SYLLABUS

Of the

Associate Membership Examination

SECTION A & B

Modified & Updated
Effective Dec 2008 Session

(Approved by Ministry of Human Resource and Development, Govt of India, vide letter no. F.24-4/2002 TS-III, dated 31Dec04)

THE AERONAUTICAL SOCEITY OF INDIA
13 - B, Indraprastha Estate, New Delhi - 110002
Telephone : 23370516 Fax : 23370768
E-mail : aerosoc@bol.net.in
Website : www.aerosocietyindi.com

INSTITUTIONS ADMITTING AeSI STUDENTS FOR HIGHER STUDIES

Institutions	Recognised for	Addl Conditions	Reference No.
Osmania University	PG and MBA courses	Nil	753/L1507/II/85/Acaddated 22 Feb 1985
Anna University, Chennai	M.E./M.Tech	2 yrs experience Gate/exam	1216/AUC/DD2-DAC2008 DATED 15.05.2008
IISc, Bangalore	PG studies	BSc	
IIT, Madras	PG studies	-	
IIT, Khadagpur	PG studies	-	IIT/Dean (Ac)/79/4 dated 09 Aug 1979
IIT, Bombay	PG studies	2 yrs experience	
Cochin University	PG studies	-	
BHU, Varanasi	PG studies	-	
MLNNIT, Allahabad	PG studies	-	

1. Student-members are advised to confirm status as on date directly from the concerned institution.
2. AeSI HO extends required support to students seeking admission in institutions, however it may be appreciated that it is up to the institution management to accede to such requests.

Besides, several foreign Universities are also admitting AeSI graduates for post graduate studies.

TABLE OF CONTENTS

FOREWORD

The syllabus of the Associate Membership Examination is intended to serve as a guide to those who wish to appear in Section A & B Examination of the Society.

The Associate membership Examination was started in December 1953, it then consisted of Parts II & III. The syllabus was revised in 1973 when the Parts II & III scheme was superceded by the scheme having Sections A & B. Since 1959 a pass in the Associate Membership Examination has been recognized by Ministry of Education as being equivalent to a degree in Aeronautical Engineering.

To ensure that the syllabus continues to fulfill its objectives and is relevant to the needs of industry/users, a revision became necessary. Many significant developments in technologies have taken place. Computer and Electronics have come to play an ever increasing and important role in every aspect of aeronautics and allied sciences. New systems, materials and techniques have been introduced. In addition, it was also observed that in the current syllabus, the degree of specialization available under eight different streams in Section B was excessive and had limited acceptance.

A Committee was, therefore, constituted to undertake the revision and make recommendations. The Committee, besides rationalizing the syllabus, added a number of new subjects. The proposed syllabus was further reviewed by experts from IIT-Kanpur, MIT-Madras, IISc-Bangalore, Director General of Civil Aviation, etc. and their comments/observations have been considered.

AICTE has also reviewed the Syllabus and their recommendations have been incorporated. Ministry of human resource Development, Govt of India has accorded its approval to this syllabus vide their letter F.24-4/2002-TS-III dated 31Dec04.

We acknowledge with gratitude the contributions made by Dr kota Harinarayana, Prof NS Venkataraman, Prof Iyengar, Prof SC Sharma, Prof Tulapurkar and by other professional experts in this endeavor.

Revised and duly updated syllabus has two sections, named Section A and Section B. A student shall clear Section A in full before he can be admitted for Section B. The brief details of the Section-A and Section-B are as below :

A) Section A: Section-A comprises of 10 core-engineering subjects and one practical training capsule. The subjects are; Applied Mathematics-1; Fluid Mechanics; Basic Electronics; Strength of Materials; Engineering Thermodynamics; Electrical Engineering; Microprocessors & Software Engineering; Introduction to Aeronautics; Engineering Drawing & Design; and Workshop Technology. Basic Electronics and Microprocessors & Software Engineering have been introduced as two separate subjects to reflect the growing importance of electronics and computers in every field. The training capsule of 6 weeks duration has been introduced to familiarize the students with various workshop practices.

B) Section B: Section-B has four under mentioned specialized streams in line with the practices prevalent in the Civil Aviation.

   (i) Aero-Mechanical Stream

   (ii) Avionics Stream

   (iii) Maintenance & Production (Mechanical) Stream

(iv) Maintenance & Production (Electrical) Stream

A candidate can select either of the four specialist streams. Each Stream has ten theoretical subjects and two practical training capsules.

The ten theoretical subjects comprise 8 compulsory and one optional technical subjects and one compulsory management subject. The optional group comprises of 19 subjects and a candidate may choose any one subject of his interest. For further details regarding structuring in syllabus, please go through page no. 42-63 of this book.

Two training capsules, each of six weeks duration, have been introduced in each of the streams. One capsule is for familiarization with various laboratories in the respective stream and the second capsule is for professional training or project work in the industry.

After introduction of this syllabus, all candidates who enroll shall be eligible to appear in the Associate Membership Examination under the Revised Scheme only.

The existing scheme of examination with unmodified syllabus shall run concurrently for few semesters.

H.C. BHATIA

Secretary (Admn.)

01 Sept, 2008

STRUCTURING OF SUBJECTS (MODIFIED SYLLABUS)

In order to ensure that every student member for Associate Membership Examination does devote a minimum of recognized four years for a BE/B.Tech course, structuring of subjects which could be opted in different exam session has been introduced. Student members are advised to read these instructions and understand the implications in full. The instructions are as follows:-

1. The Syllabus has two parts, Section - A and Section-B. A student has to first successfully complete all subjects of Section - A before he can attempt subjects of Section -B.

2. A student has to take and appear in minimum of four exam sessions to complete a total of ten subjects of Section - A. (If a student does not apply for an exam semester, that will not be counted towards the stated number of "four exam sessions").

3. While in Section-A, a student is free to take any subject(s), however there is a restriction on numbers with minimum of one and maximum of four only in one exam session. (In case a student successfully completes all the ten subjects in first three semesters, he will have the option to use the fourth semester only for improvement in his scores. He will be allowed to graduate to Section -B only after completion/passage of fourth exam semester.)

4. The Workshop Training Capsule of six weeks as per details in the Syllabus will be arranged by student members under their own arrangement at all such facilities with engineering institutions, however, it will be necessary for the student(s) to produce a certificate, signed by qualified BE/B Tech Engineer certifying that the training capsule has been gone through by the student.

5. While in Section -B, students will be free to take subject(s), minimum one and maximum four in one exam session, and appearance in minimum of four exam sessions is essential. (Similar to Sl. No. 3 above)

6. A student having successfully completed a subject is not allowed to repeat it. In case he is keen to improve his score in the subject, he must seek prior permission from AeSI HO and such permission could be granted with a pre-condition that his existing score will be removed and the score made in repeat-attempt would be placed on record. Also once graduated to Section-B, option of performance improvement will not be exercised for subjects of Section-A.

7. Every student will have to go through 6 weeks training in familiarization with different laboratories as per the Syllabus. The training will have to be managed by students themselves at any of aero-institutions, under supervision of qualified BE/Btech qualified engineer. A student may under go the training after successful completion of Section - A.

8. Six weeks project work in Section - B will also be undertaken by a student member. A student is expected to get the subject of his choice approved by the HO or by an experienced professional nominated for the purpose by the HO.

9. Students having BE/BTech or its equivalent qualification will be entitled to get exemption from appearing in upto six subjects of Section-A, as per their discipline in BE/BTech course.

   (a) The candidates belonging to Electrical/ Electronics and Allied streams may get

exemption of subjects, namely, Applied Maths-I, Basic Electronics, Electrical Engineering, Microprocessors & Software Engineering, Engineering Drawing & Design, and Workshop Technology.

(b) The candidates belonging to Mechanical, Civil, Chemical and Allied disciplines may get exemption in subjects, namely, Applied Maths-I, Fluid Mechanics, Strength of Material, Engineering Thermodynamics, Engineering Drawing & Design, and Workshop Technology.

(TRUE COPY)

Telegram : "EDUCIND"
Shiksha Mantralaya
Bharat
MINISTRY OF EDUCATION
INDIA

No. F. 18-1/78-T-7 Dated the 2nd August 1978

TOWHOMSOEVERITMAY CONCERN

Certified that a pass in the Associate Membership Examinations, Parts II and III/ Section A & B, of the Aeronautical Society of India has been recognized at par with a Bachelor's degree in Aeronautical Engineering from an Indian University for purposes of recruitment to superior posts and services under the Central Government.

Sd/- (Y.P. SINGH)
2.8.78
EDUCATION OFFICER (TECH.)
Ministry of Education & S.W.

No.F.24-4/2002-TS-III
Government of India
Ministry of Human Resource Development
Department of Secondary & Higher Education
****

New Delhi, the 31st December 2004

To,

The Secretary (Administration)
The Aeronautical Society of India,
13-B, I.P. Estate,
New Delhi- 110 002

Subject : Approval of revised and updated syllabus of A.M.E. (Section A & B) conducted by the Aeronautical Society of India.

Sir,

Kindly refer to this Department's letter of even number dated 16.11.2004 on the subject noted above.

On the recommendation of the AICTE, the High Level Committee of this Ministry in its meeting held on17.09.2004 approved the revised syllabus for implementation. The approval for implementing the revised syllabus is subject to all other conditions of recognitions mentioned in our earlier letter, remaining same.

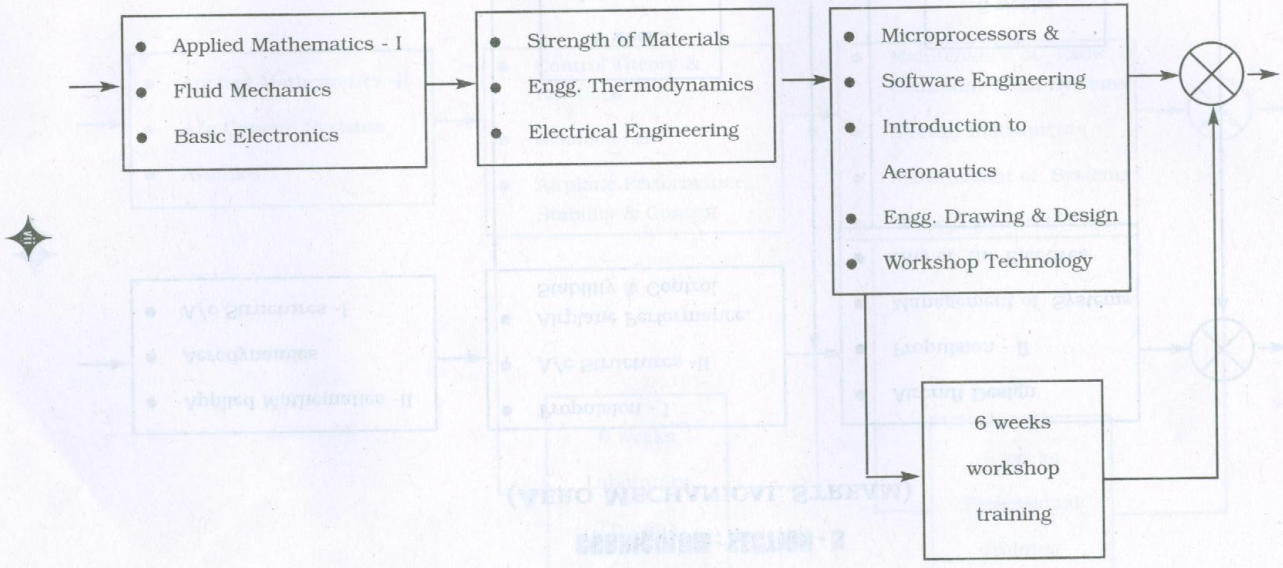
A copy of the approved revised syllabus for Associate Membership Examination(Section A & B), duly authenticated is forwarded herewith. The earlier letter dated 16.11.2004 in this regard, may please be treated as withdrawn.

Yours faithfully,

(Dr. G. L. Jambhulkar)
Deputy Educational Advisor (NIT)
Tel : 2338 4276

THE AERONAUTICAL SOCIETY OF INDIA

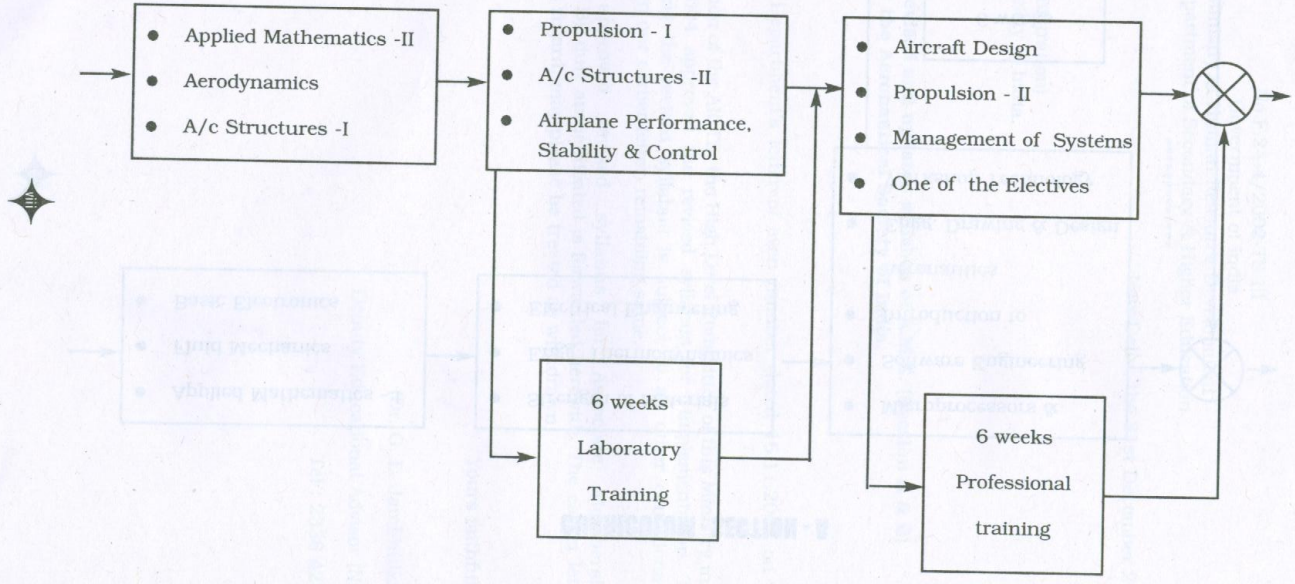
CURRICULUM : SECTION - A



THE AERONAUTICAL SOCIETY OF INDIA

CURRICULUM : SECTION - B

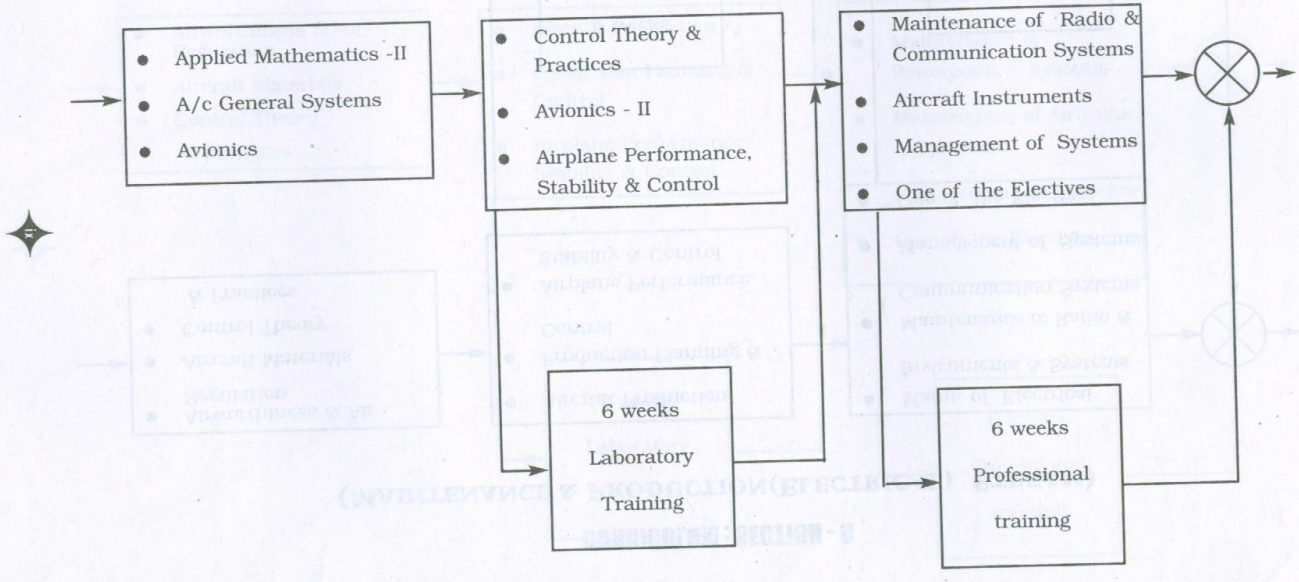
(AERO MECHANICAL STREAM)



THE AERONAUTICAL SOCIETY OF INDIA

CURRICULUM : SECTION - B

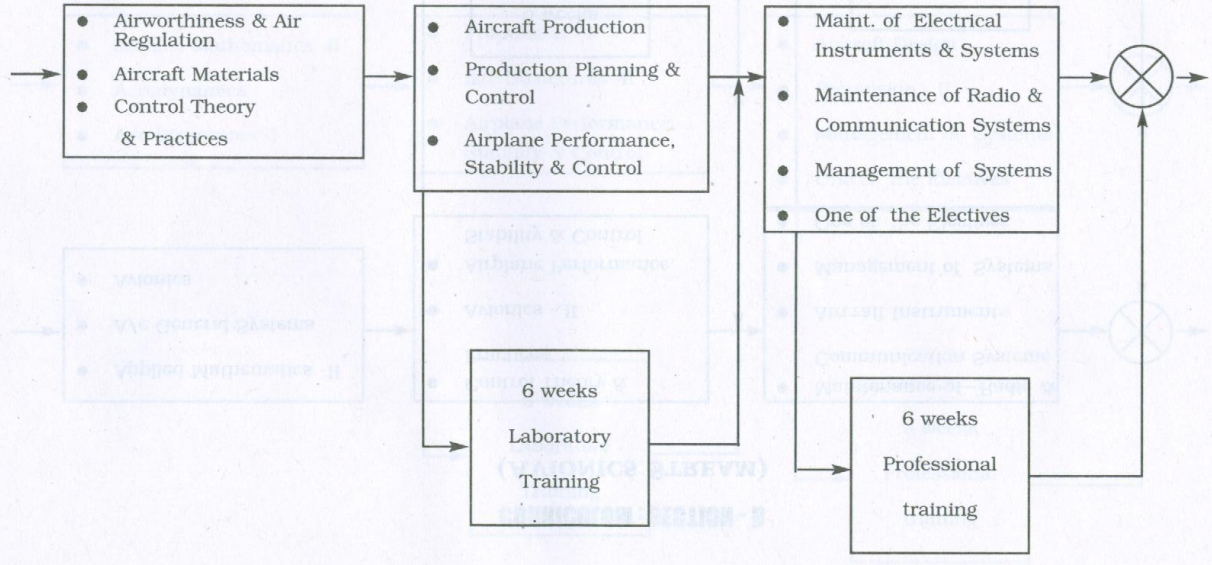
(AVIONICS STREAM)



THE AERONAUTICAL SOCIETY OF INDIA

CURRICULUM : SECTION - B

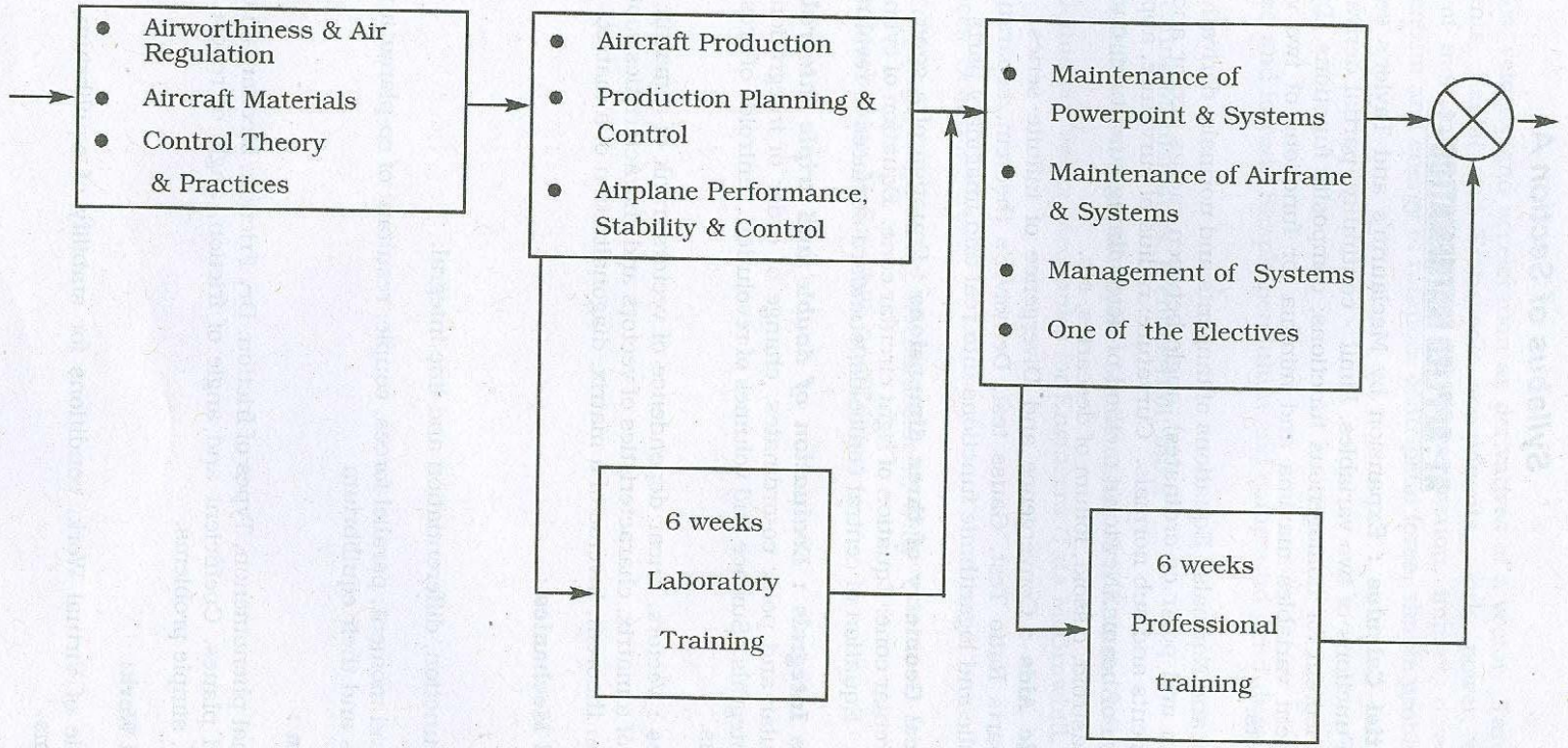
(MAINTENANCE & PRODUCTION(ELECTRICAL) STREAM)



THE AERONAUTICAL SOCIETY OF INDIA

CURRICULUM : SECTION - B

(MAINTENANCE & PRODUCTION(MECHANICAL) STREAM)



Syllabus of Section A

A1:APPLIEDMATHEMATICS- I

Differential Calculus : Expansion by Maclaurin's and Taylor's series. Indeterminate forms. Functions of two variables, Limit - continuity, partial derivative, total derivative. Euler's theorem for homogenous functions; composite functions. Taylor's series for two independent variables maxima and minima for functions of two variables, errors and increments.

Tangents and Normals. Equations of tangents and normals, derivative of the length of arc (cartesian and polar co-ordinates), angle between radius vector and tangent at a point. Sub tangents and sub normals. Curvature: radius of curvature, approximate formula for curvature of beams, Newton's method of determining curvature, curve tracing, catenary, cycloid, astroid, cissoid, folium of descartes, etc.

Algebraic Aids : Convergence and Divergence of infinite series. Cauclur's root text, D'Alembarts Ratio Test, Gauss test, Demoivre's theorem, separation of Trigonometric, Hyperbolic and logarithmic functions into real and imaginary parts

Analytical Geometry of three dimensions : Equation of a cone, with vertex at origin. Right circular cone: Equation of right circular cone. Equation of cylinder and right circular cylinder. Equation of central conicoids, standard surfaces of revolution.

Multiple Integrals : Evaluation of double and triple integrals : double integrals, rectangular and polar co-ordinates, change of order of integration, change of variable. Triple integrals. Surface and volumes of revolution, centroids of arcs, plane areas, Pappus theorems.

Matrices : Vectors, linear dependence of vectors, rank of a matrix, linearly independent vectors of a matrix, characteristics of vectors and characteristics roots of a matrix, Cayley-Hamilton theorem, Inverse of a matrix, diagonalization of a matrix.

Applied Mechanics :

Statics :

Vector function, differentiation and line integral.

Force and moment, parallel forces, couple, resultant of co-planar and non co-planar force systems and their equilibrium

Friction :

Frictional phenomenon, Types of friction, Dry Friction, Mechanism of Friction, Friction on inclined planes, Coefficient and angle of friction, angle of repose, laws of friction, belt friction, simple problems.

Virtual Work:

Principle of Virtual Work, conditions for stability of equilibrium, application to simple problems.

Vectorial Dynamics :

Kinetics and Kinematics, velocity and acceleration as derivatives of a vector. Tangential and normal components, Radial and Transverse components, work, power, energy, momentum, moment of momentum. Impulse, Impulsive motion, impact, direct and oblique, angular momentum and energy of rotation, centripetal force, simple problems.

Mechanical Vibrations :

Vibrations, free, damped and forced. Simple pendulum and compound pendulum.

Text Books :

1. B S Grewal, Engineering Mathematics, Prentice Hall, India
2. J S Bindra and K S Gill, A text book of Applied Mathematics, S K Kataria & Sons
3. F P Beer and E R Johnston, Vector Mechanics for Engineers, Tata McGrawhill, 1996

Reference Books :

1. Frank Ayres, Matrices, Schaum Series
2. J L Merriam and L G Kraige, Engineering Mechanics,John Willy
3. D E Christie, Vector Mechanics, McGrawhill, 2nd Edition

A2:FLUIDMECHANICS

Introduction: Fluids : Definition of fluids, the science of fluid mechanics, fluid properties, capilliarity, surface tension, compressibility, units and dimensions.

Normal and Shear stresses in fluid flows, measurement of fluid velocity.

Regimes of fluid flows : Continuum and free molecular flow, inviscid and viscous flows, incompressible and compressible flows, Newtonian and Non-Newtonian flow, Aerodynamic force and moments, Dimensional analysis, Non-dimensional parameters, M, Re, Fr etc.

Fluid Statistics : Pascal's law, types of forces on a fluid system, measurement of pressure, use of manometers and gauges, numerical problems. Hydraulic devices, forces on partially and fully submerged bodies, including that on curved surfaces, numerical problems, buoyancy, stability of floating bodies, centre of gravity and meta centric heights.

Description of Fluid Motion : Lagrangian and Eulerian methods, description of properties in a moving fluid, local and material rate of change, equation of conservation of mass for control volume.

Streamlines, path lines, streak lines, vorticity and circulation, laws of vertex motion, translation, rotation and rate of deformation of fluid particle.

Equations of Fluid Motion : Euler's and Navier stokes equation, derivation of Bernoulli's equation for inviscid and viscous flow fields momentum equation and angular momentum equation in Integral form.

Inviscid - Incompressible Flow : Condition on velocity for incompressible flow, Laplace's equation, potential function, stream function. Basic elementary flows: uniform flows, source flows, doublet flow and vortex flow. Super-imposition of elementary flows, non lifting and lifting flow over a circular cylinder. Pressure distribution over circular cylinder in real flow. Kutta - Juokowaski Theorem, Generation of lift. Lift on air foils.

Introduction to Viscous Flows : Qualitative aspects of viscous flows, viscosity and thermal conductivity, phenomenon of separation, Navier stoke's equations in vector form, viscous flow energy equation, some exact solutions of Navier stoke's equations: Plane poisuille flow, Couette flow, Hagen - Poisuelle flow, Hele - Shaw flow, flow through co-rotating cylinders. Transition from laminar to turbulent flow. Turbulent flow in circular pipe.

Introduction to Incompressible Boundary layer (BL) : BL Concept, BL Properties, derivation of Prandtl's BL Equation, Blasius solution, Karman's Integral equation, Turbulent BL over a flat plate, skin friction drag, BL Control.

Dimensional Analysis and Similitude : Buckingham's theorem, non-dimensional groups, Geometric, Kinematic and Dynamic similarity, Applications.

Elements of Compressible Flows : Compressible flow properties, total Enthalpy, total temperature, temperature and pressure ratio as function of mach number. Mass flow parameter (MFP), Isentropic area ratio A/A*, velocity - area variation, 2-D small amplitude wave propagation, Adiabatic Steady Flow Ellipse. Description of flow regimes, Introduction to Normal and Oblique shock waves, working out solutions through Gas Tables/Charts

Text Books:

1. John D Anderson Jr., Fundamentals of Aerodynamics, McGraw Hill, 2nd Ed.
2. S W Yuan, Foundations of Fluid Mechanics, Prentice Hall
3. Gupta Vijay and Gupta S K, Fluid Mechanics and its Applications, Wiley-Eastern, 1982

Reference Books :

1. Jack D Mattingly, Principles of Gas Turbine Propulsion, 1st Ed., McGrawHill, 1997
2. H. Schlichting and K. Gersten, Boundary Layer Theory, 8th Ed., McGrawHill, 2000
3. Frank M White, Fluid Mechanics, 2nd Ed., McGrawHill, 1986
4. E. Rathakrishnan, Gas Dynamics, Prentice Hall India

A3:BASICELECTRONICS

Transistors : Transistor operation, configurations, small signal analysis of Basic Transistor Amplifier, Stabilization, Essentials of a Biasing Network, Biasing Methods for Amplifiers. Field effect transistor, Junction Field effect transistor, MOSFET, and unijunction transistor. Integrated circuits.

Amplifiers and Oscillators : Classification of Power Amplifiers, Push Pull Power amplifier, Voltage Amplifiers, Feedback in Amplifiers, different types of oscillators. Tuned collector oscillator, Hartley oscillator, Colpitt's oscillator, Phase shift and Wein Bridge oscillator.

Modulation and Demodulation: Principles of Radio Transmission and Reception. Modulation, Types of Modulation Amplitude Frequency and Phase Modulation Demodulation.

Analog and Digital : Operational Amplifier, Scale changer, sign changer, integrator, Differentiator, phase shifter, Logrithmic Amplifier, Positive and Negative Logic Systems, Logic Gates, Binary Number system, Binary Arithmetic Binary Code, Half Adder, Full Adder, Binary Adder, Digital input - output devices.

Power Control Devices : Silicon Controlled Rectifier, Characteristics, Triac, Diac Shockley diode, Silicon Bilateral Switch, Unijunction Transistor, Choppers, Inverters and their Applications.

Text Books:

1. Bapat, Electronics Circuits and Systems Analog and Digital, Tata McGrawHill, Delhi
2. H C Rai and Mahesh Popli, Fundamentals of Electronics, Dhapat Rai & Sons, Naisarak, Delhi
3. Mehta V K, Principles of Electronics, S Chand & Co., New Delhi

Reference Books :

1. Mathur, Kulsheshtra and Chadha, Electronic Devices: Applications and Integrated Circuits, Umesh Pulbilcations
2. C Millman and Holkias, Electronic Devices and Circuits, McGrawHill
3. Ramabhadran S, Electronic, Principles and Techniques, Hindustan Publishing Corporation (I)

A4:STRENGTHOFMATERIALS

Introduction : Concept of Stress, axial loading normal stress, shearing stress, bearing stress, stress on an oblique plane under axial loading.

Deformation : Concept of strain, normal strain under axial loading, stress-strain diagrams, Hooke's law, modules of elasticity, Poisson's ratio, thermal stresses, bulk modulus, modulus of rigidity, shearing strain, stress-strain relationship.

Transformation of Stress and Strain : Principal stresses, maximum shearing stress, Mohr's circle for plane stresses. Stresses in thin-walled pressure vessels, measurement of strain Rosette.

Pure Bending : Deformation in a transverse cross-section, derivation of formula for bending stresses. Bending stresses in composite sections.

Shearing Force and Bending Moment : Diagram for simply supported Beam, Cantilevers, with concentrated, uniformly distributed and variable loads. Castigliano's theorems, unit load method.

Deflection of Beams : Deflection in simply supported beams and cantilevers with concentrated loads, uniformly distributed loads and combination of these. Macaulay's method, moment area method.

Springs : Design of Helical (closed coiled) springs and leaf springs.

Columns : Euler formula for pin-ended columns and its extension to columns with other end conditions. Rankine Gordon formula.

Torsion : Deformation in a circular shaft, angle of twist, stresses due to torsion, derivation of torsion formula, torsion in composite shafts.

Loads on Airplane Components: Steady and unsteady load.

Text Books :

1. S Ramamrutham, Strength of Materials, Dhanpat Rai Publishing Co.
2. E P Papov, Mechanics of Materials, Prentice Hall Inc.
3. U C Jindal, Strength of Materials, Umesh Publications

Reference Books :

1. S Timoshenko, Strength of Materials, D Van Standard Co. Inc.
2. G H Ryder, Strength of Materials, B I Publications, Mumbai

A5:ENGINEERINGTHERMODYNAMICS

Fundamental Concepts and Definitions : Scope and limitations of thermodynamics. Thermodynamic system, state, property, change of state, thermodynamic equilibrium, path process, cycle density, pressure and their molecular interpretation - dimension and units - Zeroth law of thermodynamics and concept of temperature, temperature scales, work and heat definition and units of work and heat, work of frictionless process, PV diagram, indicator diagram.

First law of Thermodynamics : Statement of the first law. Energy. Internal energy and its microscopic interpretation, enthalpy, applications of first law.

Steady Flow Energy Equation (SFEE). The steady - state, steady -flow process. The Joule-Thomson coefficient and the throttling process. Uniform state, Uniform flow process, SFEE and its applications.

Second Law of Thermodynamics : Limitations of the first law, heat engines, reversed heat engines and their performance, Kevlin-Planck's and Clausius statements of the second law reversibility-reversible and irreversible processes: Carnot cycle thermodynamic temperature scale: Clausius-Clapeyron equation.

Entropy : The property, entropy, principle of increase of entropy, calculation of entropy changes, T-S and h-s diagrams. Microscopic interpretation of entropy-Helmholtz (A) and Gibbs (G) functions.

Physical properties : Pure substance definition-internal energy and enthalpy of a pure substance, specific heats, equilibrium of phases, phase diagrams, phase changes, critical state, PVT surface, tabulated properties and process calculations. Maxwell relations.

Ideal and Real Gases : Definition-internal energy and enthalpy, specific heats and their calculation from simple kinetic theory, gas tables, Van dcr Waal's equation of state, principle of corresponding states, compressibility factor.

Vapour Power Cycles : Carnot cycle using steam, Rankine cycle, reheat cycle, binary vapour cycles.

Air Standard Power Cycles : Carnot cycle, Otto cycle, Diesel cycle, dual cycle, gas turbine cycles, inter cooling, reheating and regeneration, gas turbine jet propulsion, deviation from ideal cycles.

Text Books :

1. C O Van Wylen; Classical Thermodynamics Wiley 2001
2. J B Jones and C A Hawkins, Engineering Thermodynamics, John Wiley and Sons Inc., New York
3. P K Nag, Engineering Thermodynamics, Tata McGrawHill Book Co. 1981

Reference Books :

1. R A Sonntag and C O Van Wylen, Fundamentals of Thermodynamics, Wiley, New York
2. D B Spalding and E H Cole, Engineering Thermodynamics, 2nd Ed., Arnold, London. 1973
3. John F Les and Francis W Sears, Thermodynamics: An Introductory Text for Engineering Students, Addison, Wesley Reading

A6:ELECTRICALENGINEERING

Electromagnetic : Coulomb's Laws, Gauss's Law, Biot-Savart Law, Kirchhoff 's Laws, Faradays Laws of Electromagnetic Induction, Magnetic Energy Stored in an Inductance AC Circuits (R-L-C), Composite Magnetic Circuits, Lifting power of an electromagnet, Stat-Delta Connections, Thevenin Theorem, Norton's Theorem, Maximum Power Transfer Theorem. Loop/Mesh Method of Analysis.

DC Machines : DC Generator, Magnetisation Curve Characteristics of DC Generators, Critical Resistance, E M F Equation, causes of failure to Build up Voltage, Applications. Principle of DC Motor, Types, Motor Charactseristics, Speed control Applications of DC Motors.

AC Machines : Classification of AC Machines, General theory of Induction Motors, Equivalent circuit characteristics and applications of Induction Motor, Theory of Synchronous Machines, Emf Equation of Synchronous Alternator, winding factors, Synchronous Motors, Synchronous condensers and applications, Amplidyne, metadyne, rectifiers and converters, solid state rectifiers, invertors, applications. Design of electric machines, radio interference suppression, fault finding, testing, protection, cooling, special requirements for airborne applications.

Modern Measurement System: Analogue meters for Voltage, current, Power, Energy, Digital Meters.

Generation, Transmission and Distribution: Different types of generating stations, choice of voltage for transmission and distribution, characteristics of overhead lines and cable. Different types of faults, Corona effect,. Ferranti effect, Inductive interference.

Energy Storage System and Utilization : Type of aircraft batteries: construction and details of lead acid and nickel cadmium batteries, capacity, charging, common defects and rectification. Distribution of electric power, cables and their identification, circuit breakers, OVPs, voltage regulators, relays, actuators, lighting. Electric heating-Induction and dielectric heating.

Text Books

1. H. Cotton, Transmission and Distribution of Electric Energy, B1 Publishers Pvt. Ltd.
2. B.L. Thereja, Electric Technology, S. Chand and Co. New Delhi.
3. M V Deshpande, Elements of Electrical Machines, MV Publisher.

Reference Books

1. Del Toro, Fundamentals of Electrical Engineering, Prentice Hall.
2. H. Cotton, Advanced Electrical Technology, Pitman.
3. H. Zefferet, Principles and Practice of Aircraft Electrical Engineering, George Newness Ltd., London.

A7:MICROPROCESSORSANDSOFTWAREENGINEERING

The CPU : CPU register, ALU Control Unit, status, flags, introduction, execution, instruction, timing diagrams, instruction cycles, microprogamming and the control unit, chip slice units.

Logic beyond the CPU - Interfacing programs and data. Memory program i/o interrupt, error detection, various protocols, synchronous serial data transfer, programmable control/ timers. Real time clock, logic distribution among microcomputer devices.

Programming microcomputer, review of programming language, source program, object program, assembly language, memory addressing, the stack indirect addressing, indexed addressing, base relative addressing, memory segmentation., Introduction to set a - CPU architecture. A description of instructions, advanced microprocessor instruction set concepts.

Boolean algebra, postulates and theorems, standard forms, formulation of switching functions, simplification of Boolean expressions. Basic building block, realization of switching function using NAND and NOR gates. Flip flops, counters and shift registers.

Introduction to computers, computer characteristics, types of programming languages. Introduction to BASIC, fundamental concepts of BASIC language such as numbers, variables and formulas. BASIC statements, BASIC programs, branching and looping, additional features of BASIC.

Advanced BASIC, functions and sub-routines, vectors and materials, data files, introduction to micro computer BASIC.

Programming using Fortran IV, Fortran statement constants and variables, arithmetic operation and expressions, logical constants and operations, logical expressions, rading and printing formats, control and decision statements, GO TO statement, IF statement, DO loop - DO statement, continue statement. Multi-dimensional arrays and nested DO loops, library functions, sub-routines and simple Fortran programmes, Computer Languages such as C and C+.

- Central Maintenance Computer Systems
- Data Loading Systems
- Electronic Library Systems

Text Books :

1. A P Mathur, Introduction to Microprocessors, Tata McGraw Hill
2. P D Choudhari, Computer Organization and Design, Prentice Hall
3. Glenn A Gibson, Microcomputer Systems, Prentice Hall

Reference Books :

1. C W Gear, Computer Organisation and Programming
2. Rajaram V, Computer Programming in Fortran IV, Prentice Hall
3. Heaps H S, An Introduction to Programming Languages

A8:INTRODUCTIONOFAERONAUTICS

Note : This is first exposure of Airplane as a whole to the students. Frequent use of free hand sketches shall prove useful in understanding and answering in examination.

Introduction : Mankind's desire to fly, various efforts in Pre-Wright Brothers era - brief historical sketch, Wright flyer, Earlier types of flying machines, Development of aeronautical science in 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/STOL machines, modern developments

Airplane Aerodynamics : Nomenclature used in Aerodynamics, different parts of airplane. Wing as lifting surface, Types of wing plan forms, Aerodynamic features like Aerofoil pressure distribution, Aerodynamic forces and moments, Lift and Drag. Drag polar, L/D ratio, high lift devices, Airplane performance like Thrust / Power available, climb and glide, maximum range and endurance, take off and landings. Illustrations through sketches/plots.

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 elevators ailerons and rudder.

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-Prop engine. 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 airplane, Rocket Propulsion, Classification of rockets like liquid and solid propellant rockets.

Airplane Structure, Materials and Production : Structural arrangement of earlier airplane, developments leading to all metal aircraft. Strength 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.

Aircraft Instruments : Flight instruments : Air speed indicators, Altimeters, Rate of climb/descent meter, Gyro based instruments. Engine Performance measuring instruments. Basic instruments in Avionics.

Aircraft Systems : Elementary ideas about Hydraulic and pneumatic systems, pressurization, temperature control and oxygen system. System Integration, accessories. Aircraft Electrical System: Generation and distribution of Electricity on board the airplane. Flight Control System temperature / Environment, Aircraft Fuel System, Fire Protection, Ice and Rain Protection System.

Airplane Design, type Centrification and Airworthiness : Basic steps in airplane design, airplane specification part/component wise specification, design and testing for certification, Airworthiness requirements, Air safety requirements and standards.

Text Books :

1. R S Shevell, Fundamentals of Flight, Prentice Hall
2. E H J Pallet, Aircraft Instruments, Himalayan Books
3. John Anderson Jr., Introduction to Flight, McGraw Hill

Reference Books :

1. E H J Pallet, Aircraft Electrical Systems, Himalayan Books
2. E W Somerset Maugham, Jet Engine Manual, BIP Publications
3. Fundamentals of Flight; By Dr. O. P. Sharma and Lalit Gupta (under print)

A9:ENGINEERINGDRAWING&DESIGN

Plane Geometry : Construction of plane figures and curves used in Engineering Practice. Parabola, ellipse, hyperbola, rectangular hyperbola, cycloids, involutes of a circle, spiral.

Practical Solid Geometry : Projections, types of projections, first angle, first angle and third angle projection, projections of points, lines, traces of lines, projection of planes, projection of soild CG sections of solids such as prisms, pyramids, cylinders, cones and spheres. Development of surface for solids viz-cylinders and cone. Isometric scale and projection.

Machine Drawing : 1. Diagonal scales. 2. Types of lines, lettering and dimensioning. 3. Forms and proportions of bolts and nuts. 4. Engineering fastenings: (a) temporary - bolts and nuts and screws and nuts, etc., studs and nuts, keys cotters and pins; (b) permanent fastening-Riveted joints. 5. Helics and Screw threads. 6. Tolerances, Limits and fits.

Bearing wall brackets, shaft couplings, toothed gearing, bolt and rope pulleys.

Simple machine parts such as pistons, connecting rod ends, cross-heads, stuffing boxes, cranks and crankshafts, Eccentrics, valves, pipes and pipe joints.

Graphic statics : (1) Resultant of coplanar concurrent forces, force polygon, funicular polygon, conditions of equilibrium of a system of coplanar, concurrent and non-concurrent forces, resultant of parked forces. (2) Area centre of gravity and moment of inertia of plane figures 3 (a) Stresses in simple frames-subjected to deadload 3 (b) Stresses in roof trusses subjected to combined dead and wind loads.

Text Books :

1. N D Bhatt; Engineering Drawing; Charotar Publishing House 2000
2. N D Bhatt; Machine Drawing; Charotar Publishing House 2000
3. K L Narayana & P Kannaiah; Tata Mc Graw-Hill Publishing Company Ltd; 2000

Reference Books :

1 Warren J Luzadder; Fundamentals of Engineering Drawing; Prentice-Hall of India Pvt. Ltd. 11th edition 2000

A10:WORKSHOPTECHNOLOGY

Materials : Composition, physical and mechanical properties.

Engineering uses of common metals and their alloys such as cast iron and varieties of cast iron, wrought iron, mild steel, medium carbon steel. Tool steels, highspeed steels. Effect of alloying elements. Alloys of aluminium, tin, copper, zinc and magnesium, bearing materials.

Heat treatment of steels : Relation between heat treatment and physical properties of steels, critical temperatures, annealing, normalizing hardening, tempering, case carburising and hardening, nitriding and other surface hardening methods, quenching, Hardness number. Hardness Testing Machines.

Fitting Work : Files, their specifications and uses, marking scheme for a fitting job, surface plates, vee blocks, marking block, steel scale, punch, vernier caliper, micrometer, hammers, scrapers, chisels, angle plates, bench vice, spanners - their specifications and uses, Pipe and chain wrenches, hacksaws. Drilling, lapping and die cutting.

Sheet metal working : shearing, bending, cup drawing, operations, presses and press working operations, classification of presses, press tools.

Shaping Machines : Principles of operation - types of driving mechanisms, feed and speed control, hydraulic shapers.

Slotting Machines : Principle of operation - driving mechanisms, feed control

Planing Machines : Methods of driving planners - clamping of work, cutting speeds, etc.

Drilling Machines : Vertical, radial, speed and feed control mechanism

Lathes: Types of Lathes : Description of lathe, headstock, tailstock, gear box, carriage, apron, feed controls - longitudinal and transverse, compound tool resets, cutting speeds and feeds, leadscrew, change gears, Lathe accessories, Lathe Operations: surfacing, sliding and screw cutting, taper turning.

Chucks : 3-jaw, 2-jaw, use of soft jaws, faceplate - carriers

Milling Machine : Plane milling machine, universal milling machines, universal dividing head, rotory table, cutting tools used in milling.

Numerical Control Manufacturing :

Nomenclature of NC Machines, Axis, types of NC Machines, Features of NC Machine Tools, Machine Control Unit, Computer programme for computer aided part programming.

Text Books:

1. W A J Chapman, Workshop Technology, Parts I, II & III, CBS Publication
2. S K Hajra Choudhury and S C Bhattacharya, Elements of Workshop Technology, Vol. I & II, Media Promoters & Publishers.
3. T K Kundra, P N Rao, N K Tiwari, Numerical Control and Computer Aided Manufacturing

Reference Books :

1. V. Austin, Workshop Theory, Macmillan and Co. Ltd.
2. F.H. Hallet, machine Shop Theory and Practice, Macmillan & Co. Ltd.
3. C.H. Sumans, Engineering Metals and their Alloys, Macmillan & Co. Ltd.
4. E. Pull, Workshop Practice

Syllabus for six week Training Capsule on Workshop Technology

Training Module

1. Fitting shop	:	Use of drilling m/c. Files. Hacksaw
2. Welding shop	:	Gas Welding & Electric Arc Welding, Spot Welding, Joints
3. Carpentry shop	:	Planer, Marking tools, Joints, Pattern making
4. Sheet Metal shop	:	Development of surfaces, Joints, Soldiering, Brazing
5. Machine shop	:	Introduction to lathe, Milling m/c. shapers, if possible, NC and CNC m/cs.
6. Foundry shop	:	sand, Binders, Moulding Boxes, Moulds, Casting
7. Forging shop	:	Anvil. Swage block, tools. Forging Manual. Steam Hammers.

IMPORTANT POINTS:

1. Candidate to inform the HQ 4 weeks in advance about the place where he intends to undergo Workshop Training.
2. The training should be under the supervision of a "Qualified Engineer" in a Workshop/ Company/ Organisation/ Engineering College*/ Polytechnic*/ ITI/ Institution recognized by DGCA for conduction 3 years AME course (*Approved by AICTE).
3. The certificate for completion of 6 wek Workshop Training must b e signed by the Principal or Head of Organisation/ Head of Department/ In-charge Workshop.
4. The training will be for a period of 6 weeks with 2 weeks each in any three shops from the above mentioned seven shops.

EXEMPTIONS:

The candidates with following qualifications are exempted from 6weeks Workshop Training capsule

a) Graduate Degree in Engineering
b) Diploma in Engineering (3years)
c) AME course (3 years duration)

Syllabus of Section B

(a)Aero-mechanical Stream

AS1:APPLIEDMATHEMATICS-II

Vector Calculus : Curl, grad and divergence of a vector, physical interpretation, integration of vector functions, line, surface and volume integrals, Green's theorem, Stoke's and Divergence theorem. Irrotational and solenoidal fields, derivations of Poisson and Maxwell's electro magnetic field equations.

Complex Variables : Limit, continuity, Analytic function, Cauchy Reimann Equations, Laplace's equation, Cauchy's Integral theorem, Cauchy's Integral formula, Morera's theorem, Louville's theorem. Tailor and Laurent series, Zeros and singularities, Residue, Residue theorem and simple applications in the evaluation of real definite integrals with circular contours.

Fourier Series : Dirichlet's condition, general form of Fourier series. Expansion of function in the form of Fourier series, fourier integrals, evaluation of fourier coefficients.

Differential Equations : Formation of Differential equations and their order and degree, methods of solving first order and first degree differential equations. Linear differential equations of second and higher order with constant coefficients.

Partial Differential Equations : Formation and solution of first order partial differential equations, solution of linear p.d.e.'s of higher order with constant coefficients. Classification of linear second order equations with constant coefficients. Solution of 1-D wave and conduction (heat) equation in cartesian coordinates. 2-D Laplace's equation in cartesian and polar coordinates.

Statistics : Random variables, probability distributions: Binomial, Poisson and Normal, sampling theory, Random samples, sampling distributions for means, difference of means, proportions tests of significance, chi-square test of goodness fit.

Applied Numerical Techniques : Errors in Numerical calculations, round off and truncation errors, solution of algebra and transcendental equations in one variable using generalized Newton's method for multiple roots, Chebyshev's method and Halley's method.

Interpolation : Finite differences, forward, backward and central differences. Application of Newton's, Bessel's, Striling and Gauss, Lagrange's interpolation formule for unevenly space points.

System of Linear Algebraic Equations and Eigen Value Problems.

Numerical Differentiation and Integration.

Text Books :

1. R K Jain & S K K Iyengar, Numerical Methods for Scientific & Engineering Computations, 2nd Ed., Willy Eastern
2. B S Grewal, Engineering Mathematics
3. E Kreysig, A Text Book of Engineering Mathematics, John Wiley

Reference Books:

1. S S Sastry, Introductory Methods of Numerical Analysis, Prentice Hall India
2. Frank Ayres, Complex Variables (Schaum series), McGraw Hill
3. Frank Ayres, Matrices, McGraw Hill

AS2:AERODYNAMICS

Conformal Transformation : Complex potential function, Blasius theorem, principles of conformal transformation, Kutta Joukowski Transformation.

2-D Incompressible Flows around Thin Airfoils : Circulation and the generation of Lift, Bound vortex and starting vortex, Kutta condition, Glauert's thin airfoil, theory, thin symmetric flat plate airfoil, Circular arc foil, general thin airfoil section, the flapped airfoil. Determination of mean camber line shapes for uniform and linear distribution of circulation, flow about multi element airfoils.

Incompressible Flow about Wings of Finite Span : Downwash and Induced drag, Biot-Savart's law and Helormholtz's theorems. Vortex system around a lifting wing, Prandtl's classical lifting line theory, unswept wings, fundamental equations, elliptic lift distribution, influence of aspect ratio on lift and drag, drag polar and lift correlation to aspect ratio. Techniques for general spanwise distribution, monoplane equation, calcuation of lift and vortex induced drag, numerical problems based on above. Panel methods : General description of the panel methods. Vortex Lattie Method: wing as a surface covered by horse shoe vortices (HSV), velocity field due to a general HSV, application of boundary conditions and working out solution for a planar wing, extension to a swept wing.

Delta Wing Aerodynamics : Polhamus's leading edge suction analogy, preliminary calculations of lift coefficient, description of flow field, effect of aspect ratio on lift coefficient, leading edge extensions, high angle of attack effects.

Ground effect and formation flying.

Dynamics of a Compressible Inviscid Flow Field : Basic aerodynamic effects, second law of thermodynamics and irreversibility, (Recap from Fluid Mechanics of the relevant portion on adiabatic and isentropic flow in variable area stream tube). Characteristic Equation and Prandtl-Meyer flow, shock waves. Shock wave boundary layer interaction - an introduction.

Compressible Subsonic and Transonic Flows : Compressible Subsonic Flow: Linearized theory for subsonic compressible flow about a thin wing at small angles of attack.

Transonic Flow past unswept airfoils, swept wings at transonic speeds, Area-Rule, forward swept wing, Extension to transonic aircraft.

2-D Supersonic Flows around thin Airfoils : Linearized theory and its application for calculation of lift, drag and pitching moments.

Busemann's theory and shock expansion technique.

Introduction to CFD: CFD as a design tool; explicit and implicit methods; O,C,H types of grids, various space discretisation methods such as FDM, FVM, FEM; concept of state update formula.

Text Books :

1. John D Anderson Jr., Fundamentals of Aerodynamics, 2nd Ed., McGrawHill
2. J J Bertin and M L Smith, Aerodynamics for Engineers, 2nd Ed., Prentice Hall
3. E. Rathakrishnan, Gas Dynamics, Prentice Hall of India

Reference Books :

1. R S Shevell, Fundamentals of Flight, 2nd Ed., Prentice Hall
2. E L Houghton and N B Carruthers, Aerodynamics for Engineering Students, Arnold, 2nd Ed.
3. John D Anderson Jr., Computational Fluid Dynamics, The basics with Applications, McGraw Hill, Indian Edition.

AS3:AIRCRAFTSTRUCTURES-I

V-n diagram for the loads acting on the aircraft, salient features of the

V-n diagram. Flight envelope for different flying conditions.

Analysis of statically indeterminate structures : planar and space trusses; Deflection of Beams; Area moment Method, slope-deflection method, moment distribution method, Basic elasticity, stresses and strains, equations of equilibrium, plane stress and plane strain problems, compatibility equations, stress - strain relations.

Strain energy and complementary energy, total potential energy; principle of virtual work; principle of the stationary value of the total potential energy and total complementary energy. Application to deflection problems, application to statically indeterminate problems, Rayleigh Ritz and Galerkin techniques.

Bending of open and closed section thin walled beams, shear of open section and closed section beams, shear centre and centre of twist, Torsion of closed and open section beams, membrane analogy. Deflection of open and close section beams.

Aircraft materials-properties of flight vehicle materials importance of strength to weight ratio, temperature variations, factors affecting choice of materials for different part of airplane.

Light metal alloys: heat treatment, high temperature and corrosion resistant alloys, Aircraft steels, effect of alloying elements, heat treatment, selection of steel for aircraft application composite materials: classification and characteristics of composite materials, strength to weight comparison with metals, fiber reinforced and particulate composites.

Text Books :

1. T H G Megson, Aircraft Structures for Engineering Students, Edward Arnold, U.K.
2. R M Rivello, Theory and Analysis of Flight Structures, McGrawHill Book Co.
3. E F Bruhn, Analysis and Design of Flight Vehicle Structures, Tri State offset Co. USA

Reference Books :

1. G F Titterton, Aircraft Materials and Processes, Himalayan Books, New Delhi
2. E T Hill, The Materials for Aircraft Construction, Pitman, London

AS4:PROPULSION-I

Aircraft Piston Engines : The internal combustion engine process, brief historical sketch, spark ignition and compression ignition, (SI and CI) engines, 4-stroke and 2-stroke engines. Combustion processes various types of arrangements for multi cylinder aircraft engines. Intake and Exhaust manifolds. IHP, BHP and SHP Engine performance, Effect of altitude and speed, power required and power available. Super charging, types of super chargers.

Propellers : Ideal Froude Momentum theory, blade element theory, vortex theory, relative merits, numerical problems, use of propeller charts. Selection and choice of propellers. Fixed/variable pitch and constant speed propellers, Relative merits and applications, Ducted propellers, prop-fan, Helicopter Rotor in Hover and climbing. Materials for propellers.

Elements of Heat Transfer :

a) Conduction : Heat Transfer process, Heat conduction, Thermal conductivity, General equation of heat conduction in 1-D and 2-D.

b) Convection and Radiation Heat Transfer: Convection process, free convection heat transfer from vertical flat plate, planes, cylinder and sphere, free convection.

c) Thermal Radiation and Emissive power. The Plank distributive law, Radiation properties

Aircraft Gas Turbine Engine : Compressor and Turbine work, compressor and turbine efficiencies, general layout, gas flow diagram. Engine intake and Exhaust nozzles, After burner arrangements for thrust augmentation.

Compressors; centrifugal and axial types of compressors, Materials of Construction.

Combustion chambers : Various arrangements, simplex and Duplex type of Burners. Materials for combustion chambers

Expansion process : Turbine and its action, constructional details of turbine. Materials of construction, general arrangement of turbo-prop and turbo-shaft engines. High and Low by pass ratio, turbo-fan engines, dual shaft gas turbine engines, its merits over single shaft engines.

Gas Turbine Systems and Components : Fuel system components, various types of fuel systems, lubricating oils and lubricating systems. Secondary air systems, arrangements of bleeding of compressor air for aircraft pressurization and oxygen systems. Engine starting systems.

Text Books:

1. J P Holman, Heat Transfer, 2nd Ed., McGraw Hill

2. J D Mattingly, Elements of Gas Turbine Propulsion, McGraw Hill, 1997

3. H. Cohen, G F C Rogers and H I H Sarvanmatto, Gas Turbine Theory, Longman 1987

Reference Books :

1. B Gebhart, Heat Transfer, 2nd Ed., McGraw Hill

2. J L Kererbrock, Aircraft Engine and Gas Turbine, MIT Press, 1991

3. Gordon C Oates, Aircraft Propulsion, System Technology & Design, AIAA Publications

AS5:AIRCRAFTSTRUCTURES-II

Bending of thin plates; pure bending, plate subjected to bending and twisting, plates subjected to distributed load, combined bending and in-plane loading of a thin rectangular plate, energy method for bending of thin plates.

STRUCTURAL STABILITY :

Euler buckling of columns : inelastic stability of columns, effect of initial imperfections, energy method for the calculation of buckling loads in columns, flexural and torsional buckling of the thin walled columns, buckling of stiffenced plates, local instability.

Stress analysis of aircraft components: tapered beams, fuselages, wings, fuselage frames, wing ribs, shear lag.

Matrix methods of structural analysis : stiffness matrix for an elastic springs, pinjointed frame work, application to statically indeterminate frame works, matrix analysis of space frames, stiffness matrix for a beam. Concept and introduction to finite element methods.

Introduction to vibration : Free and forced vibration of single, two and multiple degrees of freedom systems, Principal modes, normal modes, static coupling and dynamic coupling.

Text Books :

2. T H G Megson, Aircraft Structures for Engineering Students, Edward Arnold, U.K.
3. R M Rivello, Theory and Analysis of Flight Structure, McGrawHill Book Co.
4. N G R Iyengar, Structural Stability of Columns and Plates, Affiliated East West Press (P) Ltd, New Delhi.

Reference Books :

1. W T Thomson, Vibration Theory and Application
2. Perry, D.E Azar, Aircraft Structures, McGraw Hill
3. Bruhn, Fundamentals of Aircraft Structures, McGraw Hill

AS6:AIRPLANEPERFORMANCE,STABILITYANDCONTROL

Atmosphere : ISA, Geopotential and Geometric altitude, Troposphere and Stratosphere, stability of atmosphere.

Aerodynamic characteristics : Drag Aerodynamics, Drag polar, estimation of drag. Forces and moments from dimensional analysis, pressure distribution over airfoils, variation with angle of attack, aerodynamic centre, centre of pressure - related problems. Estimation of CL, CD and CM from pressure distribution , variation of aerodynamic coefficients with Reynolds number and Mach number. Effect of span, aspect ratio, planform, sweep, taper and twist on aerodynamic characteristics. High lift devices. V/STOL configurations.

Airplane Performance in Steady and Level Flight : Equations of motion of aircraft, variation of drag with flight, power required and power available, minimum drag and minimum power conditions, climbing and gliding performance.

Airplane Performance in Accelerated Flight : Take off and landing distances, Jet Assisted Take off, Range and Endurance. Turning flight performance.

Static longitudinal stability : Stick fixed static longitudinal stability, neutral point, power effects, stick free static longitudinal stability. Hinge moments, Aerodynamic Balancing, Static Margin. In flight measurement of stick fixed and stick free neutral points.

Maneuvering flight : Elevator angle per g and stick force per g maneuver margin.

Lateral and Directional Stability and Control: Assymmetric flight, weather cock stability, Rudder fixed and Rudder free static directional stability - Rudder lock, dihedral effect. Control in Roll, Aileron control power. Cross coupling of lateral and directional effects. Numerical problems.

Dynamic Stability : Equations of motion of airplane, stability derivatives, split-up of equations in symmetrical and non-symmetric groups of motion.

Analysis of short period and phugoid mode

Analysis of roll and spiral modes, Dutch Roll.

Text Books:

1. John D Anderson Jr., Introduction to Flight, McGraw Hill

2. R C Nelson, Flight Stability & Automation Control, McGraw Hill

Reference Books:

1. B Etkins, Dynamics of Flight, John Wiley

2. E L Houghton and N B Caruthers, Aerodynamics for Engineers, Edward Arnold, UK

AS7:AIRCRAFTDESIGN

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.

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

Basics of 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

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

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.

Introduction to 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

Text Books:

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

Reference Books:

1. E Torenbeek, Synthesis of Airplane Design
2. L M Nicholai, Fundamentals of airplane Design, Univ. of Dayton DHIO, 1975

AS8:PROPULSION-II

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:

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 factor, 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 of 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.

Text Books:

1. J D Mattingly, Elements of Gas Turbine Propulsion, McGraw Hill, 1st Ed., 1997
2. H Cohen, G F C Rogers and H I H Sarvanmutto, Gas Turbine Theory, John Wiely
3. P G Hill & C R Peterson, Mechanics and Thermodynamics of Propulsion, Additson-Wesley, 1970

Reference Books:

1. Gorden C Oates, Aircraft Propulsion Systems Technology & Design, AIAA Publication
2. J L Kererbrock, Aircraft Engines and Gas Turbine, MIT Press, 1991

AS:9MANAGEMENTOFSYSTEMS

Systems Approach to Management : Systems concept; Types and characteristics of manufacturing and service systems; overall conceptualization of business systems, model building; Planning, analysis and control of engineering systems; Communication for planning and control.

Organisational Concepts : Management hierarchy for different types of industry: Organisation principles, structures, tools for coordination and planning

Human Resource Development : Management function for human resource planning-people, profit and productivity. Staffing, recruitment policy, training and development programmes, motivation, incentive and promotion policies, collective decision-making, trade unions and collective bargaining.

Projectology : Project formulation and implementation strategies. Monitoring and control of projects. Project evaluation - benefit - cost analysis.

Management Information System: Significance of information as a corporate resource. Identification, collection, storage and retrieval of information. Frequency of reporting and updating. Introduction to Decision Support Systems.

Planning and Control of Production Systems : Product design and development, product life cycle; Demand analysis and forecasting - Time series analysis, simple exponential smoothing models, input - output analysis. Resource requirement planning. Basic models for shop loading, sequencing and scheduling. Materials requirement planning. Management functions for planning maintenance, maintenance strategies.

Managerial Economics : Concepts of managerial economics; Production and cost analysis; Managerial uses of production and demand functions. Determinants of price - pricing under different objectives. Role, objective and goals of financial management.

Text Books:

1. E S Buffa, Modern Production/Operation management, ES., Wiley Eastern, New Delhi
2. Gupta A K, Management of Systems, Macmillan Book CO., New Delhi
3. Chary S N, Production and Operations Management, Tata McGraw Hill Book Co., New Delhi

Reference Books:

1. S C Keshu & KK Ganapathy, Aircraft Production Technology and Management, Interline Publications
2. Palmer, Maintenance, Planning and Scheduling Manual, McGraw Hill
3. Wright, Management of Organisation, McGraw Hill

(b) Avionics Stream

LS2:AIRCRAFTGENERALSYSTEMS

General Maintenance Practices : Jacking, levelling, and mooring, refuelling and defuelling of aircraft, safety precautions. Hydraulic and fluid systems, precautions against contamination. Identification colour coding, symbols and other markings to identify the fluid systems.

Hydraulic system : Advantages and disadvantages: types of circuits: flow through pipes: pumps and motors: static performance: actuators: seals and backup rings: reservoirs: accumulators: contamination control filters: tubings and hose pipes: indicating and warning systems: emergency and redundant systems valves: flow dividers and integraters: cooling systems.

Servo-Control System : Stability and response: electro-hydraulic servo systems: position and force feedback: frequency response: principles of automatic control

Pnuematic Systems : Airconditioning and pressurisation systems: deicing systems: heat loads: plumbing: coldair units: compact heat exchangers: valves: filters: air bottles: capsules and bellows: indication and warnings.

Oxygen Systems: Gaseous and liquid oxygen systems: breathing masks: oxygen regulators: oxygen bottles: liquid to gas converters: emergency systems: pressure suits: indication and warnings.

Landing Gear Systems : Types of landing gears and their design principles: shock absorbing devices: retracting mechanisms: wheels and brakes: antiskid system: steering systems: indications and dwarnings.

Fuel Systems : Types of fuels: their properties and testing: colour codes: fuel requirements: pumps: fuel transfer systems: fuel tanks: plumbing: valves: indications and warnings.

Lubrication Systems : Types of lubrication systems: lubricants: cleaning agents;

Auxiliary Power Unit - Construction and operational features.

Fire Protection Systems : Types of systems: Flame proofing: Fire walls: Fire detection systems: Fire extinguishing systems.

Seat Safety Systems : Ejection seats: Survival packs: Parachutes: Pilot's personal equipment: life rafts: Doors, Windows and Emergency exits, Seat belts.

System Testing : Ground handling equipment.

Text books

1. J V Casamassa and RD Bent, Jet Aircraft Power Systems, McGraw Hill.
2. E H J Pallet, Automatic Flight Control, BSP Profession Books.1993
3. Civil Aircraft Inspection Procedures (CAP 459), Himalayan Books

Reference Books

1. W Thomson, Thrust for Flight, Sir Issac Pitman.1992
2. Michacl J. Kroes Thomas W.Wild, Aircraft Power Plants, McGraw Hill
3. Michacl J. Kroes, William A Watkins and Frank Delp, Aircraft Maintenance and Repair, McGraw Hill 1993
4. Airframe and Power Plant, Mechanics General Hand Book (EA-AC 65-9A), Himalayan Books1994

LS3:AVIONICS-I

PRINCIPLES

Information : Communication systems: signals, analogue, digital and coded forms, time and frequency representation, signal spectra, types of distortion

Information : Nature and measure, influence of bandwidth and signal/noise ratio on channel capacity, elements of Shannon's theorem and its implications. Problems of communicating in presence of noise.

Modulation : Amplitude, angle and phase modulations, single and vestigial sideband forms, demodulation, Superheterodyne principle, automatic gain and frequency control, typical circuit arrangements.

Pulse modulation : sampling principles, sampling criterion, quantisation and quantisation noise, selection of number and distribution of quantisation levels, bandwidth requirements, examples of coding and decoding circuits.

Transmission : Transmission lines and their circuit representation, characteristic impedance, complex propagation constant, standing wave radio, matching and impedance charts.

Channel Performance : Amplitude and phase distortion, phase and group delay distortion caused by multiple effects. Noise, origin, measurements, noise figure and noise temperature effect on channel performance. Frequency and time division multiplexing.

RADIO & TELEVISION ENGINEERING

Radiation : Principles: application of basic formulae for unipole and dipole, aerials, effective height, directional, properties, gain, impedance, linear arrays, traveling wave aerials, rhombicas, parasitic elements.

Propagation : Principles: influence of ionosphere and troposphere reflection from earth's surface, field strength calculations, fading diversity reception.

Television Waveforms: Scanning, interlacing, horizontal and vertical resolution, bandwidth requirements. Colour television, principles, chrominance and luminance signals, basic definitions of photometry and colorometry, trichromatic systems.

Circuits : Circuits for communication transmitters and receivers, block diagrams and examples of typical circuits, television receivers, Camera and display tubes.

Systems : Description of typical point-to-point and broadcast radio systems, choice of typical parameters (eg. operating frequency, type of modulation, transmitter power level, bandwidth).

Special Systems (Principles) : VHF, UHF, Fibre optics and Laser Technology, Satellite communication and related equipment, electronic counter measures, low-level TV and Head-down displays, CRT displays, Direction finding. Air borne telemetry systems. Laser and infrared systems, Air data and flight recording systems.

Satellite communication, spread spectrum technology: satellite transponders, earth terminals.

Text Books:

1. F E Terman, Radio Engineering, McGraw Hill
2. E C Jordon, Electromagnetic Waves and Radiating System, Prentice Hall
3. B P Lathi, Communications Systems, John Wiley and Sons

Reference Books:

1. Prasad, Antenna and Propagation
2. Schwattz Bennet MWR and Stein S, Communication Systems and Techniques, McGraw Hill, NY
3. Carlson A. N., Communication Systems - An Introduction to Signals and Noise in Electrical Communication, McGraw Hill, New York, 1968.

LS4:CONTROLTHEORYANDPRACTICE

Introduction to Laplace transform, Fourier transforms, Definition of feedback terms, symbols to represent feedback control variables, characteristics of basic feedback loop. Introduction to dynamics of stable and unstable vehicles. Definition of Aerodynamic coefficients, force and moment equations, definition of relaxed static stability , CCV concept in modern flight control system.

Models of Components and Systems : Its variables and equations, modeling of passive electrical components and systems, static and dynamic variables, modeling of DC motors and servo systems, transducer, sensors and actuators, transport delay.

Frequency response analysis :

a) Open loop and closed loop poles and zeros

b) Nyquist diagram

c) Nyquist stability criterion

d) Stability margins, illustration of phase margin and gain margins

The BODE magnitude plot : Studies on BODE phase plot, stability margins on the BODE plot, Time delay effects.

The root focus method : the locus equations, properties and sketching rules, loci for systems.

Time Response : Steady state error, transient response to a input, performance measures.

System design : (a) Signal conversion and processing: Digital signals and coding, data conversions and quatization sample and hold devices, digital to analog conversion, analog to digital conversion, the sampling theorem, reconstruction of sampled signals. (b) Compensation networks, system effects of offset and noise. (c) Servo components: Synchros, Sensors, actuators, computers (d) Electronic design aspects: rating, time delays, reasonable values, etc. proportional controller, proportional integral controller, proportional integral differential controller (PID)

The Z-Transform : (a) Definition of Z Transform (b) Evaluation of Z Transform

(c) Mappling between s-plane and the z-plane (d) the inverse Z transform (e) Theorems of

Z transform.

The State Variable Technique : (a) State equations and state transition equations of continuous data system (b) State transition equations of digital systems (c) Relation between state equation and transfer function (d) Characteristic equation, eigen values and eigen vectors (e) Diagonalisation of A matrix (f) Methods of computing the state transition of A matrix.

Stability of digital control system, time domain analysis, frequency domain analysis.

Text Books:

1. Katsuhiko Ogata, Modern Control Engineering, Prentice Hall of India

2. Robert C Nelson, Flight Stability and Automatic Control, McGrawHill, New York

3. B Etkin, Dynamics of Aircraft, McGraw Hill, New York

Reference Books:

1. Duglas B Miron, Design of Feed Back Systems, Harcourt Brace Jovanovic Publications, NY

2. Benjamin C Kuo, Digital Control Systems

3. Mc Ruer, Ashkenaus and Graham, Aircraft Dynamics and Controls, Prinston Univ. Press, NJ

LS5:AVIONICS-II

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.

Microwave Engineering : Various types of radar transmission Lines, Rectangular and circular waveguides, coaxial lines, field patterns, modes (high order and evanescent), passive components (eg., Directional couplers, filters, isolators and circulators)

Devices: Magnetron, Klystron, backward wave oscillator, Traveling wave tubes, Amplifiers and parametric amplifiers. Diode detectors and mixers.

Aerials and Propagation : Antenna theory, various types of antenna for medium wave, short wave, VHF and UHF frequencies, propagation at microwave frequencies, atmospheric attentnation, effects of precipitation, reflection, Refraction and Diffraction phenomenon, clutter signals.

Electronic Navigation : Maps 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 standard ILS, various categories of ILS accuracy, MLS, Ground Control Approach Systems. Dead reckoning navigation systems, Doppler navigational and inertial navigation, Global Positioning System (GPS), Traffic Alert and Collision Avoidance System (TCAS).

Special Systems : Analogue and Digital computers for aeronautical application, Head up displays.

Text Books:

1. Merril I, Sklonik, Introduction to Radar Systems, McGraw Hill 1980
2. Myron Kayton and Walter R Fried, Avionics Navigation Systems, John Wiley and Sons
3. L Tetley and D Calcutt, Electronic Aids to Navigation, Edward Arnold Publishers Ltd. 1986

Reference Books

1. G J Sonnenberg, Radar and Electronic Navigation
2. B S Walker, Introduction to Computer Engineering
3. P S Dhunta, Avionics for Pilots and Engineers, Deep Publications, 1998
4. F E Terman, Electronic and Radio Engineering, McGraw Hill Book Company

LS7:MAINTENANCEOFRADIO&COMMUNICATIONSYSTEMS

Basics 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).

AC and DC measuring instruments.

Electrical power distribution systems, the operation and construction of static inverters, rotary inverters and transformer rectifier units.

Basics of interference caused by electrical and ignition system to radio apparatus, methods of minimizing or suppressing such interference, bonding and screening.

Construction and Identification of various types of antennas; the voltage and current distribution along antenna of various length; characteristics of ground planes.

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.

The performance levels expected and specifications of typical airborne HF and VHF communication systems; the principle of operation, installation practices and procedures, functioning of the operating controls and indications and maintenance of typical HF and VHF communication transceivers.

Theory of operation, performance level and specifications of an Audio Integration System.

Working principles and testing of Lead Acid and Nickel Cadmium and Silver Zinc batteries

Principles, Characteristics and operation of the undermentioned systems:

- Automatic Direction Finder (ADF) Systems,
- Very High Frequency (VHF) Omn, Directional Range System.
- Instrument Landing Systems,
- Weather Radar Systems.
- Microwave Devices.
- Air Traffic Control (ATC) Transponder System.
- Omega Navigation System.
- Radio Altimeter Systems
- Cockpit Voice Recorder.
- Distance Measuring Equipment
- Doppler Navigation System.
- Microwave Landing System
- GPWS

- Emergency Locator Transmitters.
- Computers
- Simulators.
- Flight Control Systems.

Basics of state-of-the-art communication and navigation systems.

Principles of Satellite Communications and its application to aircraft.

Text Books:

1. RF Hansforde, Heywood and Company London: Radio Aids to Civil Aviation.
2. George Kannedy: Electronic Communication System, McGraw Hill
3. Brian Kendal: Manual of Avionics, Blackwell

Reference Books:

1. Dennis Reddy and John Cooler: Electronic Communication, Prentice Hall of India, New Delhi.
2. J. Powell: Aircraft Radio Systems, Himalayan Books
3. Keith W. Bose: Aviation Electronics, Jeppesen

LS8:AIRCRAFTINSTRUMENTS

Units and Standards, theory of measurement, functional analysis of measurements, errors and error estimation. Measurement of voltage and current in DC and AC, VTVM digital voltmeter, measurement of power, phase angle, power factor. Extension of range by instrument transformers, fluxmeter, measurement of frequency, heterodyne techniques and digital frequency counters, signal generators.

Measurement of circuit elements, LCR direct and bridge methods. Waveform analysis, Cathode ray oscilloscopes, measurement of harmonic and Intermodulation distortion, distortion analyser, spectrum lanalyser.

Generalised configurations and performance characteristics of instruments, motion requirement, relative displacement and velocity. Translational and sesmic displacement, velocity and acceleration measurements. Torque measurement and rotating shaft, pressure and flow measurements. 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

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.

Moving map displays, multifunction displays, head-up displays, glass cockpit. Cockpit lighting, panels:integral, glopanels.

Typical Electronic/ Digital Aircraft Systems

- ECAM (Electronic Centralised Aircraft Monitoring)
- EFIS (Electronic Flight Instrument Systems)
- EICAS (Engine Indicating & Crew Alerting Systems)
- FMS (Flight Management Systems)

Text Books

1. E H J Pallet: Aircraft Instruments - Principles and Applications, Himalayan Books
2. E H J Pallet, Automatic Flight Control, Blackwell
3. Leach Malvino, Digital Principles and Applications, Tata McGraw Hill

Reference Books:

1. A K Sawhney: Electrical Measurements and Measuring Instruments.
2. C.A. Williams: Aircraft Instruments, Galgotia
3. Civil, Aircraft Inspection Procedures (CAP459) Two Volumes, Himalayan Books.

(C) Maintenance & Production Streams (Mechanical & Electrical)

PS1:AIRWORTHINESSANDAIRREGULATIONS

Introduction to aircraft rules as far as they relate to airworthiness and safety of aircraft. Airworthiness requirements for civil and military aircraft CAA, FAA, JAR and ICAO, regulations, Defence standards. Military standards and specifications.

Privileges and responsibilities of various categories of AME license and approved persons. Knowledge of mandatory documents like certificate of Registration, certificate of Airworthiness - conditions of issue and validity. Export certificate of Airworthiness. Knowledge of Log Book, Journey Log Book, Technical Log Book, etc.

Procedure for development and test flights and certification. Certificate of Flight release, Certificate of Maintenance, Approved Certificates.

Technical Publications, Aircraft Manual, Flight Manual, Aircraft Schedules.

Registration Procedure, Certification, Identification and Marking of Aircraft.

Modifications, concessions, airworthiness directives, service bulletins. Crew training and their licenses, approved inspection, approved materials, identification of approved materials. Bonded and quarantine stores. Storage of various aeronautical products like rubber goods, various fluids.

Accident investigation procedures. Circumstances under which C of A is suspended.

ICAO and IATA regulations, Chicago and Warsaw conventions.

Familiarisation of recent issues of Advisory Circulars.

Civil Aviation Requirements Section 2 - Airworthiness.

Text Books and Reference Books:

1. The Indian Aircraft Act and the Rules
2. Manual of Civil Aviation
3. DEF STANDARD 970
4. Gran E L, Statistical Quality Control, McGraw Hill
5. Civil Airworthiness Requirements
6. Aeronautical Information Circulars (relating to Airworthiness)
7. Advisory Circulars - DGCA
8. Civil Aircraft Airworthiness Information and Procedures (CAP 562)
9. Civil Aviation Requirements Section 2 - Airworthiness.

PS2:AIRCRAFTMATERIALS

Engineering Materials, Structural properties of materials, Atomic and lattice structure, Bonding in Solids, Imperfections in crystals, Solid phase and phase diagrams, mechanical properties and testing, Isotropy, Orthotropy, True stress and strain, Strength and elasticity, Stiffness, Resistance, Plasticity, Ductility, Toughness and Hardness of materials. Concept of Fatigue and Creep. Mechanical Testing. Factors Affecting Strength. Deformation, Plasticity and Viscoelasticity, Fracture. Heat treatment, Chemical, thermal and Technological Properties, Board classification of aircraft materials. Ferrous materials, nonferrous materials and alloys, ceramic materials and fibre reinforced composite materials, polymers, metal matrix particulate.

Furnishing Materials : Plastic, wood, plywood, glue, dopes and rubber used in aircraft manufacture. Methods of testing and storage. Paints, surface finishes and materials. Specifications: Indian Standard, British, American, French, German, and International specifications.

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.

Text Books:

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

Reference Books:

1. King and Butler, Principles of Engineering Inspection, Clever Humes Press.
2. C G K Nair, Aircraft Materials, Interline
3. Balram Gupta, Aerospace Materials, S Chand

PS4:AIRCRAFTPRODUCTION

Introduction : Function of process planning (Methods). Organizing for process planning - place in production planning and control. Relationship with other departments. Tool engineering.

Heat Treatment : Final and intermediary heat treatment operations carried out on aircraft materials (both ferrous and non-ferrous) and the equipment used, the importance of test pieces. Finishing by anodizing.

General activities carried out in manufacturing and assembly shops, machine shop, sheet metal shop, welding shop, plastic shop and assembly shop.

Process Shop : Theory of planting, finishing processes carried on aircraft materials - planting and finishing equipment.

Jigs and Fixtures : Importance of special production tools used in manufacturing activity of various types of jigs and fixtures used in aircraft industry. Difference between jigs and fixtures. Design consideration. Choice of materials. Types of assembly fixtures such as table box, picture-frame, next and so on. Typical jigs for wings, fuselage and control surfaces, jigs and fixtures for turning, milling and drilling. Universal tooling.

Cutting Tools : Theory of metal cutting. Typical types of cutting tools used in the manufacturing shops, the advantages, of tipped tools. Ceramic tools, tool life, optimum cutting speeds and feeds, factors limiting speeds, feeds and cuts. New development in cutting tools, use of DBN Diamond, ceramics and coating on cutting tools

Inspection Gauges and Equipment : Various inspection gauges in the manufacturing shops and their application. Fits. limits and tolerances, engineering reference systems, station and datum lines, chord and fuselage reference lines, lofting aerofoils, use of templates, test equipment used in aircraft production, necessity for and importance of interchangeability media, application of inter-change-ability media viz., acceptance gauges, reference gauges, aperture gauges. Use of digital read out on measuring tools.

Process Planning : Definition of mass and batch production, various types of charting techniques viz., operation process chart, flow process chart etc., definition of planning breakdown and its importance, factors to be considered for process planning, comparison of methods, simple exercise on process planning - simple machine shop and sheet metal components. Different approaches in process planning during pre-production and production phases.

Text Books and Reference Books :

1. M L Begman. Manufacturing process, Media Promoters
2. ASTME, Tooling for Aircraft and Missile Manufacture
3. Sachs, Sheet Metal Fabrication
4. S C Keshu and K K Ganapathy, Aircraft Production Technology and Management, Interline 1993

PS5:PRODUCTION,PLANNINGANDCONTROL

Scope of Production Management : Elements of production-the production cycle-Necessity for planning and control-analysis of production planning and control functions. Production planning control as the nerve system of the production unit.

Factors affecting planning, forecasting information necessary for pre-planning. Sources of information. Methods of forecasting, aircraft components requiring overhaul, repair, modifications, premature, failures, Project planning. Estimates of plant, machinery, buildings, manpower, materials, spare parts, time and cost estimates.

Materials, Machines and Processes : Production engineering knowledge necessary for planning, machine tools and processes. Materials including aircraft materials and their processing, Spare parts required for overhaul and maintenance. Ground handling equipment. Testing of components and aircraft after overhaul. Standards for acceptance after overhaul.

Equipment and Tools : Pre-planning required for provision of special tools, jigs, fixtures and test equipment required for overhaul and maintenance. Types and description of major test equipment.

Production Planning : Production planning function of routing estimating and scheduling-LOB-CPM and PERT. Queing theory, sequencing in jobs, shop scheduling. Assembly line balancing. Charts and graphs.

Production Control : Production control functions of dispatching, progressing and evaluation. Activities of progressing. Shop procedures. Maintenance of critical data statistics of evaluation control charts.

Design of PPC Systems : PPC as a management information. System design parameters. Charting information for systems charts.

ORGANISING FOR PPC : Centralized and decentralized systems. Organizing PPC around information flow-concepts and practices in Indian Airlines and Air India, practices in other countries.

Text Books and Reference Books :

1. Frankling S Moore, Production Control, McGraw Hill.
2. E H MacNiec, Production Forecasting Planning and Control John Wiley.
3. Landy Thomas, Production Planning and Control M,McGraw Hill.
4. Carson Gordon, Production Hand Book B Ronald Press Company.
5. Mages John F., Production Planning and Inventory Control, McGraw Hill.
6. Churchman, Operations Research, Ackoff and Arnoff.
7. Hoffman and Wadsworth, Production Management and Manufacturing Systems.
8. K C Batra, Production Management

(C.1) Maintenance & Production Stream (Mechanical)

PSM1:MAINTENANCEOFPOWERPLANTANDSYSTEMS

Piston Engines : Two and four stroke engines. Efficiency, factors affecting engine performance. Knowledge of the function and construction of various parts and accessories of the engine including induction, exhaust and cooling system, engine mounting. Engine fire detection and protection systems.

Propellers : Knowledge of purpose and functioning of parts of constant speed, variable pitch and feathering propellers and associated control system components.

Engine fuel and Oil System : Construction, features of carburettors, engine fuel and oil systems. Characteristics of aviation fuel and oil, common sources of contamination, methods of checking contamination.

Ingition and starting systems : Magnetos and ignition system components, various types of engine starters.

Engine Instruments : Principle of operation. Superchargers-constructional features and principles of operation and function of various types of superchargers and its related component.

Gas Turbine : Principle of operation, general constructional details and function of various type of gas turbine engines such as turbojet, turbo fan and by-pass engine. Theory of gas turbine engines, advantages and disadvantages of each type. Induction, exhaust and cooling systems, anticing of engine, engine mountings, thrust augmentation. Compressor surge and stall, bleed control system. Principles of operation, general constructional details and functions of fuel and oil systems, ignition and starting systems and their components. Engine controls of various types, including Full Authority Digital Electronic Control Engine instruments. Power augmentation devices, thrust reversers and auxiliary power units.

Engine Maintenance : Piston/Gas Turbines: Periodical servicing procedures, engine installation checks, control rigging, ground running checks, priming, bleeding and performance checks. Engine on condition maintenance. Trouble shooting and rectification. Inspection after shock landing. Crack detection. Procedure for long and short terms storage of engine and accessories, engine preservation and depreservation.

Text Books and Reference Books :

1. E Mangham and A Peace, Jet Engine Manual, Himalayan Books
2. Jet Engines, Rolls Royce Ltd. 1992
3. Casamassa and Bent, Jet Aircraft Power Systems, Tata McGraw Hill
4. Civil Aircraft Inspection Procedures (CAP 459), Himalayan Books
5. Pratt and Whitney, Gas Turbine Engine
6. Michacl J. Krose Thomas W.Wild, Bent, Aircraft Power Plants, McGraw Hill 1994
7. H Cohen, G F C Rogers and H I H Sarvanmutto, Gas Turbine Theory, John Wiely
8. Irvine Treager, Aircraft Gas Turbine Engine Technology, Tata McGraw Hill 1997

PSM2:MAINTENANCEOFAIRFRAMEANDSYSTEMS

Airframe Structure : Various types of structures in aiframe construction, tubular, braced monocoque, semimonocoque, etc, longerons, stringers, formers, bulkhead, spars and ribs, honeycomb construction. Airplane controls, ailerons, elevators, rudder, trimming and control tabs, leading and trailing edge flaps, tailplane and fins. Basics of structure and structural components fabricated from metal, glass fibre, vinyl, prespex, composites. Finishing materials, paints, surface finishes and associated materials.

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, oxygen, air-conditioning and pressurisation systems, wheels, tyres, brakes, antiskid system. Windows, doors and emergency exists. Reliability and redundancy of systems design.

Inspection : Basic principles of inspection, inspection gauges, and tools. Standard inspection techniques and procedures. Go/No go gauges, gauge calibration and maintenance, limits and tolerance. NDT techniques.

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, Periodical inspections, heavy landing, overweight landing checks, abnormal flight loads. Aircraft weighing, weight schedule, calculation of centre of gravity.

- Electrostatic Sensitive Devices
- Electromagnetic Environment

Typical Electronics/ Digital Aircraft Systems

- Electronic Centralised Aircraft Monitoring (ECAM)
- Electronic Flight Instrument Systems (EFIS)
- Engine Indicating & Crew Alert Systems (EICAS)
- Fly by Wire (FBW)
- Flight Management Systems (FMS)

Text Books and Reference Books :

1. Aircraft Manual, government of India.
2. Civil Airworthiness requirements CAA, UK.
3. FAR's FAA, U.S.A.
4. Parkinson, Engineering Inspection, Wheeler
5. Michacl J. Kroes and James R Fardn, Aircraft Basic Science, McGraw Hill
6. Michacl J. Kroes and William A watkins, Aircraft Maintenance and Repair, McGraw Hill
7. Civil Aircraft Inspection Procedures (CAP 459) Pt II Aircraft, Himalayan Books
8. Airframe and Power Plant Mechanic (AC 65-15A) Airframe Hand Book, Himalayan Books.1991

(C.2) Maintenance & Production Stream (Electrical

PSL1:MAINTENANCEOFELECTRICALANDINSTRUMENTSYSTEMS

Group 'A' Instruments:

Principle of operation of rate of climb and descent indicators and their design requirements. The use of variable leak and theory of equation of constant 'n' of the instrument.

Theoretical basis of airspeed and Mach number measurement. Mathematical derivation of formula for indicated airspeed, Machmeter calibration and maximum safe airspeed indicator, design details of airspeed indicators, Machmeter and safe airspeed indicator

Theory of operation of an accelerometer, constructional details, accuracy of measurement.

Measurement of total and static pressure - design of a pressure head, accuracy of measurement of static and pilot pressure for subsonic and supersonic speed.

Transmission of the measured pressure to the instruments and effect of errors in pressure measurement to the indicators.

Definition of a gyroscope and the effect of external torques on the gyroscopic system: -

i) Effect of earth's rotation, Gyro wander and gimbal lock, Toppling of a gyroscope.

ii) Monitorted gyroscope and restrained gyroscope.

iii) Design criteria of gyroscopic instruments and their errors.

Construction and Principle of operation of a Bourdon tube. Construction and operation characteristic of diaphragms and bellows under pressure reversals.

Theory of magnetism, magnetic moment, magnetic potential, terrestrial magnetism and description and constructional details of direct reading compass :

i) Acceleration error and turning error.

ii) Construction and working of a compass.

iii) Installation and compensation of DR Compass.

Group 'B' Instruments:

Thevenins theorem as applied to DC Circuits. The unit exponential functioin. Transient response of RC circuits. Decible conversion, converting ammeter to voltmeter. Input resistance of a voltmeter and voltmeter loading error. Construction of an ohm meter and volt ohm millimeter.

Construction and operation of Deflection type instruments Permanent magnet moving coil types:

Moving iron type-electrodynamic type - induction and electrostatic type.

Temperature measurement in a fluid in motion : Construction and working principle of

i) Electrical transmitting thermometers.

ii) Resistance thermometers.

iii) Thermoelectric thermometers and their cold junction compensation by bimetallic and resistance element.

Working principle of electric tachometer and synchroscope. The theory and working principle of the following remote indicating systems :

Desyn, autosyn, selsyn and magnesyn.

Theory and construction of electromechanical fluid flow indicators - positive displacement type and inferential type.

Measurement of fuel contents - Theory and working principle of ' Pacitron' systems developed by Honeywell and Smith.

Text Books and Reference Books:

1. E H J Pallet; Aircrarft Instruments; Himalayan Book New Delhi 1981
2. C A Williams; Aircraft Instruments, Galgotia Publications New Delhi 1973.
3. C A Williams, E W Knott and E Sloley - Aircraft Instruments, Himalayan Books
4. R W Sloley and Coulthard; Instruments.

Electives

OS1:PRINCIPLESOFHELICOPTERENGINEERING

Introduction : Helicopter as an aircraft, Basic features, Layout, Generation of lift, Main rotor, Gearbox, tail rotor, power plant, drive to main and tail rotor, considerations on blade, flapping and feathering, Rotor controls various types of rotor, Geometry of the rotor, Blade loading, Effect of solidity, profile drag, compressibility etc., Blade area required, number of Blades, Blade form, Power losses, Rotor efficiency.

Aerodynamics of Rotor Blade : Aerofoil characteristics in forward flight, Hovering and Vortex ring state, Blade stall, maximum lift of the helicopter calculation of Induced Power, High speed limitations; parasite drag, power loading, ground effect.

Power Units and Flight Performance : Piston engines, Gas turbines, Ramjet principle, Comparative performance, Horsepower required, Range and Endurance, Rate of Climb, Best Climbing speed, Ceiling in vertical climb, Autorotation.

Dynamic Stability and Control : Physical description of effects of disturbances, Longitudinal dynamic stability, stick fixed dynamic stability, longitudinal stability characteristics, lateral dynamic stability, lateral stability characteristics, control response.

Differences between stability and control of airplane and helicopter.

Rotor Vibrations: Dynamic model of the rotor, Motion of the rigid blades, flapping motion, lagging motion, feathering motion, Properties of vibrating system, phenomenon of vibration, fuselage response, vibration absorbers, Measurement of vibration in flight.

Rotor Blade Design: General considerations, Airfoil selection, Blade construction, Materials, Factors affecting weight and cost, Design conditions, Stress analysis.

Text Books and Reference Books :

1. John Fay, The Helicopter and How It Flies, Himalayan Books 1995
2. Lalit Gupta, Helicopter Engineering; Himalayan Books New Delhi 1996
3. Joseph Schafer, Basic Helicopter Maintenance, Jeppesen 1980
4. R W Prouty, Helicopter Aerodynamics

OS2:GASDYNAMICS

Normal Shock Waves : Equation of motion for a normal shock, normal shock relations for a perfect gas, stagnation conditions, Rankine-Hugoniot relations Propagating shock waves, weak shock, Reflected shock wave, centered expansion waves, shock tube.

Oblique Shock Waves : Introduction, oblique shock relations, relation between shock angle and turning angle, use of oblique shock chart, Supersonic flow over a wedge, weak oblique shocks, Supersonic compression, Detached shock.

Expansion Waves : Supersonic expansion by turning, Prandtl-Meyer flow. Simple and non-simple regions. Reflection and interaction of shocks and expansion waves, Mach reflection, method of characteristics.

Airfoils in Compressible Flow : Introduction: Linearized compressible flow, Airfoils in subsonic flow, Prandtl-Glauert transformation, critical Mach number, supercritical flow, Airfoils in Transonic flow, Governing equation, Shock wave-boundary layer interaction, stability and control problems.

Lift and drag in supersonic flow : Shock expansion theory, Flow field in supersonic flow. Thin airfoil theory, Analytical determination of lift, drag coefficients on flat plate, bi-convex, diamond -shaped profiles in supersonic flow. supersonic flow past wings.

Potential equation for compressible flows : Introduction, Crocco's theorem, derivation of basic potential equation for compressible flow, linearization of potential equation & boundary conditions. Small perturbation theory, application to wavy wall and bodies of revolution.

Measurements in compressible flows; Instruments used in compressible flow; Rayleigh - Pitot-formula, Subsonic, transonic and supersonic wind tunnels- Design and operation of supersonic wind tunnel. Flow visualization by interferometer, schlieren and shadow graph methods. Instrumentation for Hypersonic wind and shock tunnels, Aeroballistic range, Terminal ballistic range. Rocket-sled facility.

Text Books:

1. John D Anderson, Modern Compressible Flow with Historical Perspective
2. E Rathakrishnan, Gas Dynamics
3. Arnold M Kuethe Chuenyen, Chow, Foundations of Aerodynamics, 4th Ed., John Wiley & Sons

Reference Books:

1. M J Zucrow and Hoffman, Gas Dynamics
2. A Pope & K L Goin, High Speed Wind Tunnel Testing
3. J Lucasiwicz. Experimental Methods in Hypersonics

OS3:WINDTUNNELTESTING

Aerodynamic testing facilities for different speed regimes, low speed wind tunnels, main features of supersonic, transonic and hypersonic tunnels, shock tunnels, closed and open circuit tunnels.

Design of contraction and diffuser and other components. Instrumentation and calibration of test section.

Testing procedure, data reduction, blockage effects and boundary layer corrections, correction to lift drag, moment coefficient due to wind tunnel wall interference.

Measuring devices, pitot static tube, yaw probes, five hole probe, hot wire anemometers, scanivalve system; Flow visualization techniques oil flow, tuft survey and smoke.

Flow field pressure measurements, Schlieren, shadowgraph and interferometer technique, laser Doppler anemometer; Wind tunnel balances, mechanical and strain gauge balances and their design. Scale effects.

Non - aeronautical use of wind tunnels.

Text Books:

1. W H Rae Jr and Allen Pope, Low Speed Wind Tunnel Testing, John Wiley & Sons, 2nd Ed.
2. A Pope and L K Goin, High Speed Wind Tunnel Testing, John Wiley & Sons
3. A Pope and J J Harper, Low Speed Wind Tunnel Testing, John Wiley & Sons.

Reference Books

1. Goethert B H, Transonic Wind Tunnel Testing, Pergaman Press

OS4:VIBRATIONANDAEROELASTICITY

Rectilinear Motion of a Particle : Differential equation of motion in a resisting medium. Free vibrations with viscous damping. Forced vibration with harmonic disturbing force and general disturbing force. Plane harmonic motion. Motion of a projectile with and without damping. Motion of a particle subjected to a central force, planetary motion.

Dynamics of System of Particles: Principle of linear momentum and angular momentum. Rectilinear motion of a variable mass, Rockets. Kinetic energy and work. Law of conservation of energy.

Dynamics of a System with Constraints : Equations of constraints. Generalized coordinates. Generalized forces, Equations of equilibrium in generalized coordinates. Application of generalized coordinates in bending of beams. D'Alembert's principle. Lagrange's equation and applications. Hamilton's principle and applications.

Small Oscillations of Conservative Systems : Free vibrations of conservative systems. Linear oscillations of two coupled masses. Free vibration of systems with two degrees of freedom and systems with several degrees of freedom. Principal modes and their orthogonal property. Normal modes, static coupling and dynamic coupling. Approximate methods of calculating principal frequencies.

Dynamics of Elastic Bodies : Vibration of a string under tension. Free vibration of beams with various end condition and the determination of the various modes of vibration and their natural frequencies. Vibration of beams with concentrated masses. Critical speed of a rotating shaft. Forced vibration of beams. Torsional vibration of a shaft and disc-shaft combination. Approximate methods of calculating natural frequencies.

Aeroelasticity : Elements of aeroelasticity. General nature of aeroelastic problems. Nature of static aeroelastic phenomenon. Wing divergence and control system reversal for an idealized two dimensional wing and approximate solution for a finite wing. Flutter phenomena and flutter analysis. Difference between flutter instability and resonance. Simplified expressions for aerodynamic forces and moments for an oscillating airfoil. Determination of flutter speed and frequency for an idealized two dimensional wing as well as for a finite wing. Methods of flutter control and prevention. Elementary theory of buffeting.

Text Books and Reference Books:

1. S Timoshenko, Vibration Problems in Engineering, Van Nostrand. 1982
2. W T Thomson, Vibration Theory and Application, Allen and Unwin
3. Y C Fung, Introduction to the Theory of Aeroelasticity
4. R L Bisplinghoft, H Ashley and R L Halfman, Aeroelasticity, Addison Wesley.

OS5:CAD-CAM

CAD : History and development of computer aided design, hardware and software. Principle of modelling, drafting and their differences. Basic geometric entities and their representation in the data base. Manipulation of geometric entities. Verification and analysis of geometric entities. Different types of modelling, wireframe, surface and solid modelling.

Merits and demerits of different types of modelling. Display, shading and filing in modelling. Geometry data transfer between different CAD systems - use of translators. Review of existing CAD systems. Application areas and their relevance to Industrial needs. CAD interface to finite element analysis, computational fluid dynamics etc.

CAM : Concepts of NC, classification of NC Systems, CNC systems concepts and working principles, types of interpolators. Axis drives and classification of control systems, NC/CNC programming: manual, computer assisted and integrated CAD/CAM techniques. Mode and structure of NC programmes. Local and machine co-ordinate system. Codification of NC programs and tape preparation systems. Two axis, three axis and multiaxis programming for different applications.

Linear, circular and helical interpolations, co-ordinate/axis translations, rotations, axis symmetry, mirror imaging, work offsets, tool length, diameter and tool nose radius compensation. Tools and tooling for CNC, vacuum fixturing and modular tooling. Net working and distributed numerical control. Customized post processors and generic post processors. Quality control methodologies and advanced inspection techniques. CNC practices and general safety measures.

CIM : computer integrated manufacturing concepts.

Text Books and Reference Books :

1. Mikell P Groover and Zimmers Jr, CAD/CAM Computer Aided Design and manufacturing, Prentice Hall.
2. Eric Teicholz, CAD/CAM Hand Book, McGraw Hill Publications.
3. Warren S. Seames, Computer Numerical Control Concepts and Programming, Delmer Publishers Inc.

OS6:INDUSTRIALENGINEERING

Industrial Economics : Economics and society-wealth, capital and income-profit, theory and surplus value. Demand and supply, law of diminishing returns. Monopolies, Trust, Cartels and Managing Agencies-Markets and Stock Exchange. Monetary and Fiscal systems, Joint stock companies-stock exchange. The company's act. Mixed economy-public and private sectors. Companies, corporations and departmental organizations. Five year plans.

Economic Analysis : Feasibility studies - systems of returns. Allowance for errors and estimates. Decision making. Uncertianity. Breakeven and minimum cost analysis. Replacement problems. Utilization of personnel, depreciation and taxation.

Cost accounting and Control : Cost Accounting - Capital and Revenue expenditure. Direct and indirect costs. Factory overheads. Evaluation of cost accounting, data pricing, budgets and balance sheet. Standard costing, pricing and saleability depending on market. Evaluation of operations like loading of equipment, utilization, economic order quantities, economic batch quantities and other factory operations.

Production Cycle : Generation of demands by consumers. Market Research, Product Development. Activities of research and development. Production Management Functions. Materials and quality control.

Personnel Management : Personnel Management Staff and line responsibilities. Selection and Induction. Promotion, termination and retirement. Working conditions, health and welfare. Discipline. Grievance procedures. Responsibilities in the line management. Maintenance of good employee relation.

Tex Books:

1. Ravi Shankar, Industrial Engineering and Management, Galgotia
2. Dinesh Kumar, Industrial Engineering and Management, Galgotia
3. Juran, Gryna, Quality Planning and Analysis, Tata McGraw Hill

Reference Books

1. Rasul Castro, Corporate Aviation Management, Illinois Univ. Press.

OS7:TOOLDESIGNANDFABRICATION

Tooling Materials : Selection of material, properties, testing, heat treatment and application.

Jigs and Fixtures : General design consideration, types of jigs, construction methods, bushing types and application, types of fixtures and their technological construction methods. Assembly jigs, Sub assembly jigs, etc.

Sheet Metal Tooling : Shearing, bending, forming, drawing dies, progressive, compound and combination dies, multiform tools, rubber dies, stretch form tools and spinning tools.

CNC Tooling : Materials, design consideration, construction of tools and application

Cutting Tools : Fundamentals of Cutting Tool design, design of single point cutting tools, multiple point cutting tools design of form cutters. Tool life, wear etc.

Gauges : Design of plain, taper and thread gauges for bolts internal and external features, functional gauges.

Moulds and Dies : Basic concepts on plastic moulds, die casting dies, forging dies, design and application.

Metrology : Measuring instruments like vernier, screw gauges, slip gauges, height gauges, comparators, CMM, optical tooling for jig setting, principles and application.

CAD/CAM : CAD/CAM and its application in tool design and manufacture.

Text Books and Reference Books :

1. ASM Metal Hand Book Vol I & II, ASM Intl., USA
2. R K Jain, Metrology, Khanna Publications, Delhi 1981
3. S Roth (SME), Functional Gauges
4. Sen & Bhattacharya, Principles of Metal Cutting, New Central Book Agency, Calcutta
5. S K Basu and Mukherji, Fundamentals of Tool Engineering Design
6. Fixtures Design Handbook, ASTME

OS8:STATISTICSANDQUALITYCONTROL

Quality Control : Definitions of quality, quality control and inspection, difference between quality control and inspection. Drawbacks of inspection. Concept of total quality control, quality characteristic, variables and attributes.

Collection and organizing data. Histograms, measurement of variability. Frequency distribution, normal or Gaussion distribution relative frequency, change and assignable causes, meaning of state statistical control measures of location and dispersions.

Control charts for individual measurements, average and range interpretation of control charts, calculation of control limits, standard deviation.

Test of significance of means. Regression analysis. Definition of process capability, specification, inter-relationship of tolerance, fits and clearances, chance errors of measurement, procedures for studying process capability of machines and processes.

Theory of probability, characteristics of binomial and Poisson distribution. Control charts for fraction defectives, number of defectives, defects per unit, interpretation of control charts. Acceptance sampling. OC Curves, published sampling plans, acceptance sampling by attributes AQL, AOQL and LTPD CONCEPTS, concepts.

Use of control charts like cumulative sum charts, master control system and special purpose charts, control by gauging. Design of experiment, factorial experiments. Quality costs, failure costs, appraisal costs and prevention costs.

Managing programme of reliability, life testing maintainability. Total quality control: Organizing for quality control of incoming material, control of process, evaluation of product and quality audit. Quality control organization: Manpower requirements, Solutions, testing and training.

Improving quality mindedness: Seminar, appraisal talks, inplant training, exhibitions, posters, vendor relations. Vendor quality rating. Selection of vendors. Establishing of Vendor Quality Standards. Exchange of information. Inspection of vendor material, technical assistance to vendor.

Managing, inspection and test. Acceptance in general inspection planning, Selection of inspection stations, interpretation of specifications, Classification of defects. Quality control manual.

Inspection of component finishing processes.

Measurements : Conflict in measurements, maintaining accuracy of instruments, design of measuring equipment, accuracy of inspection.

Non Destructive Tests for both metallic and non metallic material by radiography ultrasonic methods, magnetic particle inspection eddy current, dye penetrant and visual inspection, acoustic emission etc. Defect investigation and analysis.

Metrology : Knowledge of instruments and devices of accurate physical dimensional checks covering linear measurements, intricate geometric shapes, contours and profiles. Internal and external diameters of screwthreads etc and gear testing. Measuring surface roughness, flatness and clearance between mating surfaces.

Text Books and Reference Books :

1. T R Banga, N K Agarwal and S C Sharma, IE and M Science, Khanna Publishers
2. Ravi Shankar, Industrial Engineering and Management, Galgotia
3. John S Oakland and Roy F Followell, Statistics Process Control, EWP
4. Dinesh Kumar, Industrial Engineering Management, Galgotia
5. J M Juran and F M Gryna, Quality Planning and Analysis, Tata McGraw Hill
6. S Dalela, Mansoor Ali, IE and MS, Standard Publishers

OS9:AIRNAVIGATION

The Problems of Air Navigation : The Aircraft, Aids of Navigation VOR, ADF, ILS, MLS,GCA, DME, TACAN. Doppler and basics of inertial navigation inertial reference system, Their limitations and uses. Weather, Air Traffic Control, Communications, GPS, TACAS, ATC Interrogation Radar.

The Earth: Its Form & Features : Principle Physical Features of the Earth, Latitude, Sidereal Time. The Seasons, Climate, Duration of daylight,

Chart Projection for Air Navigation : The Round Earth on a Flat Chart. Properties obtainable in Projection. Distance on Sphere. Direction on a Sphere. The Lambert Projection. The Mcrcator Projection, The Gnomonic Projection. The Stereographic Projection. Projections for Weather Charts. Calculation on Rhumb Line Tracks and distances.

Magnetism : Review of the Elementary laws of magnetism. Terrestrial magnetism, Horizontal and vertical components of earth's magnetic field and their variation with latitude. Isogonic and agonic lines. Isoclinic lines. Aircraft Magnetism; Resolution into P,Q and R components, coefficients and deviation associated with them, compass course deviation.

Instruments : Units of measurement of distances and height. The function of navigational Instruments. The Speed Indicator. The Rate of Climb indicator. The Altimeter. The magnetic Compass. The Turn and Bank indicator. The Directional Gyro. The Artificial Horizon. Radio, Radar Altimeter. Machmeter. Fluxgate Compass ADI, HSI and RMI.

Chart Reading : Distinctive Properties of Charts. The importance of chart reading. Topographic Information. Aeronautical Data. Legend and written Notes. The practice of Chart Reading.

Dead Reckoning : The place of Pilotage. Advantage of Dead Reckoning. Basic Problems in Dead Reckoning.

Special Problems & Dead Reckoning: Climb and Descent. Off-course corrections. Double Drift. Radius of Action. Cruise Control. Alternate Airport Problem. Interception. Tracking Equal time point, point of safe return.

Air Navigation Computers : Function and Usefulness. The Slide Rule Side. The Wind Triangle Side.

Radio Navigation: Principles of radio transmission and reception; properties of electromagnetic waves; classification of frequency bands, elementary knowledge of Radar.

An elementary knowledge of principles of the following radio and radar aids and systems:

Airborne D/F : The manual loop and automatic radio compass including methods of Calibration.

Ground D/F : M.F., H.F. and V.H.F. Systems.

Radio/Radar track guides approach and landing aids and systems including V.O.R., N.D.B., I.L.S. and M.L.S.

Plotting Radio Bearings on Mercator Charts and Lambert Chart. Relating Bearings.

Celestial Navigation : Elements of Astronomy; the universe; Solar system, movements of earth, moon and planets, earth's orbit; Kepler laws, declination, altitude, azimuth etc. Practical Value. Accuracy. Simplicity. Basic principles. The Line of position. Celestial Coordinates. Determining the Greenwich Hour Angle (GHA) Determining the Local Hour Angle (LHA). A Line of position from Polaris. A Line of Position from an Unidentified Star. Radio Time Signals. Identification of Stars. Star Names. Brightness of Star. The planets. Motion of the Stars and Planets. The Practice of Celestial Navigation. Astro-Navigation instruments.

The Practice of Navigation : Details of Navigation. Preparation of Charts for use in Flight Pilotage. Contact Instrument Flying. Future Air Navigation system(FANS), Cruise controls, Flight planning using charts and tables, Extended Range Operations, Aircraft Performance.

Pressure Pattern Flying.

Text Books and Reference Books:

1. The Air Pilot's Manual, Flying Training Vol.3, Airlife Publishing
2. J E Hitercock, Navigation for Pilots, Airlife Publishing 1997
3. R B Underdown, Ground Studies for Pilots, Vol.3, Blackwell
4. Trevor Thom, Air Navigation, Airlife Publishing
5. A E Bramson and N H Birch, Radio Navigation for Pilots, Airlife Publishing 1984

OS10:AIRCRAFTEVALUATION

Aerodynamics & Performance : International Standard Atmosphere and its significance pressure and density altitudes, Compressibility effect, Mach number and its variation with altitude and temperature.

Take-off and landing, single engine performance at altitude, climb and descent performance at altitude. Effect of horizontal speed during climb and descent on performance and economics. Cruise performance cruise at constant speed (or Mach No). Constant altitude, constant angle of attack and their effect on block speed and economics. Noise regulatory requirements.

Aircraft Equipment : Cockpit layout and instrumentation, automatic landing system, Air Data Computer, ICAO landing categories, communication and navigation equipment and their functions in general, Flight Recorder and Cockpit Voice Recorder and related intercom; music reproducer etc. Emergency facilities/equipment and related regulation, weather radar and its uses. Environmental control, air conditioning and pressurization, their significance and necessity.

Service Support Equipment : Airframe spares-insurance parts and consumable. Spare engine and the criteria for their proportion to installed engines-engine spares their relation to fleet size and utilization. Accessories-Rotables and consumable items. Ground support equipment.

Aircraft Scheduling : Factors affecting airlines schedules-Commercial operation, Technical Meteorological, Aircraft Facilitation-run-way strength and related requirements, Load Classification. Criteria for runaway and aircraft. Air Traffic Control and other number and other ground communication/navigation facilities-their relationship and effect on related aircraft equipment. Airport emergency Facilities-fire fighting, First aid etc.

Aircraft Maintainability : Evolution of maintenance philosophy, periodic maintenance system based on checks at specific intervals and continuous maintenance system. Daily Inspection and trip inspection system. ON CONDITION maintenance techniques, their evolution and effect on design of aircraft systems.

Accessibility, repairability, interchangeability, Structural inspection programme and sampling criteria, system redundancy, back up, Despatch reliability and goals, T.B.O. and M.T/B/F/ concepts and criteria.

Determination of labour requirements for maintenance and over-haul, Component removal and replacement criteria on overhaul costs. Engine life development techniques and effect on overhaul costs.

Operating Cost : Direct operating cost Depreciation of airframes and engine, insurance (Hull Insurance, passenger liability their party liability etc.). Housing and parking charges. Indirect operating cost-their breakdown and criteria for estimation of payload. Range and Block speed. Characteristics of aircraft and their effect on operating cost.

Unit operation costs : Cost per tonne kilometer and cost per seat kilometer-Break-even load factor both in terms of passengers as well as total available payload.

Other Costs: Introductory Costs, (Crew training, technical personnel training, ferry flights. Additional building and workshop facilities costs, route proving etc.). Financing charges, aircraft suitability for Traffic and Route system.

Life cycle cost.

Text Books and Reference Books:

1. Daniel P Raymer, Aircraft Design: A conceptual approach, AIAA Series, 1992
2. John D Anderson Jr., Introduction to Flight, McGraw Hill
3. L Tetley and D Calcutt, Electronic Aids to Navigation, Edward Arnold Publishers Ltd. 1986
4. Michacl J Kores and William A Watkins, Aircraft Maintenance and Repair, McGraw Hill

OS11:ROCKETSANDMISSILES

General Introduction : Difference between Rockets and Missiles, Types of Rockets and Missiles, Satellite launch vehicles. Manned Rockets.

Aerodynamics Characteristics of Air Frame Components: Introduction, Bodies of revolution. Different forebody shapes. Summary of characteristics of bodies of revolution, Base pressure. Aerodynamic controls. Jet control.

Performance of Missiles and Rockets : Introduction, various types of drags. Boost glide trajectory, Graphical solution, Boost sustainer trajectory, long range cruise trajectory, long range Ballistic trajectory. Powered and unpowered flight. Brief description of Fin stabilized and spin stabilized rockets and their force systems. Thrust misalignment.

Stability and Control:

Longitudinal : Two degrees of freedom analysis, complete missile aerodynamics with forward and rear control, Static stability margin

Directional : Introduction, cruciform configuration, Body, Wind and Tail contribution on directional control.

Lateral : Induced Roll, Interal control and design consideration for cruciform and monowing; Damping in Roll.

Manoeuvring Flight: Introduction, Flat turns for cruciform and monowing. Pull ups Relationship of manoeuvrability and static stability margin.

Dynamic Stability : Equations of motion, longitudinal and lateral dynamics.

Miscellaneous : Launching problems. Re-entry and Recovery of Space Vehicles, Modern Concepts, Manned Missions.

Text Books and Reference Books

1. S S Chin, Missile configuration Design, McGraw Hill
2. Davis Follin & Blitzer Van, Exterior Ballistics of Rockets, Nostrand
3. Seifert & Brown, Ballistic Missiles and Space Vehicle Systems, John Wiley
4. Ed. Seifert, Space Technology, John Wiley

OS12:INTRODUCTIONTOTHEFINITEELEMENTMETHODS

Introduction to differential equations and numerical methods for solution of differential equations; finite difference, collocation, weighted residual methods.

Introduction to a second order ordinary differential equation, e.g. stretching of a bar under axial loads or the one-dimensional steady-state heat conduction problem, introduction to the principle of virtual work, weak formulation for differential equation,

definition of energy-norm, admissible functions for approximation.

Introduction to the finite element method for given weak form, essential and natural boundary conditions, construction of basis and shape functions (Lagrangian shape functions), definition of stiffness matrix and load vector, mapping to the master domain, numerical integration, element stiffness matrix and load vector, assembly, charactseristics of the matrix problem, choice of solvers for the matrix problem (skyline, banded or frontal), development of a working one dimensional finite element code.

Convergence characteristics of solution, a-priori error estimates, characteristics of finite element strains and stresses (Flux); postprocessing of finite element solution for recovery of "better" stresses (nodal averaging or extrapolation from Gauss points).

Introduction to Euler-Bernoulli beam theory, weak formulation, smoothness requirements and Hermite shape functions, solution of problem, quality of computed quantities (e.g. displacement, shear force, bending moment), introduction to Timoshenko beam theory, shear locking, shear correction factor, reduced integration.

Steady-state heat conduction problem in two-dimensions, weak formulation, boundary conditions, mesh generation, triangular or quadrilateral elements, connectivity information, linear mapping construction of shape functions (e.g. for triangles, tensor product or serendipity for quadrilaterals), numerical integration; element stiffness matrix, element load vector, assembly, imposition of essential boundary conditions; solution, convergence characteristics of finite element solution, postprocessing of finite element fluxes.

Subparametric, isoparametric and superparametric mappings, transformation from master to physical element; Jacobian calculation.

Introduction to plane stress and plane strain problems. Weak formulation. Essential and natural boundary conditions, construction of element stiffness matrix and load vector, solution of problem, quality of finite element stresses, post processing for better stressess.

Development of a two-dimensional finite element code for the plane stress/strain problems.

Introduction to plate theory; Kirchhoff plate theory, weak formulation; Hermite shape functions in two-dimensions, Rcissner-Mindlin plate theory, higher order plate theories.

Text Books and Reference Books:

1. J.N. Reddy, An Introduction to the Finite Element Method, Mc Graw Hill International.
2. I.H. Shames and S. L. Dyin, Energy and Finite Element Methods in Structural Mechanics, New Age International Publishers Ltd.
3. O.C. Zienkiewicz and R.L. Taylor, Finite Element Methods: Vol I&II, McGraw Hill, NY.

OS13:COMPUTATIONALFLUIDDYNAMICS(CFD)

Equations of Fluid Dynamics and their classification. Boundary conditions.

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.

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.

Basics of Finite Element Method : Isoparametric elements, bilinear and tri-linear elements. Numerical Integration, space function, Petrov- Galerkin method.

Computation of turbulent flows; RANS, turbulence modelling.

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

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

Text Books and Reference Books:

1. T J R 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

OS14:OPTIMIZATIONMETHODSINENGINEERINGDESIGN

Introduction optimum design, automated design, Reliability based design.

Linear programming : Introduction, linear programming problem solution procedure, simple algorithm sensitivity analysis.

Non-linear programming : Role of convexity in nonlinear programming, Kuhn-Trucker condition, linearization technique, single variable search simultaneous, search procedures, sequential search procedures, Dichtomous search. Fibonacci search, Golden search, Interval Bisections search, interpolation procedures.

Multivariable search : simplex method, pattern search methods, Descent methods, conjugate direction, steepest descent method, gradient and variable metric method.

Unconstrained and constrained minimization techniques.

Integer and geometric programming, Genetic algorithm, simulated annealing.

Multi-objective optimization, robust design techniques. Application to engineering design problems, comparison with other techniques.

Text Books and Reference Books:

1. Hadley G., Linear programming, Addision Wesley.
2. Iyengar, N.G.R, and Gupta S.K., Structural Design Optimization, Allied Publisher, New Delhi.
3. Kalynmoy Deb, Optimization for Engineering Design, Prentice Hall India.

OS15:NONDESTRUCTIVEEVALUATION

This course is intended to introduce the methods of NDT and highlight its role in quality assurance. The emphasis should also be on its application during the process of design, manufacturing and maintenance.

Importance of NDT in quality assurance. Different types of non destructive techniques to obtain information regarding size, location and orientation of damage or cracks.

Visual inspection techniques coin tapping technique for composite structures and adhesive bonds.

Ultrasonic testing : Pulse echo technique, pitch-catch technique, through transmission technique, A-scan, B-Scan, C-scan.

Acoustic emission: Sources of acoustic emission in composites, peak amplitude, rise time during events, ring-down counts duration of events.

X-ray radiograhy: Absorption spectra, short wave length, X-ray for detection of voids.

Die penetration technique.

Magnetic particle testing.

In each of the above techniques, (i) theory and basic principles, (ii) advantages/disadvantages, (ii) material of parts that can be inspected, (iv) physical size and shape limitation, (v) economics of process, (vi) types of defects that can be detected, (vii) environment limitation are to be discussed alongwith equipment used for each of the techniques.

Text Books and Reference Books:

1. Non destructive Testing, Edword Arnold U.K.
2. Introduction of Nondestructive testing - A training guide, John Wiley & Sons.
3. Donglas C Lalia, NDT for Aircraft, Jeppesen
4. NDT and Ultrasonic Testing for Aircraft, FAA-AC 43-3

OS16:GROUNDHANDLINGANDSUPPORTSYSTEMS

General knowledge of ground handling of Aircraft, Aircraft Safety; Mooring, Jacking, Leveling, Hoisting of aircraft, Towing, Mooring of an a/c during adverse conditions. Aircraft cleaning and maintaining.

Ground signaling/marshalling of aircraft in day & night time.

Brief knowledge of airport and its procedures. Control tower, Dipersal areas, Approns, Tarmac, Taxy track, Runway and its ends. Approach and clear zone layout.

Brief knowledge of the signals given by the control tower.

Knowledge of Airfield lighting system, Aircraft Rescue & Fire Fighting.

Maintenance and handling of ground equipments used in maintenance of aircraft. Compressors, Portable hydraulic test stands, Electrical power supply equipment, charging trolley. Air-conditioning and Heating unit, Ground support air start unit. Pressure oil unit, Fire extinguishers, jacks, Hoisting cranes/grantry, Ladders, Platforms, Trestles, Chocks.

Knowledge of safety and fire precautions to be observed during maintenance including refueling, defueling & engine start.

Maintenance of hydraulic accumulators, reservoirs and filters:

Maintenance of landing gear (L/G), Shock strut charging and bleeding, Maintenance of L/G brakes i.e., Dragging, Grabbing, Fading, Brakes and excessive brake pedal travel. Maintenance on wheels, tyres and tubes i.e., dismantling, inspection, assembling, inflating, inspection and installation

Rigging of flight control surfaces and duplicate inspection; Rigging checks-Angular alignment checks and symmetry checks, Knowledge and use of Tensiometers, Protractors etc.

Storage of Rotables.

Text Books and Reference Books

1. Airframe & Powerplant Mechanics, General Handbook AC65-9A By US Department of Transporation, FAA
2. Airframe & Powerplant Machanics, Airframe Handbook AC 65-15A By US Dept. of Transportation, FAA
3. Civil Aircraft Inspection Procedure, Part - II- Aircraft
   a) AL/3-6 - Landing Gear
   b) AL/3-7- Control Systems
   c) AL/3-8 to AL/3-10 - Fire
   d) AL/3-18 to AL/3-20 - Tyres, Wheels & Brakes
   e) Al/3-21 - Hydraulic systems
   f) GOL/1-1 & GOL/1-2 - Ground Operations
4. Michacl J Kroes and William A Watkins, Aircraft Maintenance and Repair, McGraw Hill
5. Civil Aviation Requirement - Section - 2- Airworthiness Series H for Saftey & Fire Precautions in Fuelling & Defuelling issued by DGCA

OS17:INTRODUCTIONTOAUTOMATICFLIGHTCONTROLSYSTEMS

Introduction : Open loop and Closed Loop (Feed back) control systems. Types of feed back control sytems. Laplace's transform.

Feed Back Control System : Transfer function of linear systems, Impulses response of linear systems, Block diagrams of feed back control systems, multivariable systems, Block diagram algebra.

Analysis of Feed Back Control Systems : Typical test input signals, Time domain performance characteristics of feed back control system. Effects of derivative and integral control. Steady State response of feed back control system-steady State error, Frequency response.

System Stability : Routh - Hurwitz criterion, the root locus method

Auto Pilots: Longitudinal Auto-Pilots: Brief description through Block diagrams and Root Locus of Displacement Auto Pilot, Pitch Orientational Control System. Acceleration control system.

Miscellaneous : Fly-By-Wire control system, Instrument Landing System

Text Books and Reference Books:

1. John H Blakelock, Automatic Control of Aircraft & Missiles, John wiley & Sons, 2nd Ed.1991
2. Bernard Etkins, Dynamics of Flight: Stability & Control, John Wiley & Sons, 2nd Ed., 1989
3. Robert C Nelson, Flight Stability & Automatic Control, McGraw Hill Book Co., 1989
4. E H J Pallet, Automatic Flight Control, B S Professional Books, Oxford, 3rd Ed.,1987
5. J B Russel, Performance and Stability of Aircraft, John Wiley

OS18:INTRODUCTIONTOWINDENGINEERING:

Introduction : Scope of Wind Engineering. Types of Problems. Elementary Physical Geography. Global Atmospheric Circulation. Geostrophic and Gradient Wind. Cyclones. Thunderstorms. Tornadoes Wind Data. Atmospheric Boundary Layer. Wind Profile. Terrain Categories. Extreme Wind. Gust Factor.

Basic Shape Factor. Vortex Shedding. Separation. Effect of Reynolds Number.

Static Wind Load on Tall buildings. TV Towers and Masts, Chimneys. Cooling Towers. Lattice Towers. Suspension and Cable Stayed Bridges. Stadium Roof/Light Towers.

Dynamic Effects, Single Frequency Excitation. Along-wind and Across wind Vibrations.

Wind Tunnel Testing : Model Laws. Types of Models. Special features of wind tunnels used for wind engineering studies.

Text Books and Reference Books:

1. E.L. Houghton and N.B. Carruthers, Wind Forces on Buildings and Structures: An Introduction, Edward Arnold London.
2. A.J. Mac Donald, Wind Loading on Buildings, Applied Science Publishers Ltd., London.
3. P. Sachs, Wind Forces in Engineering, Pergamon Press, Oxford 2nd edition.
4. E. Simiu and R.H. Scanlan, Wind Effects on Structures: An Introduction to Wind Engineering, John Wiley & Sons New York.

OS19:COMPOSITEMATERIALS

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.

Manufacture of composites : hand lay up technique, pressure bag and vacuum bag molding techniques, puftrusion, resin-transfer moulding, injection moulding, Bulk moulding compound, sheet moulding compound.

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, sheer modulus and strength, Poisson's ratio, effect of fiber dimension and distribution on strength and stiffness, Halpin-Tsai equations.

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, transport properties, mass diffusion.

Short fiber composites: approximate analysis of stress transfer, average fiber stress, modulus and strength of short fiber composites.

Experimental characterization of composites : uniaxial portion and compression test, inplane shear test, flexural test, determination of intralaminar shear strength and fracture toughness.

Non destructive evaluation techniques : ultrasonic techniques, Acoustic emission techniques, X - ray radiography.

Text Books and Reference Books:

1. R.M. Jones, Mechanics of Composite Materials, Technomic Publication.
2. B.D. Agarwal and L.J. Broutman, Analysis and Performance of Fibre Composites, John Wiley & Sons.
3. R.F. Gibson, Principles of Composite Material Mechanics, Mc Graw Hill International Edition.
4. Latit Gupta, Advanced Composite Materials, Himalyans Books, New Delhi 1998.

OS20 : METEOROLOGY:

Met Services for Aviation : Met, Organisation-national and International: Types of Met. Obeservations. Met. Communication network. Met forecasting Office - World Weather Watch. Area Forecast Centre.

Meteorological Instruments & Observations : Pressure Temperature. Humidity. Wind. Cloud. Visibility. Rainfall. Weather phenomena. Aircraft Weather Reports.

The Atmosphere : Composition of the atmosphere. Structure. Troposphere-Stratosphere-Mesosphere-Thermosphere. ionosphere International Standard Atmosphere. CIRA.

Pressure : Static and dynamic pressure. Pressure systems on the surface. Pressure Gradient Presure tendency, Diurnal variation of pressure. Vertical Variation of pressure. Altimetry; Pressure altimeter. Errors Altimeter Setting Procedures-D Value.

Temperature : Methods of heat transfer-Source of heat in the atmosphere. Surface temperature. Diurnal Variation. Upper air temperatures-Airfield reference temperature.

Density of Air : Density of dry and moist air. Density altitude. Vertical variation of density.

Wind : Definition. Buys Gallot's law. Effects of earth's rotation. Coriolis force. Geostrophic wind. Cyclostrophic wind. Gradient wind. Variation of Geostrophic wind with height. Thermal wind. Diurnal variation of wind. Veering and backing. Gustiness. Gale. Squall.

Local Winds : Land and sea breezes. Katabatic and Anabatic winds. Valley wind. Fohn wind-Some well known local winds.

Adiabatic changes and Lapse rate : Lapse rate. Adiabatic processes. Potential temperature. Actual lapse rates in the automsphere.

Stability and Instability : Atmospheric stability. Stability of dry air, conditional stability. Latent instability. T-gram.

Vetical Motion in the atmosphere : Types of vertical motion-Frictional eddies-Convergence-Divergence.

Condensation and Clouds : Lifting condensation level. Condensation nuclei. Formation, Classification, nomenclature features and estimation of clouds. Flying in clouds.

Precipitation : Physics of precipitation Theories of precipitation. Nature of clouds and precipitation. Snow and sleet - Orographics rain Diurnal and seasonal variation of precipitation.

Thunderstroms : Conditions favourable for Cb formation. Structure of thunderstroms, life cycle. Severe storms. Squall from thunderstroms. Diurnal and seasonal variation. Flying hazards in thunderstorms. Hail. Other instability phenomena, duststorms,tornados-waterpouts.

Atmospher Obscurity and Visibility : Visibility in the atmosphere RVR - Vertical and slant visibility. Smoke haze, Dust haze, dust raising winds, duststroms, Mist, fog and types of fog.

General Circulars over the Globe : Solar radiation. Seasons. Heat balance. Idealised pressure, wind and temperature distribution over the globe. Seasonal migration of

pressure and wind belts.

Air Masses and Fronts : Nature,origin, classification, movement and properties of air masses. Air masses of India. Polar front-Extra tropical cyclones-Warm and cold fronts and occlusion. Western disturbances.

Tropical Disturbances : Tropical discontinuties-ITCZ-Shear line, Surge, Waves in Esterlines. Tropical depression and cyclones, formation, development, movement, characteristics, evolaution and dynamics. Flying conditions in tropical cyclones, Indian cyclones - strom warning.

Monsoon : Areas-Indian Monsoons. Southwest monsoon, onset, progress, monsoon front, withdrawal, breaks. Monsoon rainfall pattern. Northeast monsoon. Recent concepts of the monsoon.

Special Aviation Phenomena :

(a) Ice Accretion : Types of icing, Temperature ranges, Airframe icing in relation to cloud forms and effects. Precautions and remedial measures against ice-accretion. Engine icing.

(b) Atmospheric turbulence : Gust and Gustiness. Clear air turbulence: mechanism, characteristic, types, features-Occurrence of CAT over India. Avoidance of CAT.

(c) Jet Streams : Characteristics. Types of Jet Stream, Jet Stream over India. Seasonal variation. Jet Streams and weather. Lower level Jets.

(d) Mountain Waves : Definition, Aviation hazards. Clouds. Rotors Lee waves - vertical currents. Seasonal and diurnal variation. Synoptic conditions for formation.

(e) Cirriform Clouds : High cloud - types-Height tropopause-Associated Weather hazards.

(f) Condensation Trails : Types - Physics of constrails. Mintra, Drytra, Maxtra levels. Avoidance.

(g) S.S.T.Flights : Meterology factors. Wind and temperature. Sonic boom. Turbulence. Ozone. Hydrometeors.

Climatology of the World : Climatic control -factors. Pressure and winds. Temperature. Percipitation, Basic - climatic zones of the world. Typical climates.

Climatology of India and neighbourhood: Physiography, Extratropical disturbances. Tropical cyclones. Climatological features-surface and upper air. Rainfall pattern. Thunder Storms, Duststroms-fog-Upper climatology.

Seasons of India : Classification-Winter, pre-monsoon, Moonson and post-monsoon seasons. Pressure, Temperature, Upper air circulation weather, aviation hazards in each season.

Climatology of neighbouring countries : Pakistan, Afganistan, Burma, Bangladesh, Tibet, China.

Weather Forecasting : Synoptic charts, plotting and basic analysis. Upper air charts-plotting and stream-line drawing. Range and accuracy of forecasts. Constant pressure charts.

Aeronautical Reports and Forcasts : Metars specis Tafors. Landing forecasts and trends. Weather warnings-sigmet-Aireps-Rareps.

Briefing and documentation : Pre -flight Information-in flight information Briefing-Documentation-Method of presentation-Chart form of documentation.

Weather Radar : Principles-Types of scopes-Choice of weather radar-Radar echos-limitations.

Weather satellites : Choice of spare vehicles - Satellites as observation platforms-Met. Observation from satellites-Cloud pictures-Use of satellite data in aviation.

Weather Modification : Artificial rain-fog dissipation. Present position and prospects.

References :

1. Manual of Meteorology for Aircrew.
2. Elementary Meteorology for Aircraft (HMSO AP 3307)
3. Handbook of Aviation Meteorology (HMSO AP 3340)
4. Understanding Weather by O.G.Sutton (Penguin Book)
5. Atmosphere , Weather and Climate, by R.C.Barry and R.J.Chorley (Methuen & Co. London).
6. Weather and Climate by R.C.Sutcliffe (Weidenfied and Nicholson)
7. Introduction to Meteorology by S.Patterson (McGraw Hill)
8. Met. Glossary (HMSO London, AP 897)
9. The Challenge of the Atmosphere by O.G.Sutton (Hutchinson)
10. International Cloud Atlas (WMO)
11. Climatological Atlas for Airmen (I.Met.D).

OS21 : AIR TRAFFIC CONTROL, AERODROMES AND AIR ROUTES

(a) Air Traffic Control

Definitions

Organisation of air traffic control services in India. Flight information regions. Control areas and control zones.

Aerodrome Control : Control of traffic on and in the vicinity of the manoeuvring area. Critical positions of aircraft in the traffic and taxi circuits. Control of taxying aircraft. Determining the proper runway for use for landings and take offs. Control of traffic in the traffic circuits.

Control of other than aircraft traffic on the manoeuvring area. Visual signal procedures. Lights and Pyrotechnic signals. Grounds signals, Radio communication procedures. Standard traffic clearances. Essential traffic information. Information on aerodrome conditions. Night operations. Fire fighting equipment and safety services.

Approach control. Expected approach time. Approach sequences. Altitude assignment. Holding aircraft in flight. Essential weather information. Weather minima. Emergency procedures and emergency descent. Various systems of approach, OGH. BABS let down procedures. GCA. Radio range let-down, Becon let down, GEE, ILS (SCS51). VOR and DME let down procedures.

Area control and flight information services. Aircraft Movement message. Air Traffic clearances. Flight navigation Flight plan. Dimensional units used for distance, altitude, speed, direction, temperature, weight, time, position reporting system in India. Altitude, time and lateral separations standards. Systems of flight progress boards and progress strips, or plotting.

Search and rescue.

Notams-code, compilation and distribution.

Information regarding various communication channels. Radio facilities in so far as they affect air traffic control service.

Radar : The use of radar and its limitations, SSR Code allotment Identification procedure, radar vectoring.

Flight information services. Coordination between tower and approach, approach and control area and between control positions whithin the same unit. Air traffic message. General provisions, Air traffic service, Air reports.

Rules of air Avoidance of collision, Right of way.

Lights to be displayed by aircraft.

Visual and instrument flight rules.

Distress urgency and safety signals.

Altering service. ATS Routes.

(b) Aerodromes

System of classification of land/water aerodromes. Requirements of land aerodromes. Lay-out, Runway-lengths, width and strength. Instrument runway. Strips Taxi-ways Aprons. Minimum clearances. Slopes. Approach areas.

Water aerodromes. Channels. Turning bases. Taxi channels. Mooring areas.

Obstruction clearing and marking. Restriction on new construction. Approach areas. Approach surfaces. Transitional surfaces. Obstruction marking. Day Marking. Lighting of obstructions. Hazard Beacons.

Visual ground aids. Wind inidcators. Runway direction indicators. Signalling devices. Ground signal panels and signal area.

Lighting of aerodromes. Boundary lights. Runway lights, Taxiway lights. Threshold lights. Angle of approach lights. Aids to location. Aerodrome Beacons. Identification beacons. Emergency lighting and emergency supply.

Day marking aids. Runway caution zone marking. Runway threshold marking. Runway designation marking. Assignment of letters. Marking of taxi -ways.

Aerodromes equipment

Effect of height on requirement of the length of runway. Effect of temperature on the length of runway.

Aerodromes in India. International aerodromes and the facilities to be provided there.

Licensing of aerodromes for public and private use. Conditions governing the use of civil and military aerodromes.

(c) Air-Routes

Definitions.

Government Agencies controlling airspace in India, their set-up and functions.

ATS Routes : principles governing their establishment, identification, designation etc. Establishment of reporting points. Delineation of airspace. Service provided on these routes. Major routes in India, their dimensions. Navigational airtraffic on these routes.

References :

1. Annex 2 to the convention on International Civil Aviation-Rules of the Air.
2. Annex 11 to the Convention on International Civil Aviation-Air Traffic Services, Air Traffic Control Services, Flight Information Service, Altering Service.
3. Indian Aircraft Act and Rules made thereunder.
4. Notices to Airmen issued by the Director General of Civil Aviation.
5. PANS-RAC-ICAO DOC. 4444 RAC/501/C or the appropriate latest edition.
6. Regional Supplementary - ICAO DOC. 7030 or the appropriate latest edition.
7. Aircraft operation - DOC. No. 8168/Ops/911.
8. Air Traffic Control and National Security. (Air Coordinating Committee).

9. G. Kropf, Airline Traffic Procedures.
10. Manual of Air Traffic Control, H.M. Stationery Office.
11. Annex 14 (Latest edition) to the Convention on International Civil Aviation.
12. A.I.P. Vol I & II.
13. Manual of Civil Aviation.
14. Famous Airports of the World, J. Stroud.
15. Air Terminal Building, U.S. Department of Commerce, Washington.

GOVERNMENT ORGANISATIONS ENROLLING ALUMNI OF AeSI FOR EMPLOYMENT AND TRAINING

1. Defence Research and Development Organisation and its laboratories.
2. Hindustan Aeronautics Ltd
3. Directorate General of Civil Aviation
4. Defence Forces
5. Indian Space Research Organisation
6. National Aerospace Laboratory, Bangalore

Besides, numerous Organisations/Industries in the private sector are also enrolling AeSI graduates for employment.