmore, D.G., Spacecraft Thermal Control Handbook, Volume I: Fundamental Technologies, 2nd ed., The Aerospace Press, American Institute of Aeronautics and Astronautics (2002).
2. NASA SP 8105

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Fortescue, P., Swinerd, G., and Stark, J.(Ed), Spacecraft Systems Engineering, 4th ed., John Wiley & Sons (2011).	2011
2	Mayer, R.X., Elements of Space Technology for Aerospace Engineers, Academic Press (1999)	1999

6AN6.2 : COMPUTATIONAL FLUID DYNAMICS

B.Tech. (Aeronautical) 6th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	FINITE DIFFERENCE SCHEMES: Projection and truncation error, Stability, consistency, accuracy and convergence of numerical schemes. Time marching methods.	4
	FDM applied to linear advection - diffusion equation, maccormack scheme and its application to Euler and N-S equations.	4
II	BASICS OF FINITE VOLUME METHOD: Equations in integral form, numerical flux at cell faces, upwind methods, flux - vector splitting, flux - difference splitting, shock capturing methods.	8
III	BASIC OF FINITE ELEMENT METHOD: Isoparametric elements, bilinear and tri-linear elements. Numerical Integration,	4
	Space function, Petrov- Galerkin method.	4
IV	Grid generation: algebraic and pde based methods, O-, C-, H-type topologies,	5
	Unstructured meshes, hybrid meshes.	3
V	Large scale problems in CFD, iterative solvers, preconditioning techniques, vector and parallel computing, post-processing for visualisation.	8
	TOTAL	40

TEXT BOOK

1. T J Hughes, The Finite Element Method: Linear Static and Dynamic Finite Element Analysis, Prentice Hall.
2. John D Anderson Jr., Computational Fluid Dynamics: The Basics with Applications, mcgraw Hill, Indian Edition.

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Charles Hirsch, Numerical Computation of Internal and External Flows, Wiley Series in Numerical Methods in Engineering, Indian Edition.	1990
2	O C Zicnkievicz and RL Taylor, The Finite Element Method, Vol I & II, mcgraw Hill, Indian Ed.	1977

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6AN6.3 AIRCRAFT RULES & REGULATIONS – II

B.Tech. (Aeronautical) 6th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Minimum equipments, instruments required for various types of operation.	8
II	Modification, concession, Airworthiness Directive, Service Bulletins. Approval of organization, Documents required to be carried on board, Issue of type approval,	8

	Registration markings.	
III	Approval of Maintenance Organisations: Terms of approval, Facility requirements, Personnel requirements, Certifying staff and support staff,	4
	Maintenance procedures and quality system, Maintenance organization exposition, Privileges and changes to the organization.	4
IV	Certification procedures for aircraft and related products and parts: General provisions, Production without production organization approval, Noise certificates,	5
	Repairs and Indian technical standard order authorizations, Identification of products, parts and appliances. Continuing airworthiness requirements : Acceptable means, Airworthiness review certificate.	3
V	Human performance and limitations relevant to the duties of an aircraft maintenance engineer licence holder, social psychology,	4
	Factors affecting performance physical environment, tasks, communication, human error, hazards in a workplace.	4
	TOTAL	**40**

TEXT BOOK

1. Civil Aviation Requirements, Section-II by DGCA, Published by English Book Store.
2. Human Factor by Hawkins.
3. Human Factor by SOA

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Human Factor by ICAO Documents – 9683	1998

6AN7: AIRCRAFT DESIGN LAB

B.Tech. (Aeronautical) 3rd semester **Max. Marks:100**

3P **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
	I : OBJECTIVE To introduce and develop the basic concept of aircraft design. Each student is assigned with the design of an Airplane (or Helicopter or any other flight vehicle), for given preliminary specifications. The following are the assignments to be carried out: **EXPERIMENTS** 1. Comparative configuration study of different types of airplanes 2. Comparative study on specification and performance details of aircraft	

	3. Preparation of comparative data sheets 4. Work sheet layout procedures 5. Comparative graphs preparation and selection of main parameters for the design 6. Preliminary weight estimations, selection of main parameters, 7. Power plant selection, Aerofoil selection, Wing tail and control surfaces 8. Preparation of layouts of balance diagram and three view drawings 9. Drag estimation 10. Detailed performance calculations and stability estimates **II : OBJECTIVE** To enhance the knowledge in continuation with the above design project each student is assigned with work in continuation of the above design project. The following assignments are to be carried out. **EXPERIMENTS** 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 CAD drawings.	

6AN8 : AERODYNAMICS LAB

B.Tech. (Aeronautical) 3rd semester **Max. Marks: 100**
3P **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
	OBJECTIVE To study experimentally the aerodynamic forces on different bodies at low speeds. **LIST OF EXPERIMENTS** 1. Calibration of subsonic wind tunnel. 2. Pressure distribution over smooth and rough cylinder. 3. Pressure distribution over symmetric airfoil. 4. Pressure distribution over cambered airfoil & thin airfoils 5. Force measurement using wind tunnel balance. 6. Flow over a flat plate at different angles of incidence 7. Flow visualization studies in low speed flow over cylinders 8. Flow visualization studies in low speed flow over airfoil with different angle	

	of incidence	

6AN9 : AIRFRAME LAB

B.Tech. (Aeronautical) 6th semester **Max. Marks: 50**
2P **Exam Hours: 2**

UNIT	CONTENTS	CONTACT HOURS
	1. Hands on experience with aircraft roll control. 2. Hands on experience with aircraft pitch control 3. Hands on experience with aircraft yaw control 4. Hands on experience with aircraft lift augmentation devices 5. Hands on experience with aircraft major components on aircraft and to identify their location. 6. Hands on experience with aircraft structure fusleage station, wing station number 7. Hands on experience understand and test electrical bonding on aircraft 8. Hands on experience with primary control surfaces 9. Hands on experience with various type of tabs 10. Hands on experience with manual system operation 11. Hands on experience with fixed volume pump 12. Hands on experience with hydraulic actuator 13. Hands on experience with Air Bottle 14. Hands on experience with stall protection system	

6AN10 : SOFT SKILL DEVELOPMENT LAB.

B.Tech. (Aeronautical) 6th semester **Max. Marks: 50**
2P **Exam Hours: 2**

UNIT	CONTENTS	CONTACT HOURS
	The course basically concentrates on soft skills and good and effective communication skills. The program includes the following modules/exercises delivered in English which will help the students to improve their personal performance and communication skills. 1. **Essential Skills for Engineers** The module will concentrates on developing skills through a questioning and	

	analytical approach which will enable students to better understand, communicate with and lead a team. **2. Communication for Collaboration** A combination of individual coaching, great tips and techniques within lively interactive training program will transform team into a dynamic and cohesive unit which works together and also communicates more effectively with clients/colleagues. **3. Professional Excellence** The module will focus on many aspects of professionalism including fundamentals of excellent professional and positive attitudes. **4. Management and Leadership Excellence** Leadership is a vital aspect of effective management, the responsibility for ensuring that each person gives of their best. The module will cover several aspects like assertive v aggressive management, giving effective feedback, business acumen, assessment of key strengths & development, basic & advanced management skills. **5. Negotiation Skills:** The module will introduce the skills required to take part in successful negotiations. It introduces a systematic approach to preparing and conducting negotiations at all levels such as analyze case studies, discuss real life experience and take part in simulations. **6. Telephone Skills** The module will give students the skills to communicate effectively over the phone. With the aid of role plays, videos and group discussions, students will learn the correct way to make a good first impression, take clear messages, listen positively and handle problems with confidence.	

	7. Email Skills The module will provide students with an in-depth understanding of how to write good emails in a style that builds better relationships. **8. Presentations and Public Speaking** The module will help students to develop confidence and skills in giving speeches, by exploring techniques for preparing and delivering talks, as well as exploring ways to engage audience in a range of situations. **9. Time Management** The module will give students the tools to overcome the barriers to working efficiently and effectively and to discover a range of techniques for prioritizing tasks, dealing with time wasters and managing yourself and others. Students will participate in a series of exercises, discussions and hands-on activities that relate time management techniques to daily life. **10. Good English Speaking** The module will focus on Introductions and meetings, Talking about studies and/or job, Expressing likes and dislikes, Describing daily routines and current activities, Talking about past states and events, Talking about future plans and intentions, Expressing preferences, Giving reasons, Expressing opinions, agreement and disagreement, Seeking and giving advice, Making suggestions.	

Suggested Readings:

1. Kamalesh Sadanand and Susheela Punitha, "Spoken English**:** A Foundation Course" for Speakers of Indian Languages, Part 2 Audio CD, Hyderabad: Orient Longman, 2008
2. Malcome Goodale, "Professional Presentations", (VCD) New Delhi: Cambridge University Press, 2005
3. Barbara Garside and Tony Garside, Essential Telephoning in English (Audio CD)**,** Cambridge: Cambridge University Press, 2002

4. Hari Mohan Prasad and Rajnish Mohan, "How to Prepare for Group Discussion and Interview (Audio Cassette)", Tata McGraw-Hill Publishing
5. Interactive Multimedia Programs on Managing Time and Stress
6. Robert M. Sherfield and et al "Developing Soft Skills",4th Edition, New Delhi, Pearson Education, 2009.

6AN11 Professional Ethics and Disaster Management

B.Tech. (Aeronautical) 6th semester **Max. Marks: 50**
2P **Exam Hours: 2**

UNIT	CONTENTS	CONTACT HOURS
	Common syllabus to all Branches.	

7AN1: AVIONICS – I

B.Tech. (Aeronautical) 7th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Basic of the application and identification of electrical cables used in Aircraft radio installation, crimping and soldering techniques, bonding continuity and insulation tests. Composition, performance (stability and tolerance) and limitations of the fixed resistors and varistors (carbon composition, carbon film, wire wound and metallic film). Basic of EMI (electro magnetic interference) and EMC (electro magnetic computability). Different types of interference caused by electrical and ignition system to radio apparatus, methods of minimizing or suppressing such interference, bonding and screening.	5
	Radar Engineering: Radar definition, Radar range equation, pulsed, CW and Doppler Radars, MTI, Noise Figure consideration, various types of radar displays, Detection of radar signals in Noise.	3
II	**Microwave Engineering**: Various types of radar transmission Lines, Rectangular and circular waveguides, coaxial lines, field patterns modes (high order and evanescent), passive components (e.g., Directional couplers, filters, isolators and circulators), Device: Magnetron, Klystron, backward wave oscillator, Travelling wave tubes, Amplifiers and parametric amplifiers. Diode detectors and mixers	4
	Aerials and Propagation: Antenna theory, various types of antenna for medium wave short wave, VHF frequencies, propagation at microwave frequencies, atmospheric attenuation, effects of precipitation, reflection, the voltage and current distribution along antenna of various length; characteristics of ground planes. Refraction and Diffraction phenomenon, clutter signals.	4
III	**Electronic Navigation:** Map and charts, classification of various navigation systems, celestial and radio navigation, Radio direction finding at medium, high and very high frequencies. The radio compass and Automatic Direction finders. Hyperbolic navigation systems, LORAN and Decca. TACAN. Aids to approach and landing, the standards ILS, various categories of ILS accuracy,	4

	MLS, Ground Control Approach Systems. Dead reckoning navigation systems, Doppler navigational and inertial navigation, global Positioning system(GPS), Alerts and collision Avoidance System(TCAS).	**4**
IV	**Communication Equipments:** Very high frequency (VHF) and high frequency (HF) airborne communications; frequency bands allocation; the methods of propagation and the ranges expected, both day and night; calculation of approximate range of communication (line of sight) with given data. Theory of operation, performance level and specifications of an Audio Integration System.	**2**
	WORKING PRINCIPLE OF FOLLOWING SYSTEMS Very high frequency (VHF) communication system., Audio integration system (AIS)., Emergency locator transmitters (ELT), Cockpit voice recorder (CVR), Very high frequency omnidirectional range (VOR), Automatic direction finding (ADF), Distance measuring equipment (DME), Very low frequency and hyperbolic navigation (VLF/OMEGA), Doppler navigation, global navigation, Satellite system, Air traffic control transponder, secondary surveillance radar, Weather avoidance radar, Radio altimeter, ARINC communication and reporting, Electronic emergency equipment requirements, Cabin entertainment equipment, IFR (Identification friends or FOE)	**6**
V	**NAVIGATION SYSTEMS** INS components: transfer function and errors – The earth in inertial space, the coriolis effect – Mechanization. Platform and strap down, INS system block diagram, Different co-ordinate systems, Schuler loop, compensation errors, Cross coupling, Gimbal lock, Alignment.	**4**
	Introduction to GPS system description, basic principles, position and velocity determination, Signal structure, DGPS, Estimation and mixed mode navigation, Integration of GPS and INS utilization of navigation systems in aircraft.	**4**
	TOTAL	**40**

TEXT BOOK

1. RF Hnasforde, Heywood and Company London: Radio Aids to Civil Aviation.
2. Geroge Kannedy : Electronic Communication System, McGraw Hill
3. Brian Kendal : Manual of Avionics, Blackwell
4. Merril I, Sklonik, Introduction to radar systems, McGraw Hill.
5. Myron Kayton and Walter R fried, Avionics Navigation Systems, John Wiley and Sons.
6. L Tetley and D Calcutt, Electronic Aids to Navigation, Edward Arnold Publishers Ltd.

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Dennis Reddy and John Cooler: Electronic Communication, Prentice Hall of India, New Delhi..	**2002**
2	J. Powell: Aircraft Radio Systems, Himalayan Books	**1990**
3	Keith W. Bose : Aviation Electronics, Jeppesen	**1990**

7AN2: FINITE ELEMENT METHODS

B.Tech. (Aeronautical) 7th semester **Max. Marks: 100**
3L+1T **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**Introduction to FEM and its applicability, Review of mathematics:** Matrix algebra, Gauss eliminationmethod, Uniqueness of solution, Banded symmetric matrix and bandwidth.	3
	Structure analysis: Two-force member element, Local stiffness matrix, coordinate transformation, Assembly, Global stiffness matrix, imposition of Boundary conditions, Properties of stiffness matrix.	5
II	**One-dimensional Finite Element Analysis:** Basics of structural mechanics, stress and strain tensor,constitutive relation,	2
	Principle of minimum Potential, General steps of FEM, Finite element model concept /Discretization, Derivation of finite elements equations using potential energy approach for linear and quadratic	4
	1-D bar element and beam element, shape functions and their properties, Assembly, Boundary conditions, Computation of stress and strain.	2
III	**Two Dimensional Finite Element Analysis:** Finite element formulation using three nodded triangular (CST) element and four nodded rectangular element, Plane stress and Plain strain problems,	4
	Shape functions, node numbering and connectivity, Assembly, Boundary conditions, Isoparametric formulation of 1-D bar elements, Numerical integration using gauss quadrature formula, computation of stress and strain.	4
IV	**Finite Element Formulation from Governing Differential Equation:** Method of Weighted Residuals,Collocation, Sub domain method, Least Square method and	4
	Galerkin's method, Application to one dimensional problems, one-dimensional heat transfer, etc. introduction to variational formulation (Ritz Method.)	4
V	**Higher Order Elements:** Lagrange's interpolation formula for one and two independent variable, Convergence of solution, compatibility, element continuity, static condensation, p and h methods of mesh refinement,	4
	Aspect ratio and element shape, Application of FEM, Advantages of FEM, Introduction to concept of element mass matrix and Damping matrix in dynamic analysis, Calculation of natural frequencies and modes.	4
	TOTAL	40

TEXT BOOK

1. Text Book of Finite Element Analysis, Seshu P., Prentice Hall India.
2. Finite Element Procedure in Engineering Analysis, Bathe K.J., Prentice Hall India.

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	An Introduction to the Finite Element Method, Reddy J.N., Tata McGraw-Hill, New Delhi.	2005
2	Concepts & Applications of Finite Element Analysis, Cook, Malkus, Plesha and Witt, Willey India, New Delhi.	2007
3	Introduction to Finite Elements in Engineering, Chandupatla and Belegundu, Prentice Hall India	1993

7AN3 :AERODYNAMICS – II

B.Tech. (Aeronautical) 7th semester **Max. Marks: 100**
3L+1T **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**One Dimensional Compressible Flow** Energy, Momentum, continuity and state equations. Velocity of sound, Adiabatic steady state flow equations,	4
	Flow through converging, diverging passages. Performance under various back Pressures.	3
II	**Normal, Oblique Shocks and Expansion Waves** Prandtl equation and Rankine – Hugonoit relation, Normal shock equations, Pitot static tube, Rayleigh and Fanno Flow. Flow past convex corners,	2
	corrections for subsonic and supersonic flows, Oblique shocks and correspond equations. Hodograph and pressure turning angle, shocks polars, flow past wedges and concave corners, strong, weak and detached shocks,	3
	Expansion hodograph, Reflection and interaction of shocks and expansion waves, Families of shocks, Methods of Characteristics, Two dimensional supersonic nozzle contours.	4
III	**Differential Equations of Motion for Steady Compressible Flows** Small perturbation potential theory, solutions for supersonic flows, Mach waves and Mach angles, Prandtl-Glauert affine transformation	4
	relations for subsonic flows, Linearised two dimensional supersonic flow theory, Lift, drag pitching moment and center of pressure of supersonic profiles.	4
IV	**Airfoil in High** Lower and upper critical mach numbers, Lift and drag divergence, shock induced separation,	3
	Characteristics of swept wings, Effects of thickness, camber and aspect ratio of wings, Transonic area rule, Tip effects.	5
V	**High Speed Wind Tunnel** Blow down, indraft and induction tunnel layouts and their design features, Transonic, supersonic and hypersonic tunnels and their peculiarities.	5
	Helium and gun tunnels, Shock tubes, Optical methods of flow visualization.	3
	TOTAL	40

TEXT BOOK

1. Rathakrishnan, E., "Gas Dynamics", Prentice Hall of India, 2003.

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Shapiro, A.H., "Dynamics and Thermodynamics of Compressible Fluid Flow", Ronold Press,.	1912
2	Anderson Jr., D., - "Modern compressible flows", McGraw-Hill Book Co., New York	1999.
3	McCornick. W., "Aerodynamics, Aeronautics and Flight Mechanics", John Wiley, New York,.	1979
4	Zucrow, M.J. and Anderson, J.D., "Elements of gas dynamics", McGraw-Hill Book Co., New York,	1919

7AN4 : AIRCRAFT PERFORMANCE

B.Tech. (Aeronautical) 7th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**ATMOSPHERE** International standard atmospheric, geopotential and geometric altitude, troposphere and stratosphere, stability of atmosphere.	5
	Pressure altitude, equivalent, calibrated, indicated air speed, primary flight instruments, ASI, VSI, Turn-bank indicator.	3
II	**AERODYNAMIC CHARACTERISTICS-I** Drag aerodynamics, Drag polar, Estimation of drag. Forces and moments from dimensional analysis,	4
	Pressure distribution over airfoils, variation with angle of attack, aerodynamic centre of pressure related problems.	4
III	**AERODYNAMIC CHARACTERISTIC-II** Estimation of C_L, C_D and C_M from pressure distribution, variation of aerodynamic coefficients with Reynolds number and Mach number.	4
	Effect of span, aspect ratio, platform, sweep, taper and twist on aerodynamic characteristics V/STOL configurations	4
IV	**AIRPLANE PERFORMANCE IN STEADY & LEVEL FLIGHT** Equation of motion of aircraft, variation of drag with flight, power required and power available,	3
	minimum drag and minimum power conditions, climbing and gliding performance,	5
V	**AIRPLANE PERFORMANCE IN ACCELARATED FLIGHT** Take-off and landing, steady climb and descent, absolute and service ceiling, cruise, cruise climb, range and endurance ,	5
	load actor, V-n diagram, jet assisted take-off, effect of head, tail and cross winds. Turning flight performance	3
	TOTAL	40

7AN5 : AIRCRAFT STABILITY & CONTROL

B.Tech. (Aeronautical) 7th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**INTRODUCTION** Static stability, dynamic stability, aircraft control, simplifying assumptions, axis of reference and notation, equations of motion,	5
	aerodynamic deviations.Longitudinal, lateral and directional stability and control.	3
II	**LONGITUDINAL STABILITY** Wing alone, wing and horizontal tail, factors affecting the tail contribution, neutral point and static margin, the stick fixed condition, determination of	4

	neutral points by flight test, the stick-free condition,	
	determination of stick free neutral point, relationship between stick-fixed and stick-free static stability, forward CG limit, general effects of other components.	**4**
III	**MANOEUVERING STABILITY** The stick-fixed aspect, the stick-free aspect, limitations, the phugoid, longitudinal control, the elevator and trim tab,	**4**
	stick force and stick gearing, variation of stick force with airspeed, effect of pitching velocity on tail incidence.	**4**
IV	**DIRECTIONAL STATIC STABILITY** The fuselage, vertical tail fin, propeller effects, the wind, damping in yaw, directional control, asymmetric power.	**3**
	Lateral Static Stability : Effect of wing dihedral, effect of wing sweepback, fuselage and vertical tail, damping in roll, strip theory, cross-coupling.	**3**
	Dynamic Effects : Directional divergence, spiral divergence and dutch roll, autorotation, the spin.	**2**
V	**AERODYNAMIC BALANCING** The set-back rings, the horn balance, the aileron, the sealed nose balance and the geared balance tab.	**4**
	Dynamic Stability : Euler angles, equations of motion, aerodynamic forces and moments, stability and control derivations, decoupling of longitudinal and lateral-directional dynamics, longitudinal modes, lateral-directional modes.	**4**
	TOTAL	**40**

7AN6.1 :SPACE MISSION DESIGN & OPTIMIZATION

B.Tech. (Aeronautical) 7th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**LAUNCH VEHICLE TRAJECTORY DESIGN** Images of launch vehicle ascent trajectory - effect of trajectory on mission – lower atmospheric parameters and its influence on trajectories –	**5**
	launch vehicle ascent trajectory design – low thrust trajectory design	**3**
II	**SATTELITE TRAJECTORY DESIGN** Basics of trajectory calculations for a satellite —	**2**
	Satellite constellation design –rendezvous mission design	**2**
	ballistic lunar and inter planetary trajectory design.	**4**
III	**BASIC STEPS IN DESIGNING SPACE MISSION** Introduction to space mission analysis and design – mission statement –	**4**
	definition of mission objectives –characterizing a mission – mission evaluation – defining mission requirement.	**4**

IV	**BASICS OF OPTIMAL CONTROL THEORY** Dynamic programming – principle of optimality – Hamilton Jacobi Bellman equation –	**3**
	variational calculations – Infinite and finite horizon optimal control.	**5**
V	**APPLICATION OF OPTIMAL CONTROL THEORY** Space flight trajectory optimization – direct and indirect	**4**
	optimization techniques – restricted 3body problem – Lagrangian point.	**4**
	TOTAL	**40**

TEXT BOOK

1. Osborne, G.F. and Ball, K.J., Space Vehicle Dynamics, Oxford Univ. Press(1967).
2. Hale, F.J., Introduction to Space Flight, Prentice Hall(1994)
3. Naidu, D.S., Optimal Control Systems, CRC Press (2003)

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	1.Chobotov, V., Orbital Mechanics, AIAA Edu. Series .	2002
2	Griffin, M.D. and French, J. R., Space Vehicle Design, 2nd ed., AIAA	2004
3	Newcomb, R.W. and Kirk, D.E., Optimal Control Theory: An Introduction, Prentice Hall	1990.
4	Bulirsch, R., Miele, A., Stoer, J., and Well, K.H.(Ed.), Optimal Control: Calculus of Variations, Optimal Control Theory and Numerical Methods, Birkhauser Verlag	1993.

7AN6.2 : HELICOPTER THEORY

B.Tech. (Aeronautical) 7th semester **Max. Marks: 100**

3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Theory of Flight—RotaryWing Aerodynamics: Terminology; Effects of gyroscopic precession; Torque reaction and directional control; Dissymmetry of lift,	**4**
	Blade tip stall; Translating tendency and its correction; Coriolis effect and compensation; Vortex ring state, power settling, overpitching; Auto-rotation; Ground effect.	**4**
II	Flight Control Systems: Cyclic control;Collective control; Swashplate; Yaw control: Anti-Torque Control, Tail rotor, bleed air; Main Rotor Head: Design and Operation features;	**3**
	Blade Dampers: Function and construction; Rotor Blades: Main and tail rotor blade construction and attachment;	**2**
	Trim control, fixed and adjustable stabilisers; System operation:manual, hydraulic, electrical and flyby-wire; Artificial feel; Balancing and Rigging.	**3**
III	Blade Tracking and Vibration Analysis: Rotor alignment; Main and tail rotor tracking;.	**4**
	Static and dynamic balancing; Vibration types, vibration reduction methods; Ground resonance	**4**
IV	Transmissions:	**3**

	Gear boxes, main and tail rotors; Clutches, free wheel units and rotor brake.	
	Tail rotor drive shafts, flexible couplings, bearings, vibration dampers and bearing hangers	**5**
V	Helicopter Structures: Airworthiness requirements for structural strength; Structural classification, primary, secondary and tertiary, Fail safe, safe life, damage tolerance concepts; Zonal and station identification systems; Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue; Drains and ventilation provisions; System installation provisions; Lightning strike protection provision.	**4**
	Construction methods of: stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement, methods of skinning and anti-corrosive protection. Pylon, stabiliser and undercarriage attachments;	**4**
	TOTAL	**40**

TEXT BOOK

1. Automatic Flight Control – E.H.J. – Pallet
2.Aviation Maintenance Technician Handbook (General) 9A – FAA
3.CAIP

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Helicopter Theory by Wayne Johnson	**1994**
2	.Helicopter Calculation & Design Vol. I, II, & III by M.L. MIL, A.V. Nekrasov, A.S. Braverman	**1966**

7AN6.3 :MAINTENANCE OF AIRFRAME AND SYSTEMS DESIGN

B.Tech. (Aeronautical) 7th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	Various types of structures in airframe construction, tubular, braced monocoque, semimoncoque, etc.	**5**
	longerons, stringers, formers, bulkhead, spars and ribs, honeycomb construction.	**3**
II	Airplane controls, ailerons, elevators, rudder, trimming and control tabs, leading and trailing edge flaps, tailplane and fins.	**4**
	Basics of structure and structural components fabricated from metal, glass fiber, vinyl, Perspex, composites. Finishing materials, paints, surface finishes and associated materials.	**4**

III	**AIRCRAFT SYSTEMS** Flying controls including power operated controls, hydraulic, pneumatic, landing gear various types, shock struts, nose wheel steering, ice and rain protection, fire detection warning and extinguishing,.	**4**
	oxygen, air-conditioning and pressurization systems, wheels, tyres brakes, antiskid system. Windows, doors and emergency exists. Reliability and redundancy of systems design	**4**
IV	**BASIC INSPECTIONS** Basic principles of inspection, gauges, and tools. Standard inspection techniques and procedures.	**3**
	Go/No go gauges, gauge calibration and maintenance, limits and tolerance. NDT techniques.	**5**
V	**MAJOR INSPECTIONS** Major and minor damage, damage tolerance. Corrosion and corrosion prevention. Major and minor defects. Defect reporting rectification and investigation. Rigging of aircraft, symmetry checks. Balancing of control surfaces,	**4**
	Periodical inspections, heavy landing, overweight landing checks, abnormal flight loads. Aircraft weighing, weight schedule, calculation of centre of gravity. Electrostatic Sensitive Devices, Electromagnetic Environment	**4**
	TOTAL	**40**

TEXT BOOKS & REFERENCE BOOKS

1. Aircraft Manual, government of India.
2. Civil Airworthiness requirements CAA, UK.
3. FAR's FAA, USA.
4. Parkinson, Engineering Inspection, Wheeler.
5. Michal J. Kroes and James R Fardn, Aircraft Basic Science, McGraw Hill.
6. Civil Aircraft Inspection Procedures (CAP 459) Pt. II Aircraft, Himalayan Books.

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REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Airframe and Power Plant Mechanic (AC 65-15A) Airframe Hand Book, Himalayan Books	1991
2	Michal J. Kores and William A Watkins, Aircraft Maintenance and Repair, McGraw Hill.	2007

7AN7: Avionics Lab - I

B.Tech. (Aeronautical) 7th semester **Max. Marks: 100**

3P **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
	1. Testing of matching of impedance olf HF, UHF and microwave antenna. 2. Observing the selcal operation by enunciator panel light and chime, checking recorded data of CVR by connecting playback head jack on control panel, while parking relay and break relay are closed. 3. Checking the functioning of ELT unit by pressing the test switch on and	

	observing for illumination of test light for continuity. 4. Testing of sensitivity of VOR and ILS TR unit by observing the RMI and HIS indications during ramp testing. 5. Testing of sensitivity and operation of ADF by observing RMI indication during ramp testing. 6. Testing of sensitivity and operation of ATC transponder in mode A, C and S during ramp testing.	

7AN8: FINITE ELEMENT LAB.

B.Tech. (Aeronautical) 7th semester **Max. Marks: 100**
3P **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
	Laboratory work for the solution of solid mechanics problems, heat transfer problems, and free vibration problems using FE packages such as NASTRAN/ANSYS/SIMULIA/ABAQUS. 1. Introduction of GUI of the software in the following areas realistic problems. 2. Analysis of beams and frames (bending and torsion problems) 3. Plane stress and plane strain analysis problems 4. Problems leading to analysis of axisymmetric solids 5. Problems leading to analysis of three dimensional solids 6. Heat transfer problems 7. Modal analysis problem	

8AN1 :AVIONICS – II

B.Tech. (Aeronautical) 8th semester **Max. Marks: 100**

4L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**AIRCRAFT ELECTRICAL POWER** A.C. Power generation, D.C. Power generation, emergency power generation, voltage regulation, power distribution, inverters, transformers, rectifiers, circuit protection, external/ground power,	5
	Batteries installation and operation, Electronic emergency equipment requirements, cabin entertainment equipment, internal and external lightings of aircraft.	3
II	**AIRCRAFT INSTRUMENTS** Generalized configurations and performance characteristics of instruments, motion requirement, relative displacement and velocity. Translational and seismic displacement, velocity and acceleration measurements. Torque measurement and rotating shaft, pressure and flow measurements.	4
	Fuel gauging systems, temperature based on expansion, electric resistance and radiation methods, Problems involved in temperature measurements, compensation techniques, magnetic compasses. Electrostatic Sensitive Devices, Electromagnetic Environment	4
III	Requirements for airborne equipment, sensors for the measurement of position, altitude, air speed, acceleration, temperature, fuel flow and quantity. Instrument displays, panels and cockpit layout, flight instruments, gyroscopic instruments, power plant instruments, navigation instruments miscellaneous instruments RLG's. **AIRBORNE EQUIPMENTS** Classification, Atmosphere, Pressure measuring devices and systems, Pitot static system, Altimeters, Vertical speed indicators, Air speed indicator, Mach meter, Altitude reporting/alerting system,	3
	Air data computer, Instrument Pneumatic System, Direct reading pressure & temperature gauges, Temperature indicating system, Fuel quantity indicating system, Gyroscopic principles, Artificial horizon, Turn & slip indicator, Directional gyro, Ground proximity warning systems, Compass systems, Flight data recording systems, Instrument warning systems including master warning systems and centralized warning panels.	3
	Stall warning systems and angle of attack indicating system, Vibration measurement and Indication (HUMS), Compass system, Flight data recording system, Working principle of flight director system (FDS), Inertial navigation system, System operation: Electrical, fly by wire, Turn co-ordinator. Moving map displays, multifunction displays, head-up displays, glass cockpit. Cockpit lighting, panels: integral, glopanels.	4
IV	**Typical Electronic//Digital Aircraft Systems** ECAM (Electronic Centralized Aircraft Monitoring) EFIS (Electronic Flight Instrument Systems)	3
	EICAS (Engine Indicating & Crew Alerting Systems) FMS (Flight Management Systems)	4

V	**AUTOFLIGHT (ATA 22)** Fundamental of automatic flight control including working principles and current terminology Command signal processing, Modes of operation; Roll, pitch and yaw channels, yaw dampers, Stability augmentation system in helicopter, Automatic trim control, Autopilot navigation aids interface, Auto throttle system.	**4**
	AUTOMATIC LANDING SYSTEM Principles and categories, modes of operation, approach, glideslope, land; go-around, system monitors and failure conditions. **AVIONICS SYSTEMS** Fundamentals of System Layout	**3**
	TOTAL	**40**

TEXT BOOK

1. EHJ Pallet: Aircraft Instrument – Principles and Applications, Himalayan Books
2. EHJ Pallet, Automatic Flight Control, Blackwell
3. Leach Malvino, Digital Principles and Applications, Tata McGraw Hill

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	AK Sawhney: Electrical Measurements and Measuring Instruments..	
2	C.A. Williams: Aircraft Instruments, Galgotia	
3	Civil, Aircraft Inspection Procedures (CAP459) Two Volumes, Himalayan Books	

8AN2 :CAD

B.Tech. (Aeronautical) 8th semester **Max. Marks: 100**
4L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**CAD TOOLS** Definition of CAD Tools, Types of system, CAD/CAM system evaluation Criteria, Graphics standards, functional areas of CAD, efficient use of CAD software. Transformations - 2D and 3D.	**4**
	CAD/CAM Data Exchange: Evaluation of data- exchange formats, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF.	**4**
II	**CURVES** Curve design concepts, continuity conditions, analytic and synthetic curves, parametric representation of synthetic curves - Hermite cubic splines,	**4**
	Bezier curves, B-Splines, rational curves – NURBS, differential geometry related to curves.	**4**
III	**SURFACE MODELING** Mathematical representation of surfaces, Surface model, Surface entities, surface	**4**

	representation, Parametric representation of surfaces, plane surface, ruled surface, surface of revolution,	
	Tabulated surface, Hermite bi-cubic surface, Bezier surface, coons patch, NURBSS, Differential geometry related to surfaces, Displaying, Segmentation, Trimming, Intersection,	**4**
IV	**SOLID MODELLING** Solid Representation - Boundary Representation (B-rep), Constructive Solid Geometry (CSG) and other methods,	**5**
	Mass property calculations, CAD database structure.	**3**
V	**ADVANCED MODELING CONCEPTS** Feature Based Modeling, Assembly Modeling, Parametric and variational modeling, Feature recognition,	**4**
	Design by features, Assembly and Tolerance Modeling, Tolerance representation - specification, analysis and synthesis.	**4**
	TOTAL	**40**

TEXT/REFERENCE BOOKS:

1. Ibrahim Zeid, CAD/CAM Theory and Practice, McGraw Hill international.

2. P. N. Rao, CAD/CAM Tata McGraw Hill.

3. Hill Jr, F.S., Computer Graphics using Open GL, Pearson Education, 2003.

4. Singeresu S. Rao, Engineering Optimization-Theory and Practice, New Age International Limited Publishers, 2000.

5. Johnson Ray, C. Optimum Design of Mechanical Elements, Wiley, John & Sons, 1981.

6. P. Radhakrishnan, S. Subramanyam, CAD/CAM/CIM, New Age International.

SN	Name of Authors /Books /Publisher	Year of Publication
1	Martenson, E. Micheal, Geometric Modelling, John Wiley & Sons,	1995
2	V. Ramamurti, Computer Aided Mechanical Design and Analysis, Tata Mc Graw Hill-.	1992
3	Foley, Van Dam, Feiner and Hughes, Computer Graphics Principles and Practice, second edition, Addison–Wesley,.	2000

8AN3 :AIRLINES AND AIRPORT MANAGEMENT

B.Tech. (Aeronautical) 8th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**Introduction** History Of Aviation – Organisation, Global, Social & Ethical Environment – History Of Aviation In India – Major Players In The Airline Industry - Swot Analysis Of The Different Airline Companies In India –	5
	Market Potential Of Airline Industry In India – New Airport Development Plans – Current Challenges In The Airline Industry -Competition In The Airline Industry – Domestic And International From An Indian Perspective	3
II	**Airport Infrastructure and Management** Airport Planning – Terminal Planning Design And Operation – Airport Operations – Airport Functions – Organisation Structure In An Airline - Airport Authority Of India -	4
	Comparison Of Global And Indian Airport Management – Role Of Aai -Airline Privatisation - Full Privatisation - Gradual Privatisation –Partial Privatisation	4
III	**Transport Services** Various Airport Services - International Air Transport Services – Indian Scenario – An Overview Of Airports In Delhi, Mumbai, Hyderabad And Bangalore –	4
	The Role Of Private Operators – Airport Development Fees, Rates, Tariffs	4
IV	**Institutional Framework** Role Of DGCA - Slot Allocation – Methodology Followed By ATC And DGCA -	4
	Management Of Bilaterals – Economic Regulations	4
V	**Controlling 8** Role Of Air Traffic Control - Airspace And Navigational Aids – Control Process – Case Studies In Airline Industry	4
	Mumbai Delhi Airport Privatisation – Navi Mumbai Airport Tendering Process – 6Cases In The Airline Industry	4
	TOTAL	40

TEXT BOOK

1.Graham.A. Managing Airports: An International Perspective - Butterworth - Heinemann, Oxford 2001.

2. Wells.A. Airport Planning And Management, 4th Edition Mcgraw- Hill, London 2000.

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	1. Doganis. R. The Airport Business Routledge, London	1992
2	Alexender T. Wells, Seth Young, Principles Of Airport Management, Mcgraw Hill	2003
3	P S Senguttavan Fundementals Of Air Transport Management , Excel Books	2007
4	Richard De Neufille, Airport Systems: Planning, Design And Management, Mcgraw-Hill London	2007
5	Manual Of Aerodrome Licensing Of Aai Airports – Aai Website – Freely Downloadable – Issue May.	2010

8AN4.1 :REFRIGERATION & CRYOGENICS

B.Tech. (Aeronautical) 8th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**REFRIGERATION FUNDAMENTALS** Introduction – analysis of VCR cycles – multistage,	3
	multi-evaporator, cascade systems	4
II	**REFRIGERATION CYCLES** Properties and selection of pure and mixed refrigerants – properties of binary mixtures – analysis of vapor absorption cycles –	4
	aqua ammonia and LiBr water cycles – air cycle refrigeration, vortex tube, thermoelectric refrigeration.	4
III	**CRYOGENIC FUNDAMENTALS** Historical background and applications – gas liquefaction systems	4
	gas separation and gas purification systems.	4
IV	**CRYOGENIC SYSTEMS** Cryogenic refrigeration systems – storage and handling of cryogens –.	4
	cryogenic insulations – liquefied natural – gas properties of materials of low temperatures	5
V	**SPECIAL TECHNOLOGIES FOR CRYOGENICS** Material of construction and techniques of fabrication	4
	instrumentation – ultra-low temperature techniques – application.	4
	TOTAL	40

TEXT BOOK

1. Stoecker, W.F. and Jones, J.W., Refrigeration & Air Conditioning, Tata McGraw-Hill (1986).
2. Barron, R.F.,Cryogenic Systems, 2nd ed., Oxford Univ. Press (1985)

REFERENCE BOOKS

SN	Name of Authors /Books /Publisher	Year of Publication
1	Gosney W.B. Principles of Refrigeration, Cambridge Univ. Press	1982
2	Weisend, J. G., The Handbook of Cryogenic Engineering, Taylor & Francis	1998

8AN4.2 : THEORY OF PLATES AND SHELLS

B.Tech. (Aeronautical) 8th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**CLASSICAL PLATE THEORY** Classical Plate Theory: – Assumptions,	5
	Differential Equation, Boundary Conditions	3
II	**PLATES OF VARIOUS SHAPES** Navier's Method of Solution for Simply Supported Rectangular Plates – Leavy's Method of Solution for Rectangular Plates under Different Boundary Conditions. Governing Equation –	5
	Solution for Axi-symmetric loading – Annular Plates – Plates of other shapes.	3
III	**EIGEN VALUE ANALYSIS** Stability and free Vibration Analysis of Rectangular Plates.	8
IV	**APPROXIMATE METHODS** Rayleigh – Ritz, Galerkin Methods– Finite Difference Method – Application to Rectangular Plates for Static, Free Vibration and Stability Analysis.	8
V	**SHELLS** Basic Concepts of Shell Type of Structures – Membrane and Bending Theories for Circular Cylindrical Shells.	8
	TOTAL	40

TEXT BOOKS

1. T. K. Varadan and K. Bhaskar, "Theory of Plates and Shells", Narosa Publishing.
2. Timoshenko, S.P. Winowsky. S., and Kreger, "Theory of Plates and Shells", McGraw- Hill Book Co.

REFERENCE BOOKs

SN	Name of Authors /Books /Publisher	Year of Publication
1	Timoshenko, S.P. and Gere, J.M., "Theory of Elastic Stability", McGraw-Hill Book Co.	1986
2	Flugge, W. "Stresses in Shells", Springer – Verlag,.	1985

8AN4.3: MAINTENANCE OF POWER PLANT & SYSTEMS

B.Tech. (Aeronautical) 8th semester **Max. Marks: 100**
3L **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**ENGINE FUEL SYSTEMS:** Piston Engine: Piston Engine Carburetor Types, construction and principle of operation; Icing and heating. Fuel injection systems: Types, construction and principle of operation.	4
	Jet Engine: Operation of engine control and fuel metering systems including electronic engine control (FADEC); Systems layout and components.	4

II	**ENGINE SYSTEMS:** Piston Engine: Starting & Ignition System : Starting systems, preheat systems; Magneto types, construction and principles of operation; Ignition harnesses, spark plugs; Low and high tension systems. **Induction, Exhaust and Cooling Systems**: Construction and operation of: induction systems including alternate air systems; Exhaust systems, engine cooling systems—air and liquid.	4
	Supercharging/Turbocharging: Principles and purpose of supercharging and its effects on engine parameters; Construction and operation of supercharging/turbocharging systems; System terminology; Control systems; System protection. Lubricants **and Fuels**: Properties and specifications; Fuel additives; Safety precautions. **Lubrication Systems:** System operation/layout and components.	4
III	**ENGINE SYSTEMS:** Jet Engine: Starting & Ignition System Operation of engine start systems and components; Ignition systems and components. **Air Systems:** Operation of engine air distribution and anti-ice control systems, including internal cooling, sealing and external air services.	4
	Power Augmentation Systems: Operation and applications; Water injection, water methanol; Afterburner systems. **Fire Protection Systems**: Operation of detection and extinguishing systems. **Lubricants and Fuels** Properties and specifications; Fuel additives. **Lubrication Systems** System operation/layout and components.	4
IV	Powerplant Installation: Configuration of firewalls, cowlings, acoustic panels, engine mounts, anti-vibration mounts, hoses, pipes, feeders, connectors, wiring looms, control cables and rods, lifting points and drains. **Engine Monitoring and**	4
	Ground Operation : Procedures for starting and ground run-up; Interpretation of engine power output and parameters Inspection of engine and components: criteria, tolerances, and data specified by engine manufacturer. **Engine Storage and Preservation:** Preservation and depreservation for the engine and accessories/ systems.	4
V	**PROPELLERS** **Propeller Construction** : Construction methods and materials used in wooden, composite and metal propellers; Blade station, blade face, blade shank, blade back and hub assembly; Fixed pitch, controllable pitch, constant speeding propeller; Propeller/spinner installation. **Propeller Pitch Control** : Speed control and pitch change methods, mechanical and electrical/electronic; Feathering and reverse pitch; Overspeed protection.	4
	Propeller Synchronizing : Synchronizing and synchrophasing equipment. **Propeller Ice Protection** : Fluid and electrical deicing equipment. Propeller **Maintenance** : Static and dynamic balancing; Blade tracking; Assessment of blade damage, erosion, corrosion, impact damage, delamination; Propeller treatment/repair schemes; Propeller engine running. **Propeller Storage and Preservation** : Propeller preservation and depreservation.	4
	TOTAL	**40**

TEXT BOOKS & REFERENCES

1. Jet Engine – Rolls Royce
2. CAIP – CAA
3. Aircraft Powerplant – Michel J. Kroes and Thomas W. Wild
4. Powerplant Text Books – Jeppesen
5. Aero Engine – LNVM Society

8AN5 :AVIONICS – II LAB

B.Tech. (Aeronautical) 8th semester **Max. Marks: 125**
3P **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
	INSTRUMENTS 1. To study the constructional details of direct reading compass, carry out compass swinging and prepare deviation correction card. 2. To study the construction details of pitot static instruments, carry out leak test and calibration check on pitot-static instruments. 3. To study the constructional details of gyroscopic instruments and carry out calibration check of gyroscopic instruments on gyro turn table. 4. The demonstration of operation and testing of desynn transmission system like, Fuel content gauge, Flap position indicator, Rudder trim indicator etc. 5. Demonstration and Calibration of temperature sensing devices and relevant indicators. **ELECTRICAL** 1.Study and perform tests on aircraft power system (Batteries, Aircraft A.C generator, Aircraft D.C generator, voltage regulator,aircraft static and rotary invertors and TRU etc). & verify their characteristics. 2.Study and test a/c power distribution system. 3.To study and test a/c internal and external lighting system.	

8AN6 : CAD Lab(Similar to 8ME5)

B.Tech. (Aeronautical) 8th semester **Max. Marks: 125**
3P **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
	EXPERIMENTS TO BE PERFORMED (MINIMUM FIVE EXPERIMENTS) 1. Introduction and different features of the CAD Software. 2. 2-D Drafting. 3. 3-D Modeling. 4. 3-D Advanced Modeling. 5. Assembly modeling. 6. Feature Modification and Manipulation. 7. Detailing. 8. Surface Modeling. (These exercises may be performed by any of the following Advanced CAD Software such as CATIA/Unigraphics/AutoCAD Inventor/PATRAN/ProE)	