III Semester (II Year) B.Tech. (Aeronautical Engineering)

3AN1: MECHANICS OF SOLIDS

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

3L+1T MM:100

UNIT 1

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, 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.

UNIT 2

Principal Stress and Strain: Combined loading, Plane stress and Plane strain, Stress and strain Transformation, Principal stress and maximum shear stress, and their planes, 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.

UNIT 3

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, Moving loads, Relation between load, shear force and bending moment.

UNIT 4

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. Strain energy in bending, Combined axial and lateral loads. Thin-walled Pressure Vessels: Stresses in cylindrical and spherical vessels.

UNIT 5

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.

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.

Suggested Readings:

1.Mechanics of Materials, James M. Gere, Cengage Learning (Brooks\Cole).
2.Mechanics of Material, Pytel and Kiusalaas, Thomson (Brooks\Cole).
3.An Introduction to the Mechanics of Solids, Crandall, Dahl and Lardner, Tata McGraw Hill.
4.Mechanics of Materials, Beer, Johnston, Dewolf and Mazurek, Tata McGraw Hill.
5.Strength of Materials, Ryder G.H., Macmillan India.
6.Strength of Materials, Sadhu Singh, Khanna Publishers.
7.Mechanics of Material, Punmia, Jain and Jain, Laxmi Publications.

3AN2 : MATERIAL SCIENCE AND ENGINEERING

3L MM : 100

UNIT 1

Atomic structure of Metals: Crystal structure, crystal lattice of (i) Body centred cubic (ii) Face centred cubic (iii) Closed packed hexagonal, crystallographic Notation of atomic planes and Directions (Miller Indices),polymorphism and allotropy, Crystal imperfection.

UNIT 2

3 Theories of plastic deformation. Phenomenon of slip, twinning and dislocation.Identification of crystallographic possible slip planes and direction in FCC, BCC, HCP. Recovery and recrystallization, preferred orientation causes and effects on the property of metals.

UNIT3

Classification of engineering materials. Solidification of metals and of some typical alloys: Mechanism of crystallisation (I) nuclear formation (ii) crystal growth. 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, 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.

UNIT 4

Engineering properties and their measurements.Principles and applications of annealing, normalising, hardening, tempering.Recovery and recrystallization. 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. Basic principles involved in heat treatment of plain carbon steel, alloy steels, cast iron 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.

UNIT 5

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. Classification of steels, BIS Standards.Fibre reinforced plastic composites: Various fibres and matrix materials, basic composite manufacturing methods, applications of composite materials.

3AN3 :ENGINEERING THERMODYNAMICS

3L+1T MM:100

UNIT 1

Basic Concepts of Thermodynamics : Thermodynamics system, control volume, Properties, state, processes and cycle, equality of temperature, Zeroth Law of thermodynamics, temperature scale, laws of perfect gas, Pure substances, vapour-Liquid -solid-phase equibrium in a pure substances, thermodynamic surfaces

UNIT 2

Work and heat, Law of conservation of mass and energy, First law of thermodynamics, steady state Processes, 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.

UNIT 3

Available and unavailable energy, availability of a non flow and steady flow system, Helmbeltz and Gibb's functions, Thermodynamic Relations: Important mathematical relations, Maxwell relations, Tds Relations, Joule-Thomson coefficient, Clayperon relation.

UNIT 4

Air - standard power cycle, Brayton cycle, Otto cycle, diesel cycle, Dual cycle, Stirling cycle, Ericssion cycle and Atkinson cycle, Mean effective pressure and efficiencies, Four stroke petrol and diesel engine, Two stroke Petrol and diesel engine.

UNIT 5

Properties of steam, phase change process, use of steam table & molier chart. Rankine cycle, Reheat cycle, Regenerative cycle, cogeneration vapour compression refrigeration cycle.

3AN4: MANUFACUTRING PROCESSES

3L MM:100

UNIT 1

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, 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.

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, casting alloys, casting defects, design of casting, gating system design, and riser design. Melting furnaces-rotary, pit electric, tilting and cupola.

UNIT 2

Metal Joining Processes: Principle of welding, soldering, brazing and adhesive bonding. Survey of welding and allied processes. Arc welding: power sources and consumables. Gas welding and cutting: Processes and equipments. Resistance welding: principle 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

UNIT 3

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. 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.

UNIT 4

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. Rapid Prototyping Operations: Introduction, subtractive processes, additive processes, Virtual Prototyping and applications.

UNIT 5

Plastic Technology: Introduction, Classification of Plastics, Ingredients of Moulding compounds, 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.

3AN5: OBJECT ORIENTED PROGRAMMING IN C++

(Common with Mechanical 3ME5A, Automobile 3AE5A)

3L MM:100

UNIT 1

Introduction to Object Oriented Programming: Basic concepts: Class, Object, Method, Message passing, Inheritance, Encapsulation, Abstraction, Polymorphism.

UNIT 2

Basics of C++ Environment: Variables; Operators; Functions; user defined, 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.

UNIT3

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, 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.

UNIT 4

Templates and Iterators: function and class templates, container classes, subclass templates, iterator classes; Libraries: standard C++ library, contents of a standard C headers, string streams, file processing: Files and streams classes, text files, binary files, classification of files, the standard template library.

UNIT 5

Data Structures Using C++: Linked lists - Singly linked list, Doubly linked lists, Circular lists, Stacks and Queues priority Queues, Stacks, Queues.

3AN6: ADVANCED ENGINEERING MATHEMATICS

3L MM:100

UNIT 1

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. 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.

UNIT 2

Laplace Transform : Laplace Transform with its simple properties . Inverse Laplace transform convolution Theorem (withoutproof) solution of ordinary differential equation with constant coefficient .

UNIT 3

Special functions : Bessel's function of first kind, simple recurrence relations, orthogonal property. Legendre's function of first kind simple recurrence relations, orthogonal property, Rodrigue's formula.

UNIT 4

Numerical Analysis : Finite differences , Difference operators, forward, Backward, central & average operators. Newton's forward and backward interpolation formula, 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 .

UNIT 5

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. Numerical solution of ordinary differential equation of first order: Picards method, Euler's, and modified Euler's method, Milne's methods and RungaKutta fourth order method..

3AN7: STRENGTH OF MATERIALS LAB

2P MM:75

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

2P MM:75

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

3P MM:100

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

3P MM:100

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 ctype.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.

IV Semester (II Year) B.Tech. (Aeranautical Engineering)

4AN 1 : INTRODUCTION TO AERONAUTICS

3L MM:100

UNIT1

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. Current Status:Different types of heavier than air vehicles, along with prominent features. Airplane, Helicopter,

Hovercraft,V/STOLmachines, modern developments

UNIT2

Airplane Aerodynamics: Nomenclature used in Aerodynamics, different parts of airplane. Wing as lifting surface, Types of wingplan forms, Aerodynamic features like Aerofoil pressure distribution, 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.

UNIT3

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, centre of gravity, its importance in stability and control. Control surfaces elevator sailer on sand rudder.

UNIT4

Airplane Propulsion: Requirement of power: various means of producing power. Brief description of thermodynamics of engines. Piston engines, Jet engines. Engine airframe combinations of various types, their performance. Detailed functioning of components of a Piston-Propengine. Use of propellers as means of producing forward thrust. 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.

UNIT5

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. 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.

Suggested Readings:

1. R S Shevell,Fundamentals of Flight, PrenticeHall
2. John Anderson Jr.,Introduction to Flight, McGrawHill.
3. Introduction to Aeronautics, By School of Aeronautics.
4. E W SomersetMaugham, Jet Engine Manual, BIPPublications
5. Fundamentals of Flight; By Dr.O.P.Sharma and Lalit Gupta.

4AN2: INSTRUMENTATION AND CONTROL ENGINEERING

3L+1T **MM : 100**

UNIT 1

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, Component Measuring Instruments, Q meter, Vector Impedance meter, Measurement of RF Power ,frequency & Voltage. Introduction to shielding, grounding and interference.

UNIT 2

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.
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, 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.

UNIT 3

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. 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.

UNIT 4

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. Effects of pole and zero addition on transient and steady state response. Absolute stability and relative stability. Routh's and Hurwitz criterion of stability. Root locus method of analysis. Polar plots,

UNIT 5

FREQUENCY DOMAIN ANALYSIS. Root locus method of analysis. Polar plots, Bode plot, Design specification in frequency domain and gain and phase margin. Nyquist stability criterion. M and N loci, Nicholas charts. Concepts of state, state variable and state model, controllability and observability.

4AN3 : FLUID MECHANICS
(Common with Mechanical Engg 4ME2A and Automobile Engg 4AE2A)

3L MM:100

UNIT 1

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. 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.

UNIT 2

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. 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.

UNIT 3

Dimensional Analysis: Buckingham variables, Model Similitude, Force ratio, Reynolds, Froude's, Mach, Weber and Euler numbers and their applications. 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).

UNIT 4

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.

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.

UNIT 5

The Boundary Layer: Description of the boundary layer. Boundary Layer thickness, Von-Karman momentum integral equation, Coefficient of drag, boundary layer separation and control.

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.

Suggested Readings

1. Yunus A. Cengel and Cimbala, Fluid Mechanics, Tata McGrawHill
2. Streeter V.L., K.W. Bedford and E.B.Wylie , Fluid Mechanics , Tata McGraw Hill
3. Robert W. Fox and Alan T. McDonald, Introduction to Fluid Mechanics, John Wiley &Sons.
4. Potter, Mechanics of Fluids, Cengage Learning.
5. Frank M. White, Fluid Mechanics, Tata McGraw Hill.
6. John F. Douglas, Fluid Mechanics, Pearson Education.
7. Modi and Seth, Fluid Mechanics and Hydraulic Machinery, Standard Book House.
8. Som, S. K., & Biswas, G. Introduction to fluid mechanics and fluid machines: Tata McGraw-Hill.
9. Munson, B. R., Young, D. F., & Okiishi, T. H. Fundamentals of Fluid Mechanics, Wiley

4AN4: THEORY OF MACHINES

3L + 1T MM : 100

UNIT 1

Kinematics: Elements, pairs, mechanisms, four bar chain and its inversions, velocity and acceleration, Klein's construction, coriolis component, instantaneous center method, synthesis of mechanisms, pantograph, scott-Russel, Tchbeicheff straight line, indicator diagram mechanisms.

UNIT 2

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. Dynamometers: Absorption and transmission type dynamometers, prony, rope and hydraulic dynamometers.

UNIT 3

Gears: Laws of gearing, gears terminology; tooth form; interference, undercutting and minimum number of teeth on pinion in contact with gear. Spur, helical, bevel gear, rack and pinion.

UNIT 4

Gear trains: Simple, compound, reverted and epicyclic gear trains, analytical and tabular methods for velocity ratio. Gear boxes- sliding and constant mesh.

Gyroscope: Principle of gyroscopic couple, effect of gyroscopic couple and centrifugal force on airplanes taking a turn.

UNIT 5

Balancing: Balancing of rotating masses, balancing of reciprocating masses, balancing of inline engines and V-engines.

4AN5: AIRCRAFT MATERIALS

3L MM:100

UNIT 1

Broad classification of aircraft materials.Ferrous materials,nonferrous materials and alloys, ceramic materials and fibre reinforced composite materials, polymers,metal matrix particulate.

UNIT 2

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, Special treatments. Titanium
and its alloys: Applications, machining, forming, welding and heat treatment.

UNIT 3

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 **Copper Alloys**–Monel, KMonel **Super Alloys**: Use–Nickel base–Cobalt base–Iron base–Forging and Casting of Super alloys–Welding, Heat treatment.

UNIT 4

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. Typical bonded joints & non destructive tests for bonded joint. Bonded Sandwich structures-Materials–Methods of

construction of honeycombs

UNIT 5

Corrosion, its detection and prevention. Protective finishes. Testing: Destructive and non-destructive testing techniques. 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.

Suggested Readings:

1. S K Hajra Chowdhary, Materials,Science and Engineering Processes, Media Promoters
2. George E.F. Titterton,Aircraft Materials, English Book Stores, Delhi
3. M L Begman,Manufacturing Processes, Asia Publishing House, Bombay.
4 Aircraft General Engineering by Lalith Gupta,Himalaya Book House, NewDelhi.
5. King and Butler,Principles of Engineering Inspection,Clever Humes Press.
6. C G K Nair, AircraftMaterials, Interline
7. Balram Gupta, Aerospace Materials, S Chand

4AN6: MACHINE DESIGN

3L+1T MM : 100

UNIT 1

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. 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.

UNIT 2

Design of members in Bending: Beams and levers. Design of members in torsion: Shafts and shaft couplings.

UNIT 3

Design of shafts under combined stresses, Calculation of transverse & torsional deflections. Brackets and screw fasteners subjected to eccentric loading.

UNIT 4

Fatigue Considerations in Design: Variable load, loading pattern, Endurance stresses, influence of size, surface finish, notch sensitivity & stress concentration. Goodman line, Soderberg criteria, Design of machine members subjected to combined, steady and alternating

stresses. Design for finite life. Design of Shafts under Variable Stresses.

UNIT 5

Design of journal bearing; method of lubrication, hydrodynamic, hydrostatic, boundary etc. Minimum film thickness and thermal equilibrium. Selection of anti-friction bearings for different loads and load cycles. Mounting of the bearings. Method of lubrication, selection of oil seals.

4AN7: MACHINE DESIGN SESSIONAL

3P MM:100

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

2P MM : 75

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.

2P MM:75

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.

3P MM:100

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

3L+1T MM: 100

UNIT 1

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: 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.
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.

UNIT 2

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, 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.

UNIT 3

System with Two Degree of Freedom: Principle mode of vibration, Mode shapes, Undamped forced vibrations of two degrees of freedom system with harmonic excitation, Vibration Absorber, Undamped dynamic vibration absorber and centrifugal pendulum absorber.

UNIT 4

Many Degree of Freedom Systems: Exact analysis (Undamped free vibration), approximate methods, Rayleigh's, Dunkerley's, Stodola's and Holzer's methods

UNIT 5

Vibrations of continuous systems: Transverse vibration of a string, Longitudinal vibration of a bar, Torsional vibration of a shaft and flexural vibrations of a beam.

Suggested Readings:

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.
5. Elements of Vibration Analysis, Leonard Meirovitch, Tata McGraw-Hill, New Delhi.
6. Principles of Vibration, Benson H.Tongue, Oxford Publcation.

5AN2: HEAT TRANSFER

3L+1T MM: 100

UNIT 1

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.
Conduction : General 3-Dimensoinal conduction equation in Cartesian, cylindrical 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.

UNIT 2

Heat Transfer from Finned Surfaces: fin efficiency and effectiveness, two dimensional steady state heat conduction using analytical and numerical methods, periodic heat conduction.
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.

UNIT 3

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.
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.

UNIT 4

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, effectiveness of heat exchanger, N.T.U. method, fouling factor, constructional and manufacturing aspects of Heat Exchangers.

UNIT 5

Thermal Radiation: Plank distribution law, Kirchhoff's law, radiation properties, diffuse radiations, Lambert's law, radiation intensity, heat exchange between two black bodies, heat exchanger between gray bodies, shape factor, electrical analogy, reradiating surfaces heat transfer in presence of reradiating surfaces.

Suggested Readings:

1. Heat Transfer, Holman J.P., Tata McGraw-Hill, New Delhi.
2. Heat and Mass Transfer, Cengel, Tata McGraw-Hill, New Delhi.
3. Heat and Mass Transfer, Kumar D.S., Kataria and Sons.
4. Heat Transfer, Sharma and Lal, Vardhan Publisher Jaipur.
5. Heat and Mass Transfer, Nag P.K., Tata McGraw-Hill, New Delhi.
6. Fundamental of Heat and Mass Transfer, Thirumaleshwar M., Pearson Education.
7. Heat Transfer, Rajput R.K., S. Chand Publication.

5AN3: AIRCRAFT SYSTEMS

3L MM: 100

UNIT 1

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, Introduction to Communication and Navigation systems Instrument, landing systems, VOR - CCV case studies.

UNIT 2

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, Landing Gear systems - Classification – Shock absorbers - Retractive mechanism. Anti skid system, wheels and brake, steering systems, indications.

UNIT 3

FUEL SYSTEMS
Types of fuels, their properties and testing, color codes, fuel requirements, pumps, fuel transfer systems, fuel tanks, plumbing, valves, indications and warnings

UNIT 4

AUXILIARY SYSTEM
Various types systems, components and operation of air-conditioning System, Pressurization System, Oxygen Systems, Fire Protection Systems, Deicing and Anti Icing systems, Seat Safety System: Ejection seats, survival packs, parachutes, pilots's personal equipment, life rafts, doors, windows, emergency exits and seat belts.

UNIT 5

GENERAL MAINTENANCE PRACTICES
Jacking, levelling and mooring, refuelling and defuelling of aircraft, safety precautions. Hydraulic and fluid systems precautions against contamination. Identification color coding, symbols and other markings to identify the fluid systems.

Suggested Readings:

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. A & P Technician Airframe Text Book – Jeppeson
6. Aircraft Oxygen System – Scheppler Robert : Himalayan Books.
7. A & P Technician General Test Book - Jeppeson

5AN4: AIRCRAFT STRUCTURE-I

3L+1T MM: 100

UNIT 1

Analysis of structure for slope and deflection by double integration method, Maclauy's method, Area moment theorm.

UNIT 2
Statically Determinate Structures:
Analysis of plane truss – Method of joints, Method of sections, Graphical methods, 3 D Truss Tension coefficient methods.

UNIT 3
Statically Indeterminate Structures:
Fixed beam, continous beam analysis - Clapeyron's Three Moment Equation - Moment Distribution Method, Plane frame analysis using moment distribution method.

UNIT 4

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, Unit load method - application to beams, trusses, frames, rings, etc.

UNIT 5

Influence line diagram, Muller breslau principle.

Suggested Readings:

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

5AN5: PROPULSION

3L MM: 100

UNIT 1

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.

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.

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.

UNIT 2

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.

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.

UNIT 3

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.

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.

Jet Engine

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.

UNIT 4

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.

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; 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.

UNIT 5

Fundamentals of Rocket Propulsion
Operating principle - Specific impulse of a rocket - Rocket nozzle classification - Rocket performance considerations - Numerical Problems.
Chemical Rockets
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
Electric rocket propulsion - Ion propulsion techniques - Nuclear rocket - Types - Solar sail- Preliminary Concepts in nozzle less propulsion.

Suggested Readings:

1. Rolls-Royce, " Jet engine ", 3rd edition , 1983.
2. Aircraft Power Plant – Kroes & Wild
3. CAIP – CAA
4. Aero Engines – LNVM Society
5. A & P Technician Powerplant Text Book – Jeppeson.
6. Gas Turbine Theory: Cohen, Rogers and Saravanamuttu, Pearson Education
7. Elements of Gas Turbine Propulsion: J.D. Mattingly,McGraw Hill
8. Rocket Propulsion Elements: George P. Sutton, Oscar Biblarz, John Wiley & Sons.
9. Mechanics and Thermodynamics of Propulsion: P.G.Hill & Peterson, Addison-Wesley,1970

5AN6.1: RELIABILITY AND MAINTENANCE ENGINEERING

3L MM: 100

UNIT 1

Introduction: Maintenance Objectives and Functions, Maintenance Organisation and Administration of Maintenance Systems, Need of planned maintenance, Maintenance policies, Breakdown, time based maintenance, Block replacement, age replacement and periodic replacement policy, Corrective and preventive maintenance, Maintenance planning, Scheduled maintenance, Cost of maintenance versus Cost of equipment and production delays.
Inspection: Inspection intervals, Inspection reports, card history system.

UNIT 2

Predictive Maintenance: Equipment wear records, standards, Equipment used in predictive maintenance. Computerized maintenance, Total Productive Maintenance, Methods of condition monitoring, Non-destructive testing, Liquid Penetrate, Magnetic particles, Ultrasonic testing, and Vibration analysis, Oil analysis, Radiographic testing.

UNIT 3

Reliability: Definition, failure data analysis, Mean failure rate, mean time to failure (MTTF), mean time between failures (MTBF), hazard rate, Bathtub curve, Use of Weibull probability chart for assessing characteristics life, guarantee period etc.

UNIT 4

System Reliability: Series, parallel and mixed configuration, Simple problems.
Reliability Improvement: Techniques, use of Pareto analysis-Design for reliability, redundancy unit and standby redundancy, Optimization of reliability.

UNIT 5

Spare Parts Management: Spare parts, features and categorization of spares, cost considerations, Techniques of cost reduction, Selective controls used in spare parts control, ABC analysis, FSN, XYZ, VED and other approaches, Inventory control of spares.

Suggested Readings:

1. Reliability Engineering, Srinath L.S., Affiliated East West Press.
2. Maintainability Principles and Practices, Blanchand, B.S., McGraw Hill.
3. Maintenance Management, Carder, A.S. McGraw Hill
4. Practical Reliability Engineering, Patrick D.T. O'Connor, Wiley India

5AN6.2: FATIGUE AND FRACTURE

3L MM: 100

UNIT 1

Elements of solid mechanics: The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation Airy's function- field equation for stress intensity factor.

UNIT 2

Stationary crack under loading: Two dimensional elastic field- Analytical solutions yielding near a crack front- Irwin's approximation- plastic zone size- Dugdaale model- determination of J integral and its relation to crack opening displacement.

UNIT 3

Energy balance and crack growth: Griffith analysis- stable and unstable crack growth- Dynamic energy balance- crack arrest mechanism- K1c test methods- R curves- determination of collapse load.

UNIT 4

Fatigue crack growth curve: Empirical relation describing crack growth law-life calculations for a given load amplitude, effects of changing the load spectrum. Introduction to factors affecting fatigue crack propagation. Introduction to crack propagation in composite materials.

UNIT 5

Detection of cracks: NDT methods. Experimental determination of GIC, KIC, J-Integral and CTOD.

Suggested Readings:

1. Fatigue and Fracture: Understanding the Basics edited by F. C. Campbell, ASM International
2. Basic fracture mechanics, including an introduction to fatigue,R N L Smith, Butterworth-Heinemann, 1991
3. Fracture Mechanics: An Introduction, E.E. Gdouto,Springer
4. Fatigue and fracture mechanics, Alfred Martin Freudenthal, Institute for the Study of Fatigue, Fracture and Structural Reliability, George Washington Univ

5AN6.3: TOTAL QUALITY MANAGEMENT

3L MM: 100

UNIT 1

Quality and Total Quality Management: Excellence in manufacturing service, factors of excellence, relevance of TQM. Concept and definition of quality; total quality control (TQC) and Total Quality Management (TQM), salient features of TQC and TQM. Total Quality Management Models, benefits of TQM.

UNIT 2

Just-in-time (JIT): Definition, Elements, benefits, equipment layout for JIT system, Kanban system MRP (Material Requirement planning) vs JIT system, Waste elimination, workers involvement through JIT, JIT cause and effect chain, JIT implementation. Customer Satisfaction, data collection and complaint, redressal mechanism. Planning Process Policy development and implementation; plan formulation and implementation.

UNIT 3

Process Management: Factors affecting process management, Quality function development (QFD), and quality assurance system. Total Employees Involvement (TEI), Empowering employees; team building; quality circles; reward and Recognition; education and training, Suggestion schemes. Problems solving, Defining problem; Problem identification and solving process; QC tools. Benchmarking definition, concept, process and types of benchmarking.

UNIT 4

Quality Systems: Concept of quality system standards; relevance and origin of ISO 9000; Benefits; Elements of ISO 9001, ISO 9002, ISO 9003.

UNIT 5

Advanced techniques of TQM: Design of experiments; failure mode effect analysis, Taguchi methods.

Suggested Readings:

1. Total Quality Control, Feigenbaum. Armand V., McGraw Hill, 1991
2. Total Quality Management: text with cases, John S Oakland, Butterworth-Heinemann, 2003
3. Total Quality Management for Engineers, Zaire, M., Wood Head Publishing Ltd., 1991
4. Total Quality Management: International Edition, 3 E, Dale H. Besterfield, Pearson Higher Education
5. The Management and Control of Quality,(5th Edition), James R.Evans and William M.Lidsay, South-Western (Thomson Learning), 2002

5 AN 7: THERMAL ENGINEERING LAB

3 P MM 100

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

2 P MM 75

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.

LIST OF EQUIPMENT

S.No.	Name of the Equipment	Qty.
1.	Universal Testing Machine	1

3.	Electrical stain gauge	10
4.	Stain indicator	1
5.	Dial Gauges	12
6.	Beam Test set up with various end conditions	2
7.	Weight Pans	6
8.	Column Test Apparatus	1
10.	Unsymmetrical sections like 'Z' sections	2
11.	Channel section and angle section	2
12.	Weights 1Kg	10
13.	Weights 2 Kg	10
14.	Strain indicator and strain gauges	One set
15.	Photo – elastic apparatus	1
16.	Wagner beam	1
17.	Hydraulic Jack	1

5 AN 9: AIRCRAFT SYSTEM LAB.

3 P MM 100

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

LIST OF EQUIPMENTS

S.No	Items	Quantity	Experiment No.
1.	Serviceable aircraft with all above systems	1	1,2,3,4,5,6,7,1,9,10
2.	Hydraulic Jacks (Screw Jack)	5	1,2,4,1
3.	Trestle adjustable	5	1,2,4,1
4.	Spirit Level	2	1
5.	Levelling Boards	2	1
6.	Cable Tensiometer	1	1
7.	Adjustable Spirit Level	1	1
8.	Plumb Bob	1	1
9.	Relevant aircraft components	1	7,10

5 AN 10: PROPULSION LAB

2 P MM 75

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.

EQUIPMENTS REQUIRED

Sl.No.	Equipments	Qty
1.	Piston engines	2
2	Jet Engine /Engine model	1
3.	Piston Engine Test Rig	1
4.	Cross section of piston engine	1

6AN1: DIGITAL TECHNIQUES

3L MM 100

UNIT 1

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. 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.

UNIT 2

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. Realization of logic gates in RTL, DTL, ECL, C-MOS & MOSFET. Interfacing logic families to one another.

UNIT 3

MINIMIZATION TECHNIQUES:
Minterm, Maxterm, Karnaugh Map, K map upto 4 variables. Simplification of logic functions with K-map, conversion of truth tables in POS and SOP form. Incomplete specified functions. Variable mapping. Quinn-Mc Klusky minimization techniques.

UNIT 4

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. Multiplexer, demultiplexer, encoder. Octal to binary, BCD to excess-3 encoder. Diode switching matrix. Design of logic circuits by multiplexers, encoders, decoders and demultiplexers.

UNIT 5

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, Modulus counter, skipping state counter, counter design. Ring counter. Counter applications. Registers: buffer register, shift register.

Suggested Readings:

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
9. Digital Electronics Principal & Intigrated Ckt, Maini, Wiley
10. Digital Logic Design Principals, Palbanian, Wiley
11. Digital Electronics, Kharate, Oxford

6AN2 : MECHANICS OF COMPOSITE MATERIALS

3L MM 100

UNIT 1

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, methods of manufacture, surface treatment of fibers, various forms of fibers, matrix materials, polymers: Thermosetting and thermoplastic polymers, properties of polymers like epoxies, phenolics, polyester peek etc.

UNIT 2
Manufacture of Composites : Hand lay up technique, pressure bag and vacuum bag moulding techniques, puftrusion, resin-transfer moulding, injection moulding, Bulk moulding compound, sheet moulding compound. Application of composites in Aircraft Industry.

UNIT 3

Behavior of Unidirectional Composites : Volume traction, weight traction, density of composites, Micromechanics approach, longitudinal strength and stiffness factors affecting longitudinal strength and stiffness, transverse strength and stiffness, shear modulus and strength, Poisson's ratio, effect of fiber dimension and distribution on strength and stiffness, Halpin-Tsai equations.

UNIT 4

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, 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. 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.

UNIT 5

Maintenance of Composites : Assessment and Repair – Classification of damage, Inspection Methodology, Repair operation, Repair procedures. Types of Repairs – Repair failures, Typical repair procedures, Delaminations, Damage to laminate structures, Repair to sandwich structures, Repair to Honycomb structures, lightning protection, painting the composite part, Quality control.

Suggested Readings:

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.
3. R.F. Gibson, Principles of Composite Material Mechanics, Mc Graw Hill International Edition.
4. Lalit Gupta, Advance Composite Materials, Himalyans Books, New Delhi 1998.
5. Advance Composites by Joppesen.

6AN3 : AERODYNAMICS - I

3L+1T MM 100

UNIT 1

The standard Atmosphere : International standard atmosphere, geopotential and geometric altitude, pressure, temperature and density altitude. Viscous Flow : Introduction to turbulence, transition, structure of a turbulent boundary layer, momentum equation for turbulent boundary layer.

UNIT 2

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, wing theory, induced drag, qualitative treatment of low aspect ratio wings.

UNIT 3

Generation of Lift:

Kutta Joukowski's theorem. Kutta condition. Blasius theorem.

UNIT 4
Wind Tunnel Design:
Test section, diffuser, fan section, fan design, return passage, cooling, The breather-vibration, test section flow quality, effuse design, wind tunnel construction, energy ratio, final form.

UNIT 5
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.

Model forces, Moment and pressure measurement
Wind tunnel balances – internal and external balances, design of wind tunnel balances, wake survey method.

TEXT BOOKS & REFERENCES

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. Milne Thomson, L.H., "Theoretical aerodynamics", Macmillan, 1985.
4. Clancey, L.J., "Aerodynamics", Pitman, 1986.
5. Introduction to Aeronautics by SOA.

6AN4: AIRCRAFT STRUCTURES – II

3L+1T MM 100

UNIT 1

UNSYMMETRICAL BENDING:
General, Principal axis and neutral axis methods- bending stresses in beams of symmetric sections with skew loads- bending stresses in beams of unsymmetrical sections.

UNIT 2

SHEAR FLOW IN OPEN SECTIONS:
Thin walled beams, Concept of shear flow, shear centre, Elastic axis with one axis of symmetry, with wall effective and ineffective in bending, unsymmetrical beam sections.

UNIT 3

SHEAR FLOW IN CLOSED SECTIONS:

Bredt – Batho formula, Single and multi – cell structures.- Shear flow in single & multicell structures under torsion. Shear flow in single and multicell under bending with walls effective and ineffective.

UNIT 4

BUCKLING OF PLATES:
Rectangular sheets under compression, local buckling stress of thin walled section-Crippling stresses by Needham's and Gerard's methods, Thin walled column strength-sheet stiffener panels-Effective width. Thermal post buckling of aircraft wing.

UNIT 5

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-loads on aircraft –lift distribution-V-n diagram-Gust loads

Suggested Readings:

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.
3. Analysis of A/C Structure by Bruce K. Donaldson (Cambridge Aerospace Series)
4. 'Analysis of Design of Flight Vehicles Structures', by Bruhn E.H., Tri-state offset company, USA
5. 'Theory & Analysis of Flight Structure' by Rivello, R.M., McGraw Hill

6AN5 : AIRCRAFT DESIGN

3L MM 100

UNIT 1

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.

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.

UNIT 2

Airplane Weight Estimation:
Weight estimation based on type of airplane, trends in wing loading, weight-estimation based on mission requirements, iterative approach.
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.
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.

UNIT 3

Landing Gears:
Different kinds of landing gears, and associated arrangement for civil and military airplanes. Preliminary calculations for locating main and nose landing gears.

UNIT 4

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. Integration of wing, fuselage, empennage and power plant. Estimation of centre of gravity.

UNIT 5

Introduction of advanced concepts:
Supercritical Wings, relaxed static Stability, controlled configured vehicles, V/STOL aircraft and rotary wing vehicles.
Design and layout of flying controls and engine controls.

Suggested Readings:

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
5. L M Nicholal, Fundamentals of airplane Design, Univ. of Dayton DHIO, 1975
6. Aircraft Design K.D.Wood, Johnson Publishing Company, 1968

6AN6.1 : MAINTENANCE OF POWER PLANT & SYSTEMS

3L MM 100

UNIT 1

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.
Jet Engine:
Operation of engine control and fuel metering systems including electronic engine control (FADEC); Systems layout and components.

UNIT 2

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. **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.

UNIT 3

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. **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.

UNIT 4

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 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.

UNIT 5

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. **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.

Suggested Readings:

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

6AN6.2 : COMPUTATIONAL FLUID DYNAMICS

3L MM 100

UNIT 1

FINITE DIFFERENCE SCHEMES:

Projection and truncation error, Stability, consistency, accuracy and convergence of numerical schemes. Time marching methods. FDM applied to linear advection - diffusion equation, MacCormack scheme and its application to Euler and N-S equations.

UNIT 2

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.

UNIT 3

BASIC OF FINITE ELEMENT METHOD:

Isoparametric elements, bilinear and tri-linear elements. Numerical Integration, space function, Petrov- Galerkin method.

UNIT 4
Grid generation: algebraic and pde based methods, O-, C-, H-type topologies, unstructured meshes, hybrid meshes.

UNIT 5
Large scale problems in CFD, iterative solvers, preconditioning techniques, vector and parallel computing, post-processing for visualisation.

Suggested Readings:

1. T J Hughes, The Finite Element Method: Linear Static and Dynamic Finite Element Analysis, Prentice Hall.
2. O C Zicnkievicz and RL Taylor, The Finite Element Method, Vol I & II, McGraw Hill, Indian Ed.
3. John D Anderson Jr., Computational Fluid Dynamics: The Basics with Applications, McGraw Hill, Indian Edition.
4. Charles Hirsch, Numerical Computation of Internal and External Flows, Wiley Series in Numerical Methods in Engineering, Indian Edition.

6AN6.3 : HELICOPTER THEORY

3L MM 100

UNIT 1

Theory of Flight—RotaryWing Aerodynamics:
Terminology; Effects of gyroscopic precession; Torque reaction and directional control; Dissymmetry of lift, Blade tip stall; Translating tendency and its correction; Coriolis effect and compensation; Vortex ring state, power settling, overpitching; Auto-rotation; Ground effect.

UNIT 2

Flight Control Systems:
Cyclic control;Collective control; Swashplate; Yaw control: Anti-Torque Control, Tail rotor, bleed air; Main Rotor Head: Design and Operation features; Blade Dampers: Function and construction; Rotor Blades: Main and tail rotor blade construction and attachment; Trim control, fixed and adjustable stabilisers; System operation:manual, hydraulic, electrical and flyby-wire; Artificial feel; Balancing and Rigging.

UNIT 3

Blade Tracking and Vibration Analysis:
Rotor alignment; Main and tail rotor tracking; Static and dynamic balancing; Vibration types, vibration reduction methods; Ground resonance.

UNIT 4

Transmissions:
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

UNIT 5

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.

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;

Suggested Readings:

1. Automatic Flight Control – E.H.J. – Pallet
2. Aviation Maintenance Technician Handbook (General) 9A – FAA
3. CAIP
4. Helicopter Theory by Wayne Johnson
5. Helicopter Calculation & Design Vol. I, II, & III by M.L. MIL, A.V. Nekrasov, A.S. Braverman

6AN7 : AIRCRAFT DESIGN LAB

3P MM 100

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

3P MM 100

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

LIST OF EQUIPMENT

Sl.No.	Items	Quantity
1.	Sub sonic Wind Tunnel with test pieces for pressure distribution measurement and flow visualization accessories	1 No.

6AN9 : AIRFRAME LAB

2P MM 50

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

LIST OF EQUIPMENT

One complete heavy aircraft.

6AN10 : SOFT SKILL DEVELOPMENT LAB.

2P MM 50

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

2P MM 50

Common syllabus to all Branches.