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OBJECTIVES

- To enable all students of engineering and technology develop their basic communication skills in English.
- To give special emphasis to the development of speaking skills amongst the students of engineering and technology students.
- To ensure that students use the electronic media such as interne and supplement the learning materials used in the classroom.
- To inculcate the habit of reading for pleasure.

UNIT I
Listening - Introducing learners to GIE - Types of listening - Listening to audio (verbal & sounds); Speaking - Speaking about one’s place, important festivals etc. – Introducing oneself, one’s family / friend; Reading - Skimming a reading passage – Scanning for specific information - Note-making; Writing - Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Sentence completion - Autobiographical writing (writing about one’s leisure time activities, hometown, etc.); Grammar - Prepositions - Reference words - Wh-questions - Tenses (Simple); Vocabulary - Word formation - Word expansion (root words / etymology); E-materials - Interactive exercises for Grammar & Vocabulary - Reading comprehension exercises - Listening to audio files and answering questions.

UNIT II
Listening - Listening and responding to video lectures / talks; Speaking - Describing a simple process (filling a form, etc.) - Asking & answering questions - Telephone skills – Telephone etiquette; Reading – Critical reading - Finding key information in a given text - Sifting facts from opinions; Writing - Biographical writing (place, people) - Lab descriptions (general / specific description of laboratory experiments) - Definitions - Recommendations; Grammar - Use of imperatives - Subject-verb agreement; Vocabulary - Compound words - Word Association; E-materials - Interactive exercises for Grammar and Vocabulary - Listening exercises with sample telephone conversations / lectures – Picture-based activities.

UNIT III
Listening - Listening to specific task - focused audio tracks; Speaking - Role-play – Simulation - Group interaction - Speaking in formal situations (teachers, officials, foreigners); Reading - Reading and Interpreting visual material; Writing - Jumbled sentences - Coherence and cohesion in writing - Channel conversion (flowchart into process) - Types of paragraph (cause & effect / compare & contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; Grammar - Tenses (Past) - Use of sequence words - Adjectives; Vocabulary - Different forms and uses of words, Cause and effect words; E-materials - Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

UNIT IV
Listening - Watching videos / documentaries and responding to questions based on them; Speaking - Responding to questions - Different forms of interviews - Speaking at different
OUTCOMES:
Learners should be able to
- Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
- Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
- Read different genres of texts adopting various reading strategies.
- Listen/view and comprehend different spoken discourses/excerpts in different accents.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE BOOKS
EXTENSIVE READERS

Website Resources
1. www.uefap.com
2. www.eslcafe.com
3. www.listen-to-english.com
4. www.owl.english.purdue.edu
5. www.chompchomp.com

MA8151 MATHEMATICS – I
(Common to all branches of B.E. / B.Tech. Programmes)

OBJECTIVES:
- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To make the student knowledgeable in the area of infinite series and their convergence so that he/she will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modeling.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I MATRICES
9+3

UNIT II INFINITE SERIES
9+3

UNIT III FUNCTIONS OF SEVERAL VARIABLES
9+3

UNIT IV IMPROPER INTEGRALS
9+3

UNIT V MULTIPLE INTEGRALS
9+3

TOTAL : 60 PERIODS
OUTCOMES:
This course equips students to have basic knowledge and understanding in one field of materials, integral and differential calculus

TEXT BOOKS:

REFERENCES:

PH8151 ENGINEERING PHYSICS
(Common to ALL Branches of B.E./B.Tech. Programmes)

OBJECTIVE:
To introduce the basic physics concepts relevant to different branches of Engineering and Technology.

UNIT I PROPERTIES OF MATTER

UNIT II ACOUSTICS AND ULTRASONICS

UNIT III THERMAL PHYSICS

UNIT IV APPLIED OPTICS
OUTCOMES:
- The students will have knowledge on the basics of physics related to properties of matter, optics, acoustics etc., and they will apply these fundamental principles to solve practical problems related to materials used for engineering applications.

OBJECTIVES:
- To make the students conversant with basics of polymer chemistry.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To acquaint the student with concepts of important photophysical and photochemical processes and spectroscopy.
- To acquaint the students with the basics of nano materials, their properties and applications.

UNIT I CHEMICAL THERMODYNAMICS
Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore. Chemical potential; Gibbs-Duhem equation – variation of chemical potential with temperature and pressure.

UNIT II POLYMER CHEMISTRY
Introduction: Classification of polymers – Natural and Synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerisation. Types and mechanism of polymerisation: Addition (Free Radical, cationic, anionic and living); condensation and copolymerisation. Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerisation: Bulk, emulsion, solution and suspension.
OUTCOMES:

- The knowledge gained on polymer chemistry, thermodynamics, spectroscopy, phase rule and nano materials will provide a strong platform to understand the concepts on these subjects for further learning.

OBJECTIVES:

- Learn the organization of a digital computer.
- Be exposed to the number systems.
- Learn to think logically and write pseudo code or draw flow charts for problems.
- Be exposed to the syntax of C.
- Be familiar with programming in C.
- Learn to use arrays, strings, functions, pointers, structures and unions in C.
OUTCOMES:
At the end of the course, the student should be able to:

• Design C Programs for problems.
• Write and execute C programs for simple applications.

TEXT BOOKS

REFERENCES
OBJECTIVES
To develop in students, graphic skills for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION)
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I    PLANE CURVES AND FREE HAND SKETCHING
Basic Geometrical constructions, Curves used in engineering practices

Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT II    PROJECTION OF POINTS, LINES AND PLANE SURFACES
Orthographic projection- principles-Principal planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III    PROJECTION OF SOLIDS
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.

UNIT IV    PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

UNIT V    ISOGRAPHIC AND PERSPECTIVE PROJECTIONS
Principles of isometric projection – isometric scale – Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method and vanishing point method.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY)
Introduction to drafting packages and demonstration of their use.

TOTAL: 75 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
• perform free hand sketching of basic geometrical constructions and multiple views of objects.
• do orthographic projection of lines and plane surfaces.
• draw projections and solids and development of surfaces.
• prepare isometric and perspective sections of simple solids.
• demonstrate computer aided drafting.
OBJECTIVES

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

1. Torsional pendulum  Determination of rigidity modulus of wire and moment of inertia of disc
2. Non–uniform bending  Determination of young’s modulus
3. Lee’s disc  Determination of thermal conductivity of a bad conductor
4. Potentiometer  Determination of thermo e.m.f. of thermocouple
5. Air wedge  Determination of thickness of a thin sheet of paper
6. i. Optical fibre  
   Determination of Numerical Aperture and acceptance angle
   
ii. Compact disc  
   Determination of width of the groove using laser
   
7. Acoustic grating  
   Determination of velocity of ultrasonic waves in liquids
   
8. Post office box  
   Determination of Band gap of a semiconductor
   
9. Spectrometer  
   Determination of wavelength using grating
   
10. Viscosity of liquids  
    Determination of co-efficient of viscosity of a liquid by Poiseuille’s flow

TOTAL : 30 PERIODS

OUTCOMES

- The hands on exercises undergone by the students will help them to apply physics principles of optics and thermal physics to evaluate engineering properties of materials.

OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by vacometry.

1. Estimation of HCl using Na₂CO₃ as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler’s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1,10-phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
14. Determination of CMC.
15. Phase change in a solid.

TOTAL: 30 PERIODS

OUTCOMES:

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters

REFERENCE BOOKS

OBJECTIVES:
The student should be made to:
- Be familiar with the use of Office software.
- Be exposed to presentation and visualization tools.
- Be exposed to problem solving techniques and flow charts.
- Be familiar with programming in C.
- Learn to use Arrays, strings, functions, structures and unions.

LIST OF EXPERIMENTS:
1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Apply good programming design methods for program development.
- Design and implement C programs for simple applications.
- Develop recursive programs.

GE8162 ENGINEERING PRACTICES LABORATORY
(common to all branches of B.E./B.Tech. Programmes)

OBJECTIVE
To provide exposure to the students with hands-on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP – A (CIVIL & ELECTRICAL)

1. CIVIL ENGINEERING PRACTICE
Plumbing
- Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches.
- Laying pipe connection to the suction side of a pump – inlet.
- Laying pipe connection to the delivery side of a pump – outlet.

Practice in mixed pipe connections: Metal, plastic and flexible pipes used in household appliances.
Wood Work
Sawing, planning and making common joints: T-Joint, Mortise and Tenon joint, Dovetail joint.
Study
Study of joints in door panels, wooden furniture
Study of common industrial trusses using models.

2. ELECTRICAL ENGINEERING PRACTICE
Basic household wiring using switches, fuse, indicator – lamp etc.,
Preparation of wiring diagrams
Stair case light wiring
Tube – light wiring
Study of iron-box, fan with regulator, emergency lamp

GROUP – B (MECHANICAL AND ELECTRONICS)

3. MECHANICAL ENGINEERING PRACTICE
Welding
Arc welding of butt joints, lap joints, tee joints
Gas welding Practice.
Basic Machining
Simple turning, drilling and tapping operations.
Machine assembly Practice.
Study and assembling the following:
Centrifugal pump, mixies and air conditioners.

Demonstration on
(a) Smithy operations like the production of hexagonal bolt.
(b) Foundry operation like mould preparation for grooved pulley.

4. ELECTRONIC ENGINEERING PRACTICE
Soldering simple electronic circuits and checking continuity.
Assembling electronic components on a small PCB and testing.
Study of Telephone, FM radio, low-voltage power supplies.

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to fabricate carpentry components and pipe connections including plumbing works.
- Ability to use welding equipments to join the structures
- Ability to fabricate electrical and electronics circuits
OBJECTIVES
- To make the students acquire listening and speaking skills meant for both formal and informal contexts.
- To help them develop their reading skills by exposing them to different types of reading strategies.
- To equip them with writing skills needed for academic as well as workplace situations.
- To make them acquire language skills at their own pace by using e-materials and language lab component.

UNIT I
Listening - Listening to informal conversations and participating; Speaking - Opening a conversation (greetings, comments on something, weather); Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); Reading - Developing analytical skills, Deductive and inductive reasoning; Extensive reading; Writing - Effective use of SMS for sending short notes and messages; Using 'emojis' as symbols in email messages; Grammar - Regular & irregular verbs; Active and passive voice; Vocabulary - Homonyms (e.g. 'can'); Homophones (e.g. 'some', 'sum'); E-materials - Interactive exercise on Grammar and vocabulary – blogging; Language Lab - Listening to different types of conversation and answering questions.

UNIT II
Listening - Listening to situation based dialogues; Speaking - Conversation practice in real life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); Reading - Reading a short story or an article from newspaper, Critical reading, Comprehension skills; Writing - Writing a review / summary of a story/article, Personal letter (Inviting your friend to a function, congratulating someone for his success, thanking one's friend / relatives); Grammar - modal verbs, Purpose expressions; Vocabulary - Phrasal verbs and their meanings, Using phrasal verbs in sentences; E-materials - Interactive exercise on Grammar and vocabulary, Extensive reading activity (reading stories / novels from links), Posting reviews in blogs - Language Lab - Dialogues (Fill up exercises), Recording students' dialogues.

UNIT III
Listening - Listening to the conversation - Understanding the structure of conversations; Speaking - Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information – expressing feelings (affection, anger, regret etc.); Reading - Speed reading – reading passages with the time limit - Skimming; Writing - Minutes of meeting – format and practice in the preparation of minutes – Writing summary after reading the articles from the journals - Format for the journal articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices, references) - Writing strategies; Grammar - Conditional clauses - Cause and effect expressions; Vocabulary - Words used as nouns and verbs without any change in the spelling (e.g. 'rock', 'train', 'ring'); E-materials - Interactive exercise on Grammar & vocabulary - Speed Reading practice exercises; Language Lab - Intonation practice using EFLU materials – Attending a meeting and writing minutes.
UNIT IV
Listening - Listening to a telephone conversation, Viewing a model interview (face-to-face, telephonic and video conferencing) and observing the practices; Speaking - Role play practice in telephone skills - listening and responding, asking questions, note taking – passing on messages, Role play and mock interview for grasping the interview skills; Reading - Reading the job advertisements and the profile of the company concerned – scanning; Writing - Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate; Grammar - Numerical expressions - Connectives (discourse markers); Vocabulary - Idioms and their meanings – using idioms in sentences; E-materials - Interactive exercises on Grammar & Vocabulary - Different forms of résumés - Filling up a résumé / cover letter; Language Lab - Telephonic interview – recording the responses - e-résumé writing.

UNIT V
Listening - Viewing a model group discussion and reviewing the performance of each participant - Identifying the characteristics of a good listener; Speaking - Group discussion skills – initiating the discussion – exchanging suggestions and proposals – expressing dissent/agreement – assertiveness in expressing opinions – mind mapping technique; Reading - Note making skills – making notes from books, or any form of written materials - Intensive reading Writing - Types of reports – Feasibility / Project report – report format – recommendations / suggestions – interpretation of data (using charts for effective presentation); Grammar - Use of clauses; Vocabulary – Collocation; E-materials - Interactive grammar and vocabulary exercises - Sample GD - Pictures for discussion, Interactive grammar and vocabulary exercises - Pictures for discussion; Language Lab - Different models of group discussion

TOTAL : 45 PERIODS

OUTCOMES:
Learners should be able to
- Speak convincingly, express their opinions clearly, initiate a discussion, negotiate, argue using appropriate communicative strategies.
- Write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.
- Read different genres of texts, infer implied meanings and critically analyse and evaluate them for ideas as well as for method of presentation.
- Listen/view and comprehend different spoken excerpts critically and infer unspoken and implied meanings.

TEXT BOOKS

REFERENCE BOOKS
MA8251  MATHEMATICS II  L  T  P  C
(Common to all branches of B.E. / B.Tech. Programmes in II Semester)  3  1  0  4

OBJECTIVES:

- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I  DIFFERENTIAL EQUATIONS  9+3
Method of variation of parameters – Method of undetermined coefficients – Homogenous equation of Euler’s and Legendre’s type – System of simultaneous linear differential equations with constant coefficients.

UNIT II  VECTOR CALCULUS  9+3
Gradient and directional derivative – Divergence and Curl – Irotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral and volume integral - Green’s, Gauss divergence and Stoke’s theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III  ANALYTIC FUNCTION  9+3
Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions 2 1 , , , w z c az zz Bilinear transformation.

UNIT IV  COMPLEX INTEGRATION  9+3

UNIT V  LAPLACE TRANSFORMS  9+3

OUTCOMES:

- The subject helps the students to develop the fundamentals and basic concepts in vector calculus, ODE, Laplace transform and complex functions.
Students will be able to solve problems related to engineering applications by using these techniques.

TEXT BOOKS:

REFERENCES:

PH8251 MATERIALS SCIENCE L T P C
(Common to Manufacturing, Industrial, Mining, Mechanical, 3 0 0 3
Aeronautical, Automobile and Production Engineering)

OBJECTIVE:
To introduce the essential principles of materials science for mechanical and related engineering applications.

UNIT I MECHANICAL PROPERTIES 9

UNIT II PHASE DIAGRAMS 9
Solid solutions - Hume Rothery's rules - free energy of solid solution - intermediate phases - The phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the level rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions - microstructural change during cooling.

UNIT III FERROUS ALLOYS AND HEAT TREATMENT 9

UNIT IV ELECTRONIC MATERIALS 9
Classification of solids - energy bands - concept of Fermi level - conductor, semiconductor, insulator - Semiconductors: intrinsic, extrinsic - carrier concentration expression (qualitative) - compound semiconductors (qualitative) - dielectric materials - polarization mechanisms - dielectric breakdown - magnetic materials - ferromagnetic materials & hysteresis - ferrites - superconducting materials, properties, types and applications.
OUTCOMES:
• Upon completion of this course, the students can able to apply the different materials, their processing, and heat treatments in suitable application in mechanical engineering fields.

TEXT BOOK:

REFERENCE BOOKS:
UNIT IV DYNAMICS OF PARTICLES

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS

TOTAL: 60 PERIODS (L:45 + T:15)

OUTCOMES:

- ability to explain the differential principles applies to solve engineering problems dealing with force, displacement, velocity and acceleration.
- ability to analyse the forces in any structures.
- ability to solve rigid body subjected to dynamic forces.

TEXT BOOKS:

REFERENCES:

ME8251 DESIGN CONCEPTS IN ENGINEERING

OBJECTIVE:
- To impart the importance of design in today’s context of global competition, environmental awareness and customer oriented market.
- To impart the basic concepts and various aspects of design using simple examples and case studies.

UNIT I DESIGN TERMINOLOGY
Definition-various methods and forms of design-importance of product design-static and dynamic products-various design projects-morphology of design-requirements of a good design-concurrent engineering-computer aided engineering-codes and standards-product and process cycles-bench marking.
OUTCOMES:

- Ability to comprehend the steps in the new product design
- Understanding of customer equipments for new product and making specifications.
- Knowledge in the role of creativity in product design
- Ability to decide materials and processes in product development.

TEXT BOOKS:

REFERENCES:

PR8252 MANUFACTURING PROCESSES

L T P C
3 0 0 3

OBJECTIVE:
To learn the basic processes available to make a part/product. Will help the students to select the best manufacturing process based on quality/time/cost/mechanical properties.
OUTCOMES:
Students will be able

- To describe the difference between the hot and cold working of metals and give the advantages of each.
- To distinguish the types of manufacturing process are suited to producing different shapes of product.
- To analyse the processes are likely to be used for producing a particular product using a specific material or class of material.
- To describe the advantages and disadvantages of the different classes of manufacturing processes.

TEXT BOOKS:

REFERENCE BOOKS:
AIM: To impart practical knowledge in modeling.

OBJECTIVES:
- To get hands on experience in modeling of automotive, typical industrial components, etc.
- To practice Solid modeling and geometry creation software.

LIST OF EXPERIMENTS
1. 2D Modeling of automotive components using Solid modeling software.
2. 3D Modeling of components using solid modeling software.
3. 3D Modeling of industrial components using solid modeling software.
4. Assembly modeling of typical parts using solid modeling software-1
5. Assembly modeling of typical parts using solid modeling software-2

TOTAL: 45 PERIODS

OUTCOMES:
- ability to use the software packers for drafting

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PR8264 CONVENTIONAL MACHINING PROCESSES LAB

OBJECTIVE:
To get hands on experience in the conventional machines.

LIST OF EXPERIMENTS:

1. Study of all the conventions machines – Identification of parts / Mechanisms and position of tool and work piece.
2. Facing, Plain turning /Step Turning operations in Lathe.
3. Taper Turning/ Threading, Knurling operations in lathe.
4. Multi start Threading/ Burnishing operations in lathe.
5. Machining to make a cube using shaper.
6. Machining to make a V-Block in shaper.
7. Counter sinking, Counter Boring, Tapping operation in a drilling machine.
8. Surfacing/Pocket Milling in a vertical milling machine.
10. Flat surface grinding and cylindrical grinding operations.
11. Machining an internal spline in a slotting mode (To prepare the process planning sheets for all the operations and then follow the sequence during the machining process)
12. To mechanize the given blade using Lathe and milling machines.

TOTAL: 45 PERIODS

OUTCOME
- The student can operate the machines without any problem.
- The student can rectify the faults occurred during the machining processes in real life.
OBJECTIVES:

- To provide the mathematical foundations of numerical techniques for solving linear system, eigen value problems, interpolation, numerical differentiation and integration and the errors associated with them;

- To demonstrate the utility of numerical techniques of ordinary and partial differential equations in solving engineering problems where analytical solutions are not readily available.

UNIT I SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 9+3

UNIT II INTERPOLATION AND APPROXIMATION 9+3
Interpolation with unequal intervals - Lagrange interpolation – Newton’s divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton’s forward and backward difference formulae – Least square method - Linear curve fitting.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 9+3

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9+3
Finite difference methods for solving two-point linear boundary value problems. Finite difference techniques for the solution of two dimensional Laplace’s and Poisson’s equations on rectangular domain – One dimensional heat-flow equation by explicit and implicit (Crank-Nicholson) methods - One dimensional wave equation by explicit method.

OUTCOMES:

- The students will have a clear perception of the power of numerical techniques, ideas and would be able to demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields.

TEXT BOOKS:

REFERENCES:
AE8301 FLUID MECHANICS AND BASICS OF AERODYNAMICS

OBJECTIVE:
- To introduce the basic concepts of fluid statics.
- To make the student understand the basic laws governing fluid motion and its application.
- To give an introduction on fluid machines and aerodynamics.

UNIT I INTRODUCTION TO FLUID MECHANICS

UNIT II BASIC EQUATIONS
Motion of a fluid particle — Fluid deformation - Velocity and acceleration — Continuity equation - Vorticity — Stream function — Stream line — Velocity potential — Momentum equation and energy equation — Navier stokes equation — Euler equation.

UNIT III INCOMPRESSIBLE INVISCID FLOW
Bernoulli’s equation and its Applications — Flow measurement — Orifice meter — Venturi meter — Laplace equation — Circulation — Kelvin’s circulation theorem — Starting vortex - Elementary flows.

UNIT IV INCOMPRESSIBLE VISCOUS FLOW
Fully developed laminar flow between parallel plates — Laminar and turbulent flow through pipes — Velocity profiles — Energy considerations in pipe flow — Calculation of head loss in Pipe flow problems — Hydraulic and energy grade lines — Moody's diagram.

UNIT V DIMENSIONAL ANALYSIS AND MODEL STUDIES
Dimensional analysis — The Buckingham-Pi theorem — Non-dimensional numbers — Flow similarity and model studies — Real and ideal flow over a circular cylinder - Impact of jets - Streamlined and blunt bodies.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to
- Exhibit the understanding on fluid properties and fluid statics
- Demonstrate the understanding on fluid kinematics and governing equations
- Have the potential to use the governing equations for fluid flow problems and understand the elementary plane flows.
- Ability to analyse laminar and turbulent flow problems.
- Acquire the knowledge on the various types of fluid machines.

TEXT BOOKS

REFERENCES
AE8302 PRINCIPLES OF FLIGHT

OBJECTIVE:
- To introduce the concepts of flying, international standard atmosphere, structural aspects of airplanes, brief description of systems, instruments and power plants used in airplanes.

UNIT I  HISTORY OF FLIGHT  8
Balloon flight – Ornithopters - Early airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

UNIT II  BASICS OF FLIGHT MECHANICS  9
Physical properties and structure of the atmosphere, Temperature, pressure and altitude relationships, Newton’s Law of Motions applied to Aeronautics - Evolution of lift, drag and moment. Aerfoils, Mach number, Maneuvers.

UNIT III  AIRCRAFT CONFIGURATIONS  10
Different types of flight vehicles, classifications. Components of an airplane and their functions. Conventional control, Powered control, Basic instruments for flying - Typical systems for control actuation.

UNIT IV  AIRPLANE STRUCTURES AND MATERIALS  9

UNIT V  POWER PLANTS  9
Basic ideas about piston, turboprop and jet engines - Use of propeller and jets for thrust production - Comparative merits, Principles of operation of rocket, types of rockets and typical applications, Exploration into space.

OUTCOMES:
- Identify the component of Flight
- Identify suitable materials for Aircraft structure
- Perform basic calculation on Mechanics using Newton law for lift, drag and moment.

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

AE8303 THERMODYNAMICS AND BASICS OF PROPULSION

OBJECTIVE:
- To achieve an understanding of principles of thermodynamics and to be able to use it in accounting for the bulk behavior of the simple physical systems.
- To provide in-depth study of thermodynamic principles, thermodynamics of state, basic thermodynamic relations, Properties of pure substances
- To enlighten the basic concepts of heat transfer and propulsion cycles.

UNIT I  BASIC CONCEPT AND FIRST LAW  9
Concept of continuum, macroscopic approach, thermodynamic systems –closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work, Zeroth
law or thermodynamics - Concept of temperature and heat. Concept of ideal and real gases. First law. Application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipments.

UNIT II SECOND LAW AND ENTROPY

UNIT III THERMODYNAMIC AVAILABILITY AND AIR STANDARD CYCLES

UNIT IV PROPERTIES OF PURE SUBSTANCE AND POWER CYCLE

UNIT V BASICS OF PROPULSION AND HEAT TRANSFER

TOTAL: 45 PERIODS
(Use of standard thermodynamic tables, Mollier diagram and Refrigerant property tables are permitted)

OUTCOMES:
- Apply Mathematical foundations, principles in solving thermodynamics problems.
- Critically analyse the problem, and solve the problems related to heat transfer and propulsion

TEXT BOOKS:

REFERENCES:

AE8351 SOLID MECHANICS

OBJECTIVE:
- To introduce various behavior of structural components under various loading conditions.
UNIT I INTRODUCTION
Definition of stress, strain and their relations – Relations between material constants – Axial loading - Statically determinate and indeterminate problems in tension & compression - Thermal stresses – Impact loading.

UNIT II STRESSES IN BEAMS
Shear force & bending moment diagrams: Bending and shear stress variation in beams of symmetric sections, Beams of uniform strength - beams of two materials.

UNIT III DEFLECTION OF BEAMS

UNIT IV TORSION – SPRINGS – COLUMNS

UNIT V BIAXIAL STRESSES
Stresses in thin-walled pressure vessels – combined loading of circular shaft with bending, torsion and axial loadings – Mohr’s circle and its construction – determination of principal stresses.

OUTCOMES:
- Solve the problems related to the structural components under various loading conditions

TOTAL: 45 PERIODS

TEXT BOOKS:
2. Timoshenko and Young "Strength of Materials" Vol. I & II.

REFERENCES:

EI8305 ELECTRICAL AND ELECTRONICS ENGINEERING
L T P C
3 0 0 3

OBJECTIVES:
- To impart the knowledge on basic concepts of electrical circuits and electrical machines.
- To impart the knowledge on basic concepts of electronic components, devices and circuits

UNIT I BASIC CONCEPTS AND DC CIRCUITS
Ohm’s law - Electrical resistance - Series / Parallel resistive circuits - Star/Delta transformations - Kirchoff’s law - Node and Mesh analysis - Thevenin’s and Norton’s theorem.

UNIT II A.C. CIRCUITS
RMS and average value of periodic waves - Form factor - Phase and Phase difference - Simple RC,RL and RLC circuits - series and parallel resonance - power and power factor - introduction to three phase systems – power measurement in 3 phase system.
UNIT III D.C. MACHINES

UNIT IV ELECTRONIC COMPONENTS AND DEVICES
Operating principle and characteristics of Simple PN Junction Diodes, Zener diode, Bipolar Junction transistor - Field Effect Transistors – UJT – SCR.

UNIT V ANALOG CIRCUITS
Rectifier and Power Supply Circuits, clipper, clamper using diodes, Operational Amplifiers (Ideal) - properties and typical circuits like differentiator, integrator, summer, comparator.

TOTAL: 45 PERIODS

OUTCOMES:
- ability to use the various electrical machines like AC/DC, electronic components and applications of analog circuits

REFERENCES:

AE8311 MECHANICAL SCIENCES LABORATORY
L T P C
0 0 3 2

OBJECTIVE:
To train the students in testing and quantifying the mechanical properties of Engineering Materials, Engines.

LIST OF EXPERIMENTS:

MATERIAL TESTING LAB
- Tension Test
- Torsion Test
- Testing of springs
- Impact test i) Izod, ii) Charpy
- Hardness test i) Vickers, ii) Brinell, iii) Rockwell, iv) Shore
- Deflection of Beams
- Dye Penetrant Test
- Tensile testing of polymers.
- Flex Fatigue test for Elastomers.
- Injection moulding machine operation.

IC ENGINES LAB
- Performance test on a 4 stroke engine
- Viscosity determination of the given fluid
- Moment of inertia of connecting rod
- Determination of Effectiveness of a parallel and counter flow heat exchangers.
- Valve timing of a 4 stroke engine and port timing of a 2 stroke engine.
- Determination of Flash point and Fire point of the given oil.

TOTAL: 45 PERIODS

OUTCOMES:
- Upon completion of this course, the students can able to apply determine the strength materials and thermal properties
EI8361  ELECTRICAL AND ELECTRONIC ENGINEERING LABORATORY  L T P C
0 0 3 2

OBJECTIVE :
- To train the students in performing various tests on electrical drives, sensors and circuits.

LIST OF EXPERIMENTS:
1. Load test on separately excited DC shunt generator
2. Load test on DC shunt moor
3. Load test on S Transformer
4. Load test on Induction motor
5. Regulation of 3 Alternator
6. Study of CRO
7. Logic gates
8. Operational amplifiers
9. Time constant of RC circuit
10. Characteristics of LVDT
11. Calibration of Rotometer
12. RTD and Thermistor
13. Flapper Nozzle system

TOTAL : 45 PERIODS

OUTCOMES:
- The students will gain practical experience in designing robots in Mechatronics approach

MA8357  TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS  L T P C
3 1 0 4

OBJECTIVES:
- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes;
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems;
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic;
- To develop Z-transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems.

UNIT I  PARTIAL DIFFERENTIAL EQUATIONS  9+3
Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Singular solutions – Lagrange’s Linear equation – Integral surface passing through a given curve – Classification of Partial Differential Equations – Solution of linear equations of higher order with constant coefficients – Linear non-homogeneous PDE.

UNIT II  FOURIER SERIES  9+3
Dirichlet’s conditions – General Fourier series – Odd and even functions – Half-range Sine and Cosine series – Complex form of Fourier series – Parseval’s identity – Harmonic Analysis.
OUTCOMES:

- The understanding of the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

TEXT BOOKS:


REFERENCES:


Field study of common plants, insects, birds
Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II  ENVIRONMENTAL POLLUTION
Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.
Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES
Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.
Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV  SOCIAL ISSUES AND THE ENVIRONMENT

UNIT V  HUMAN POPULATION AND THE ENVIRONMENT

TOTAL : 45 PERIODS

OUTCOMES:
Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters
OUTCOMES:

- Ability to perform linear static analysis of determinate and indeterminate aircraft structural components
- Ability to design the component using different theories of failure
OUTCOMES:

- Know the operation of airplane control system, Engine system, Air conditioning and pressing system.
- Know the operation of air data Instruments system

OBJECTIVE:

- To impart knowledge of the hydraulic and pneumatic systems components and types of instruments and its operation including navigational instruments to the students

UNIT I AIRCRAFT SYSTEMS 8

UNIT II AIRPLANE CONTROL SYSTEMS 12
Conventional Systems - Power assisted and fully powered flight controls - Power actuated systems - Engine control systems - Push pull rod system - operating principles - Modern control systems - Digital fly by wire systems - Auto pilot system, Active Control Technology

UNIT III ENGINE SYSTEMS 8
Fuel systems - Piston and Jet Engines - Components - Multi-engine fuel systems, lubricating systems - Piston and jet engines - Starting and Ignition systems - Piston and Jet engines

UNIT IV AIRCONDITIONING AND PRESSURIZING SYSTEM 8
Basic Air Cycle systems - Vapour Cycle Systems, Boot-strap air cycle system - Evaporative vapour cycle systems - Evaporation air cycle systems - Oxygen systems - Fire protection systems, Deicing and anti icing system.

UNIT V AIRCRAFT INSTRUMENTS 9

TOTAL: 45 PERIODS
AE8403 LOW SPEED AERODYNAMICS

OBJECTIVES:
- To introduce the concepts of mass, momentum and energy conservation relating to aerodynamics.
- To make the student understand the concept of vorticity, irrotationality, theory of airfoils and wing sections.
- To introduce the basics of viscous flow.

UNIT I INTRODUCTION TO LOW SPEED FLOW

UNIT II TWO DIMENSIONAL INVISCID INCOMPRESSIBLE FLOW
Ideal Flow over a circular cylinder, D’Alembert’s Paradox, Magnus effect, Kutta Joukowski’s Theorem, Starting Vortex, Kutta condition, Real flow over smooth and rough cylinder.

UNIT III AIRFOIL THEORY

UNIT IV SUBSONIC WING THEORY
Vortex Filament, Biot and Savart Law, Bound Vortex and trailing Vortex, Horse Shoe Vortex, Lifting Line Theory and its limitations.

UNIT V INTRODUCTION TO BOUNDARY LAYER THEORY
Boundary layer and boundary layer thickness, displacement thickness, momentum thickness, Energy thickness, Shape parameter, Boundary layer equations for a steady, two dimensional incompressible flow, Boundary Layer growth over a Flat plate, Critical Reynolds Number, Blasius solution, Basics of Turbulent flow.

TOTAL: 45 PERIODS

OUTCOMES:
- An ability to apply airfoil theory to predict airfoil performance
- A knowledge of incompressible flow
- An explosive to Boundary layer theory
OUTCOMES:

- Students will be able to understand the concepts of mechanisms and machines
- Students can fabricate the mechanisms for their final year project work.
OBJECTIVES:
- To predict different aerodynamic propulsion used in aero application.

LIST OF EXPERIMENTS
1. Application of Bernoulli's Equation – Venturimeter and Orifice meter.
2. Frictional Loss in laminar flow through pipes.
3. Frictional Loss in turbulent flow through pipes.
5. Determination of lift for the given airfoil section.
6. Pressure distribution over a smooth circular cylinder.
7. Pressure distribution over a rough circular cylinder.
8. Pressure distribution over a symmetric aerofoil.
9. Pressure distribution over a cambered aerofoil.
10. Flow visualization studies in subsonic flows.

OUTCOMES:
- Ability to use the fundamental dynamic principle in aircraft application.

 OBJECTIVES:
- To study the properties of materials used in Aircraft structure.
- To study the failure of different component under different loading condition.
LIST OF EXPERIMENTS
1. Determination of Young’s Modulus for Metallic materials
2. Determination of Flexural strength of Metallic materials.
3. Deflection of a Simply-Supported Beam
4. Deflection of a Cantilever beam.
5. Verification of Principle of Superposition Theorem
6. Verification of Maxwell’s Reciprocal Theorem
7. Influence line study on beams
8. Buckling Load estimation of Slender Eccentric Columns
9. Construction of South well Plot
10. Study of Non-Destructive Testing Procedures
11. Determination of flexural rigidity of Composite beams
12. Shear Failure of Bolted and Riveted Joints
13. Calibration of proving Ring and Spring
Only 10 experiments will be conducted.

P: 60 TOTAL: 60 PERIODS

OUTCOMES:
- Ability to perform non-destructive testing to predict the properties of metabolic materials used in aircraft application

AE8501 AIR BREATHING PROPULSION

OBJECTIVE:
To introduce basic concepts and salient features of engine components of jet propelled engines which are operated in atmosphere to students. This course is also aimed at making students familiarize with advanced jet propulsion methods like hypersonic propulsion.

UNIT I FUNDAMENTALS OF AIR BREATHING ENGINES
OUTCOMES:

- Ability to identify the engine components of jet propelled engines
- Know the details of advanced Jet propulsion and hypersonic propulsion

TEXT BOOKS:

2. James Award, Aerospace Propulsion System

REFERENCES:


AE8502 AIRCRAFT FLIGHT MECHANICS

3 0 0 3

OBJECTIVES:

- To make the student understand the performance of airplanes under various flight conditions such as take off, cruise, landing, climbing, gliding, turning and other maneuvers.

UNIT I GENERAL CONCEPTS

International Standard atmosphere, IAS, EAS, TAS, Propeller theory- Froude momentum and blade element theories, Propeller co-efficients, Use of propeller charts, Performance of fixed and variable pitch propellers, High lift devices, Thrust augmentation

UNIT II DRAG OF BODIES:

Streamlined and bluff body, Types of drag, Effect of Reynolds number on skin friction and pressure drag, Drag reduction of airplanes, Drag polar, Effect of Mach number on drag polar. Concept of Sweep. Effect of sweep on drag.
OUTCOMES:
Students will be able to
- Understand concepts of take-off, climb, cruise, turn, descent and landing performance
- Understand the performance characteristics of the different types of power plants
- Understand and predict the behavior of fixed wing aircraft undertaking a typical flight profile
- Understand the factors that influence aircraft design and limit aircraft performance

TEXT BOOKS:

REFERENCES:
3. L.J. Clancey, Aerodynamics, Pitman, 1986
OBJECTIVES:
- To provide the students various methods for analysis of aircraft wings and fuselage.
- To provide the behavior of major aircraft structural components.

UNIT I   UNSYMMETRICAL BENDING  9
Bending of symmetric beams subject to skew loads - bending stresses in beams of
unsymmetrical sections – generalized ‘k’ method, neutral axis method, principal axis method.

UNIT II  SHEAR FLOW IN OPEN SECTIONS  9
Thin walled beams – concept of shear flow – the shear centre and its determination – shear
flow distribution in symmetrical and unsymmetrical thin-walled sections – structural idealization
– shear flow variation in idealized sections.

UNIT III  SHEAR FLOW IN CLOSED SECTIONS  9
Bredt - Batho theory – single-cell and multi-cell tubes subject to torsion – shear flow distribution
in thin-walled single & multi-cell structures subject to combined bending torsion – with walls
effective and ineffective in bending – shear centre of closed sections.

UNIT IV  BUCKLING OF PLATES  8
Bending of thin plates – rectangular sheets under compression - local buckling stress of thin
walled sections – crippling strength estimation – thin-walled column strength – load carrying
capacity of sheet stiffener panels – effective width.

UNIT V  STRESS ANALYSIS OF WING AND FUSELAGE  10
Loads on an aircraft – the V-n diagram – shear force and bending moment distribution over the
aircraft wing and fuselage – shear flow in thin-webbed beams with parallel and non-parallel
flanges – complete tension field beams – semi-tension field beam theory.

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to analyse the aircraft wings and fuselage
- Ability to demonstrate the behavior of major aircraft structural components.

TEXT BOOKS:
   USA, 1985.

REFERENCES:
OBJECTIVES:
- To introduce the concepts of compressibility,
- To make the student understand the theory behind the formation of shocks and expansion fans in Supersonic flows.
- To introduce the methodology of measurements in Supersonic flows.

UNIT I   FUNDAMENTAL ASPECTS OF COMPRESSIBLE FLOW
Compressibility, Continuity, Momentum and Energy equations for steady one dimensional flow, compressible Bernoulli's equation, Area – Mach number – Velocity relation, Mach cone, Mach angle, One dimensional Isentropic flow through variable area duct, Critical conditions, Characteristic Mach number, Area-Mach number relation, Maximum discharge velocity – operating characteristics of nozzles- Introduction to hypersonic flows.

UNIT II   SHOCK AND EXPANSION WAVES

UNIT III  TWO DIMENSIONAL COMPRESSIBLE FLOW
Potential equation for 2-dimensional compressible flow, Linearisation of potential equation, perturbation potential, Linearised Pressure Coefficient, Linearised subsonic flow, Prandtl-Glauert rule, Linearised supersonic flow, Method of characteristics.

UNIT IV   HIGH SPEED FLOW OVER AIRFOILS, WINGS AND AIRPLANE CONFIGURATION
Critical Mach number, Drag divergence Mach number, Shock Stall, Supercritical Airfoil Sections, Transonic area rule, Swept wing, Airfoils for supersonic flows, Lift, drag, Pitching moment and Centre of pressure for supersonic profiles, Shock-expansion theory, wave drag, supersonic wings, Design considerations for supersonic aircraft- aerodynamic heating.

UNIT V    EXPERIMENTAL TECHNIQUES FOR HIGH SPEED FLOWS
Wind tunnels for transonic, Supersonic and hypersonic flows, shock tube, Gun tunnels-peculiar problems in the operation of hypersonic tunnels - Supersonic flow visualization methods

OUTCOMES:
- Understanding characteristics of fluid flows
- Knowledge gained in shock phenomenon and fluid waves.
- understanding fluid flow characteristics over wings airfoils and airplanes.
- Usage of wind tunnels for evaluating flow behaviours.

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
- To study the effect of time dependent forces on mechanical systems and to get the natural characteristics of systems with more degree of freedom systems.
- To study the aeroelastic effects of aircraft wing.

UNIT I  SINGLE DEGREE OF FREEDOM SYSTEMS  10

UNIT II  MULTI DEGREES OF FREEDOM SYSTEMS  10
Two degrees of freedom systems — Static and Dynamic couplings — vibration absorber— Principal co-ordinates — Principal modes and orthogonal conditions — Eigen value problems — Hamilton’s principle — Lagrangean equations and application.

UNIT III  CONTINUOUS SYSTEMS  8
Vibration of elastic bodies — Vibration of strings — Longitudinal, Lateral and Torsional vibrations

UNIT IV  APPROXIMATE METHODS  9

UNIT V  ELEMENTS OF AEROELASTICITY  8
Vibration due to coupling of bending and torsion — Aeroelastic problems — Collar’s triangle — Wing Divergence — Aileron Control reversal — Flutter — Buffeting. — Elements of servo elasticity

TOTAL: 45 PERIODS

OUTCOMES:
- Gaining understanding of single and multi degree vibrating systems
- Ability to use numerical techniques for vibration problems
- Knowledge acquired in aero elasticity and fluttering

TEXT BOOKS

REFERENCES
OBJECTIVE:
- To make the student familiarize with the experiments in aerodynamics on wings, bodies and calibration of supersonic wind tunnel.

LIST OF EXPERIMENTS
1. Pressure distribution over a finite wing of symmetric aerofoil section.
2. Pressure distribution over a finite wing of cambered aerofoil section.
3. Pressure distribution over a Nose cone model.
4. Determination of Base drag of a missile model.
5. Determination of profile drag of bodies by wake survey method.
6. Study of flow field over a backward facing step.
7. Pressure distribution over a water tank model for various wind speeds.
8. Velocity profiles for different simulated terrains.
10. Flow visualization studies in supersonic flows.
11. Force measurements on Aircraft models

Only 10 experiments will be conducted.

OUTCOMES:
- Ability to use the fundamental dynamic principle in aircraft application.

OBJECTIVES:
- To enable the students understand the behavior of aircraft structural components under different loading conditions.
- To provide the Principle involved in photo elasticity and its applications in stress analysis for composite laminatas.

LIST OF EXPERIMENTS
1. Unsymmetrical Bending of a Cantilever Beam
2. Combined bending and Torsion of a Hollow Circular Tube
3. Material Fringe Constant of a Photo elastic Models
4. Shear Centre of a Channel Section
5. Free Vibration of a Cantilever Beam
6. Forced Vibration of a cantilever Beam
7. Fabrication of a Composite Laminate.
8. Determination of Elastic constants for a Composite Tensile Specimen.
10. Tension field beam
11. Moire techniques

Only 10 experiments will be conducted.
OUTCOMES:
Upon completion of the course
- The students can understand the fundamental concepts of frictional loss in laminar and turbulent flow through pipes.
- The students will get enough experience on calibration of a subsonic wind tunnel.
- The students will be able to determine lift for the given airfoil sections.
- The students will be able to identify pressure distribution over the various bodies.
- They will have a practical exposure on flow visualization techniques pertaining to subsonic

AE8513  PROPELLION LABORATORY  L T P C
0 0 4 2

OBJECTIVE:
- To familiarize students and to expose them practically to various aircraft piston and gas turbine engines
- To give practical exposure to various testing methods of variable area ducts, propellants, jet engine components and rockets
- To practically determine the flow behavior of jets

LIST OF EXPERIMENTS
1. Study of aircraft piston and gas turbine engines
2. Velocity profiles of free jets.
3. Velocity profiles of wall jets.
4. Wall pressure measurements of a subsonic ramjet duct.
5. Flame stabilization studies using conical flame holders.
6. Variation of regression rate of solid fuel grain in a hybrid rocket.
7. Burn rate measurements of solid propellants
8. Cascade testing of compressor blades
9. Velocity and pressure measurements in co-axial jets
10. Flow visualization of secondary injection in a supersonic cross flow
11. Wall pressure distribution in subsonic diffusers.
12. Wall Pressure measurements in supersonic nozzles
Only 10 experiments will be conducted.

P: 60  TOTAL : 60 PERIODS

OUTCOMES:
- Ability to understand details of piston and gas turbine engine
- Ability to perform various testing on ducts, propellants, jet engine components

PR8602  MANAGEMENT SCIENCES  L T P C
3 0 0 3

OBJECTIVES:
- To understand the various processes involved in Marketing and its Philosophy.
- To learn the Psychology of consumers.
- To formulate strategies for advertising, pricing and selling
UNIT I MARKETING AND PERSONNEL MANAGEMENT
Functions of Marketing – Sales Promotion Methods – Advertising – Product Packaging –
Marketing Variables – Distribution Channels – Organization – Market research – Market
Research Techniques.
Communication – Conflict - Industrial Relations – Trade union – Management functions

UNIT II INVENTORY MANAGEMENT
Purpose of Inventory – Cost Related to inventory – Basic EOQ Model – Variations in EOQ
Model – Finite Production – Quantity Discounts – ABC Analysis – MRP – Lot size under
constraints.

UNIT III OPERATIONS MANAGEMENT
Plant Location – Layout – Materials Handling – Method Study – Time Study – Ergonomics -
Aggregate Planning – Value Analysis.

UNIT IV FINANCIAL MANAGEMENT
Capital – Types – Sources – Break Even Analysis – Financial Statements – Income Statement

UNIT V OPERATIONS RESEARCH TECHNIQUES
Replacement theory – Linear Programming - Transportation and assignment problems –
Sequencing - Network Techniques - CPM and PERT.

TOTAL:45 PERIODS

OUTCOMES:
- The learning skills of Marketing will enhance the knowledge about Marketer’s Practices
  and create insights on Advertising, Branding, Retailing and Marketing Research.

TEXT BOOKS:
   Press, 2005

REFERENCES:
7. R. Kesavan, C.Elanchezian and B.Vijayaraghnam – Production Planning and Control,
OBJECTIVES:

- To make the student understand the concepts of static and dynamic stability of airplanes in stick fixed and stick free conditions.
- To introduce the concept of control of airplanes under various operating conditions.

UNIT I  STATIC LONGITUDINAL STABILITY AND CONTROL  15
General concepts-Degrees of freedom of a rigid body, Static and dynamic stability, Need for stability in an airplane, inherently and marginally stable airplanes, Stability and Controllability, Requirements of control surfaces, criteria for longitudinal static stability, contribution to stability by wing, tail, fuselage, wing fuselage combination, Total longitudinal stability, Neutral point-Stick fixed and Stick free aspects, Free elevator factor, static margin, Hinge moment, Power effects on stability-propeller and jet aircrafts, longitudinal control, Movement of centre of gravity, elevator control effectiveness, elevator control power, elevator angle to trim, elevator angle per g, maneuver point, Stick force gradient and stick force per g, Aerodynamic balancing

UNIT II  STATIC DIRECTIONAL STABILITY AND CONTROL  12
Directional stability-yaw and sideslip, Criterion of directional stability, contribution to static directional stability by wing, fuselage, tail, Power effects on directional stability-propeller and jet aircrafts. Rudder fixed and rudder free aspects. Rudder lock and Dorsal fin. Directional control, rudder control effectiveness, rudder requirements, adverse yaw, asymmetric power condition, spin recovery – Relaxed static stability of CCV.

UNIT III  STATIC LATERAL STABILITY AND CONTROL  12
Lateral stability-Dihedral effect, criterion for lateral stability, evaluation of lateral stability-contribution of fuselage, wing, wing fuselage, tail, total static lateral stability, lateral control, aileron control power, aileron effectiveness, strip theory estimation of aileron effectiveness, roll control by spoilers, aileron reversal, aileron reversal speed

UNIT IV  DYNAMIC LONGITUDINAL STABILITY  11
Equations of motion for Aircraft, small disturbance theory, Estimation of longitudinal stability derivatives stability derivatives, Routh’s discriminant, solving the stability quartic, Phugoid motion, Factors affecting the period and damping. Types of Oscillatory modes in Stick fixed and Stick free conditions.

UNIT V  DYNAMIC LATERAL AND DIRECTIONAL STABILITY  10
Dutch roll and spiral instability, Auto rotation and spin, Stability derivatives for lateral and directional dynamics.

TOTAL: 60 PERIODS

OUTCOMES:

Students who successfully complete the course will demonstrate the following outcomes by tests, homework, and written reports:

- An understanding of the different types of motion following a disturbance
- Perform preliminary design computations to meet static stability and trim requirements
- An understanding of the contribution to directional stability from various components of the airplane and the requirements of rudder
- An understanding of the dihedral effect, rolling power and control effectiveness of aileron
- Analyze dynamic flight conditions using the non-linear equations of motion
- To get familiarized with the longitudinal, directional and lateral dynamics of the airplane
- To get familiarized with writing down the equations of motion following a disturbance, solve them and investigate the stability of the disturbed motion
- Identify the lateral and longitudinal modes and relate the important physical influences of aircraft properties on these modes.
OUTCOMES:

- Understanding various propulsion systems
- Knowledge in rocket propulsion systems
- Knowing the applications and principles of liquid and solid-liquid propulsion systems
- Application of nuclear propulsion in rocketry
TEXT BOOKS:

REFERENCES:
1. James Award, Aerospace Propulsion System
2. Heter and Pratt, Hypersonic Air Breathing Propulsion

AE8603 THEORY OF ELASTICITY

OBJECTIVE:
• To make the student understand the elastic behavior of different structural components under various loadings and boundary conditions.

UNIT I BASIC EQUATIONS OF ELASTICITY
Definition of Stress and Strain: Stress - Strain relationships - Equations of Equilibrium, Compatibility equations, Boundary Conditions, Saint Venant's principle - Principal Stresses, Stress Ellipsoid - Stress invariants.

UNIT II PLANE STRESS AND PLANE STRAIN PROBLEMS
Airy's stress function, Bi-harmonic equations, Polynomial solutions, Simple two dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams.

UNIT III POLAR COORDINATES
Equations of equilibrium, Strain - displacement relations, Stress - strain relations, Airy's stress function, Axi - symmetric problems, Introduction to Dunder's table, Curved beam analysis, Lame's, Kirsch, Michell's and Boussinesque problems - Rotating discs.

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

UNIT V INTRODUCTION TO THEORY OF PLATES AND SHELLS
Classical plate theory – Assumptions – Governing equations – Boundary conditions – Navier's method of solution for simply supported rectangular plates – Levy's method of solution for rectangular plates under different boundary conditions.

TOTAL: 45 PERIODS

OUTCOMES:
• Ability to use mathematical knowledge to solve problem related to structural elasticity.

TEXT BOOKS:

REFERENCES:
OUTCOME

• The students will have enough confidence to present themselves well using proper oral and written communication skills to any interview (or) discussion (or) presentation.

Requirements for a class of 30 students
1. A PC or a lap top with one or two speakers
2. A Collar mike and a speaker
3. An LCD projector and a screen
4. CD’s and DVD’s on relevant topics

Reference Books

Extensive Readers

Web Resources
1. [www-humanresources.about.com](http://www-humanresources.about.com)
2. [www.careerride.com](http://www.careerride.com)
AE8611  AIRCRAFT DESIGN PROJECT I  L T P C
                      0 0 4 2

OBJECTIVES:
• To make the student work in groups and understand the Concepts involved in Aerodynamic design, Performance analysis and stability aspects of different types of airplanes
1. Comparative studies of different types of airplanes and their specifications and performance details with reference to the design work under taken.
2. Preliminary weight estimation, Selection of design parameters, power plant selection, aerofoil selection, fixing the geometry of Wing, tail, control surfaces Landing gear selection.
3. Preparation of layout drawing, construction of balance and three view diagrams of the airplane under consideration.

P : 60 TOTAL : 60 PERIODS

AE8701  COMPOSITE MATERIALS AND STRUCTURES  L T P C
                      3 0 0 3

OBJECTIVE:
• To make the student understand the analysis of composite laminates under different loading conditions and different environmental conditions.

UNIT I  MICROMECHANICS  10

UNIT II  MACROMECHANICS  10

UNIT III  LAMINATED PLATE THEORY  10

UNIT IV  FABRICATION PROCESS AND REPAIR METHODS  8
Various open and closed mould processes, Manufacture of fibers. Importance of repair and different types of repair techniques in Composites – Autoclave and non-autoclave methods.

UNIT V  SANDWICH CONSTRUCTIONS  7
Basic design concepts of sandwich construction - Materials used for sandwich construction - Failure modes of sandwich panels - Bending stress and shear flow in composite beams.

TOTAL: 45 PERIODS

OUTCOMES:
• Understanding the mechanics of composite materials
• Ability to analyse the laminated composites for various loading eases
• Knowledge gained in manufacture of composites
TEXT BOOKS:
1. Dam Ishai, "Mechanics of Composite Materials."

REFERENCES:
3. Calcolte, L.R. "The Analysis of laminated Composite Structures", Von –

AE8702 COMPUTATIONAL FLUID DYNAMICS FOR AERONAUTICAL APPLICATIONS

L T P C
3 0 0 3

OBJECTIVE:
• To achieve an understanding of principles of Fluid Dynamics, introduce various computational techniques applicable to fluid dynamic problems and understand the Finite Volume Methods.

UNIT I INTRODUCTION TO NUMERICAL METHODS IN FLUID DYNAMICS 9
Introduction to numerical fluid dynamics - Introduction to governing equations of fluid dynamics and modeling of fluid flow – The substantial derivative and the physical meaning of divergence of a vector. Boundary conditions for various types of fluid flow conditions - Introduction to mathematical properties of fluid dynamic equations and classification of partial differential equations - General behaviour of different classes of partial differential equations and their relation to fluid dynamics - A general discussion on hyperbolic, parabolic and elliptic equations

UNIT II GRID GENERATION 8
Introduction to grid generation in computational fluid dynamics - Structured grid generation techniques – algebraic methods, conformal mapping and methods using partial differential equations - Basic Ideas in numerical grid generation and mapping - Boundary value problem of numerical grid generation- grid control functions- branch cut - The boundary conditions of first kind – orthogonality of grid lines- boundary point grid control.

UNIT III SOLUTION OF FLUID FLOW EQUATIONS 8
Introduction to boundary layer equations and their solution - Description of Prandtl's boundary layer equations and the hierarchy of the boundary layer equations - Transformation of boundary layer equations and the numerical solution method - Choice of discretization model and the generalized Crank-Nicholson scheme - Discretization of the boundary layer equations and illustration of solution of a tridiagonal system of linear algebraic equations – Solution methods for elliptic, parabolic and hyperbolic equations.
UNIT IV  TIME DEPENDENT METHODS
Introduction to time dependent methods - Explicit time dependent methods – Euler, Backward Euler, One step trapezoidal, Backward differencing, two-step trapezoidal, Leap Frog and Adams-Bashforth Methods - Description of Lax-Wendroff Scheme and Mac Cormack’s two step predictor – corrector method - Description of time split methods.
Introduction to implicit methods and respective stability properties of explicit and implicit methods - Construction of implicit methods for time dependent problems - Linearization, choice of explicit operator and numerical dissipation aspects.

UNIT V  FINITE VOLUME METHOD
Introduction to Finite volume Method - Different Flux evaluation schemes, central, upwind and hybrid schemes - Staggered grid approach - Pressure-Velocity coupling - SIMPLE, SIMPLER algorithms- pressure correction equation (both incompressible and compressible forms) - Application of Finite Volume Method for 1-D and 2-D problems.

OUTCOMES:
- The students will be able to do the numerical grid generation and having knowledge about the mapping techniques.
- The students will be able obtain the solution for boundary layer equations and transformation equations.
- The students will have wide ideas about the explicit time dependent methods and their factorization schemes.
- The students will be able to do the stability analysis and linearization of the implicit methods.
- They had enough knowledge on the fundamental aspects of finite volume method and their application to fluid dynamics problem.

TEXT BOOKS:

REFERENCES:
5. Peric, Computational Fluid Dynamics.
OBJECTIVE:

- To give exposure various methods of solution and in particular the finite element method. Gives exposure to the formulation and the procedure of the finite element method and its application to varieties of problems.

UNIT I INTRODUCTION


UNIT II DISCRETE ELEMENTS

Bar elements, uniform section, mechanical and thermal loading, varying section, 2D and 3D truss element. Beam element - problems for various loadings and boundary conditions – 2D and 3D Frame elements - longitudinal and lateral vibration. Use of local and natural coordinates.

UNIT III CONTINUM ELEMENTS


UNIT IV ISOPARAMETRIC ELEMENTS

Definitions, Shape function for 4, 8 and 9 noded quadrilateral elements, Stiffness matrix and consistent load vector. Evaluation of element matrices using numerical integration.

UNIT V FIELD PROBLEM AND METHODS OF SOLUTIONS


TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the Students can able to understand different mathematical Techniques used in FEM analysis and use of them in Structural and thermal problem

TEXT BOOKS:


REFERENCES:

OBJECTIVES:
Students will get exposure to the use of structural analysis software for solving varieties of problems. Students will be grouped into several batches, each batch containing two students, and each batch has to select a problem solve it and verify the results with that obtained from the software.

1. Axial Loading. Statically determinate and indeterminate cases.
2. Static analysis of beam using beam element, plane stress and solid elements.
3. Buckling column using beam and plane stress element.
4. Stress concentration. Plate with hole.
5. Analysis torque arm.
6. Free vibration of beam with various end conditions.
7. Combined loading.
8. Thin cylinder under internal pressure.
9. Heat transfer in composite wall
10. Analysis heat transfer in extended surface
11. 2-D heat transfer problem
12. Thermo-structural analysis of axially loaded bar
13. Solving problems by command mode

Only 10 experiments will be conducted.

TOTAL: 60 PERIODS

OUTCOMES:
Students will

- Have overall understanding of various approximate methods used for solving structural mechanics problems.
- Understanding the formulation of governing equation for the finite element method, convergence criteria and advantage over other approximate methods.
- Capability to solve 1-D problems related to static analysis of structural members.
- Understand the formulation of element matrices for 2-D problems.
- Exposure to isoparametric element formulations and importance of numerical integration.
- Exhibit the ability to solve eigen value problems and scalar field problems.
OBJECTIVE:
Each group of students is assigned to continue the structural design part of the airplane. The following are the assignments to be carried out.

1. Preliminary design of an aircraft wing – Shrenck’s curve, structural load distribution, shear force, bending moment and torque diagrams
2. Detailed design of an aircraft wing – Design of spars and stringers, bending stress and shear flow calculations – buckling analysis of wing panels
3. Preliminary design of an aircraft fuselage – load distribution on an aircraft fuselage
4. Detailed design of an aircraft fuselage – design of bulkheads and longerons – bending stress and shear flow calculations – buckling analysis of fuselage panels
5. Design of control surfaces - balancing and maneuvering loads on the tail plane and aileron, rudder loads
6. Design of wing-root attachment
7. Landing gear design
8. Preparation of a detailed design report with CAD drawings

TOTAL: 60 PERIODS

OUTCOMES:
• On completion of Aircraft design project II the students will be in a position to design aircraft wings, fuselage, loading gears etc., and also able to angle the design in terms of structural point of view.

OBJECTIVES:
The objective of this laboratory is to learn and understand the low cost UAV SYSTEMS which is suitable for generating variety of data to verify and validate the different types of algorithms developed by the researchers and Scientists working on MINI UAV’s and MAV’s.

1) Model Building and working with Materials
   I. Balsa : Techniques of working
   II. Coro Plast : Techniques of working
   III. Foam : Hot wire cutting of aero foils and Techniques of working
   IV. Hinging control surfaces : techniques
   V. Covering techniques using film, Mylar, Textile coat, painting etc
   VI. Integrations and Trimming of control surfaces
2) Power system integration including setting of thrust line
   I. Various types of Power system options with Test benches
   II. Propeller thrust bench glow and petrol engine
   III. Brushless DC Motor power system set ups test bench of same motor with different KV ratings and voltage to understand and study the relation between torque and speed of a DC Motor
   IV. Understanding the propeller using sensors Anemometers to measure air flow in the case of smaller and larger props and calculating the volume of air moved by the prop and correlating it to the known pitch.
   V. Understanding the procedure for choosing power systems including selection of motor/ESC and battery for a given air frame
   VI. Engine fitting and adjusting thrust line
   VII. Tuning of engines
   VIII. Studying engine efficiency with change of propellers

3) COMMAND AND CONTROL SYSTEM PROCEDURE
   I. Understanding PWM, PPM, FM signals (electronics experiment)
   II. Servo testing and its relation to digital proportional movement and PWM Inputs

4) Basic RF Experiments

5) Flight Simulator Training
   Real Flight RC Simulator training required to understand flying and the use of control systems from a practical point of view.

6) Simple flight stabilization system integration

7) Quad rotor stabilization (rotary)

Payload Communication Procedure

8) Integration and setting up of video systems both 5 V and 12 V variants
9) Auto Pilot : FY 3 ZT integration with GCS
10) Integration of Payload like Gimbal camera and its operations, sensors etc
11) Build your own UAV airframe of your own design 😊 and integrate with Autopilot system

The following experiments will be conducted by the students during the flight training programme at IIT- Kanpur in the month of November/December (Before the start of the Semester VIII) and evaluation is also done by the faculty of IIT- Kanpur

1. C.G. determination
2. Calibration of ASI and Altimeter
3. Calibration of special instruments
4. Cruise and climb performance
5. Determination of stick fixed & stick free neutral points
6. Determination of stick fixed & stick free maneuver points
7. Verification of Lateral-directional equations of motion for a steady state side slip maneuver
8. Verification of Lateral-directional equations of motion for a steady state coordinated turn
9. Flight determination of drag polar of a glider
10. Demonstration of Phugoid motion and Dutch roll

TOTAL: 30 PERIODS

OUTCOMES:
- Upon completion of the course students will be in a position to do carry out preliminary design of a simple mini UAV.
- The students will be able to validate the algorithms currently in use for control of UAV's.

AE8811 PROJECT WORK

OBJECTIVE:
Students in a group of three or four will be assigned a project involving – design – fabrication – theoretical studies – experimental studies on some problem related to Aerospace Engineering. Continuous internal assessment marks for the project will be given during project review meetings. The student has to prepare and present a detailed project report at the end of the semester and give a talk about the work done. End semester examination mark will be based on viva voce examination.

OUTCOME:
- The students will be able to think innovatively.
- The students will be able to work as team.
- They will be able to understand the concept of system engineering and product developments.
- They will be in a position to use the theoretical knowledge in the practical applications.
- They will be better placed to be practically exposed in the particular field of the domain, they work.

PRACTICAL: 180 PERIODS
OUTCOME:
Students who successfully complete this course will be able to:

- Understanding of the different aero elastic phenomenon and the methods of counteracting it
- Explain how the aeroelastic phenomena flutter, divergence and aileron reversal arise and how they affect aircraft performance,
- Formulate aeroelastic equations of motion and use them to derive fundamental relations for aeroelastic analysis,
- Perform a preliminary aeroelastic analysis of a slender wing structure in low-speed airflow, and explain under what circumstances an aeroelastic analysis can be expected to produce useful results.
- Ability to estimate the critical divergence, reversal and flutter speeds of an airplane and to investigate the stability of the disturbed motion.
- Understand Aero servo and aero thermo elasticity.
TEXT BOOKS:

REFERENCES:
3. Scanlan, R.H. and Rosenbam, R., Introduction to the Study of Aircraft

AE8002 AIRCRAFT DESIGN
3 0 0 3

OBJECTIVES:
- To make the student understand the choice of the selection of design parameters, Fixing the geometry and to investigate the performance and stability characteristics of airplanes.

UNIT I INTRODUCTION
State of art in airplane design, Purpose and scope of airplane design, Classification of airplanes based on purpose and configuration. Factors affecting configuration, Merits of different plane layouts. Stages in Airplane design. Designing for manufacturability, Maintenance, Operational costs, Interactive designs.

UNIT II PRELIMINARY DESIGN PROCEDURE

UNIT III POWER PLANT SELECTION
Choices available, comparative merits, Location of power plants, Functions dictating the locations.

UNIT IV DESIGN OF WING, FUSELAGE AND EMPHANAGE
Selection of aerofoil. Selection of Wing parameters, selection of sweep, Effect of Aspect ratio, Wing Design and Airworthiness requirements, V-n diagram, loads, Structural features. Elements of fuselage design, Loads on fuselage, Fuselage Design. Fuselage and tail sizing. Determination of tail surface areas, Tail design, Structural features, Check for nose wheel lift off.

UNIT V DESIGN OF LANDING GEAR AND CONTROL SURFACE

TOTAL: 45 PERIODS
OUTCOMES:
Students will be able to
- Initiate the preliminary design of an aircraft starting from data collection to satisfy mission specifications;
- To get familiarized with the estimation of geometric and design parameters of an airplane
- Understanding the procedure involved in weight estimation, power plant selection, estimation of the performance parameters, stability aspects, design of structural components of the airplane, stability of structural elements, estimation of critical loads etc.
- Initiate the design of a system, component, or process to meet requirements for aircraft systems;
- Complete the design of an aircraft to a level of sufficient detail to demonstrate that it satisfies given mission specifications
- Work in a multidisciplinary environment involving the integration of engineering practices in such subjects as aerodynamics, structures, propulsion, and flight mechanics
Communicate and present effectively, through both written and oral reporting, the results and consequences of their technical efforts.

TEXT BOOKS:

REFERENCES:

AE8003 AIRCRAFT ENGINE REPAIRS AND MAINTENANCE L T P C 2 0 2 3

OBJECTIVES:
- To make the students to familiarize with the Aircraft engine maintenance procedure and practice.
- Must have knowledge of basics of Aeronautics and engine components.

UNIT I
Classification of piston engines - Principles of operation - Function of components - Materials used - Details of starting the engines - Carburetion and Fuel injection systems for small and large engines - Ignition system components - spark plug detail - Engine operating conditions at various altitudes - Engine power measurements - Classification of engine lubricants and fuels - Induction, Exhaust and cooling system - Maintenance and inspection check to be carried out. Inspection and maintenance and trouble shooting - Inspection of all engine components - Daily and routine checks - Overhaul procedures - Compression testing of cylinders - Special inspection schedules - Engine fuel, control and exhaust systems - Engine mount and supercharger - Checks and inspection procedures.
OUTCOMES:

Students who successfully complete this course will be able to:

- Inspect and safely perform maintenance and troubleshooting on aircraft cabin atmospheric control, ice and rain control, position and warning, fire protection, and fuel systems using the manufacturer service manuals, acceptable industry practices and applicable regulations.
- Demonstrate a working knowledge and mechanical ability to inspect, maintain, service and repair aircraft electrical, engine (piston and turbine), airframe structure, flight control, hydraulic, pneumatic, fuel, navigation and instrument systems and other aircraft components.
- Identify, install, inspect, fabricate and repair aircraft sheet metal and synthetic material structures.
- Display proper behavior reflecting satisfactory work habits and ethics to fulfill program requirements and confidence to prepare for employment.

REFERENCES:

OBJECTIVES:
- The most obvious objective of this course is to familiarize the students in Airworthiness and to ensure design levels of reliability and operating safety of civil registered aircraft through promulgation and enforcement of highest achievable standards of airworthiness.

UNIT I C.A.R SERIES 'A' - PROCEDURE FOR CIVIL AIR WORTHINESS REQUIREMENTS AND RESPONSIBILITY OPERATORS VIS-A-VIS AIRWORTHINESS DIRECTORATE
Responsibilities of operators / owners; Procedure of CAR issue, amendments etc., Objectives and targets of airworthiness directorate; Airworthiness regulations and safety oversight of engineering activities of operators.
C.A.R. SERIES 'B' - ISSUE APPROVAL OF COCKPIT CHECK LIST, MEL, CDL - Deficiency list (MEL & CDL); Preparation and use of cockpit check list and emergency list.

UNIT II C.A.R. SERIES 'C' - DEFECT RECORDING, MONITORING, INVESTIGATION AND REPORTING
Defect recording, reporting, investigation, rectification and analysis; Flight report; Reporting and rectification of defects observed on aircraft; Analytical study of in-flight readings & recordings; Maintenance control by reliability Method.
C.A.R. SERIES 'D' - AND AIRCRAFT MAINTENANCE PROGRAMMES
Reliability Programme (Engines); Aircraft maintenance programme & their approval; On condition maintenance of reciprocating engines; TBO - Revision programme - Maintenance of fuel and oil uplift and consumption records - Light aircraft engines; Fixing routine maintenance periods and component TBOs - Initial & revisions.

UNIT III C.A.R. SERIES 'E' - APPROVAL OF ORGANISATIONS
Approval of organizations in categories A, B, C, D, E, F, & G; Requirements of infrastructure at stations other than parent base.

C.A.R. SERIES 'F' - AIR WORTHINESS AND CONTINUED AIR WORTHINESS:
Procedure relating to registration of aircraft; Procedure for issue / revalidation of Type Certificate of aircraft and its engines / propeller; Issue / revalidation of Certificate of Airworthiness; Requirements for renewal of Certificate of Airworthiness.

UNIT IV C.A.R. SERIES 'L' - AIRCRAFT MAINTENANCE ENGINEER - LICENSING
Issue of AME Licence, its classification and experience requirements, Complete Series 'L'.

C.A.R. SERIES 'M' MANDATORY MODIFICATIONS AND INSPECTIONS:
Mandatory Modifications / Inspections.

UNIT V C.A.R. SERIES 'T' - FLIGHT TESTING OF AIRCRAFT
Flight testing of (Series) aircraft for issue of C of A; Flight testing of aircraft for which C or A had been previously issued.

C.A.R. SERIES 'X' - MISCELLANEOUS REQUIREMENTS:
Registration Markings of aircraft; Weight and balance control of an aircraft; Provision of first aid kits & Physician's kit in an aircraft; Use furnishing materials in an aircraft; Concessions; Aircraft log books; Document to be carried on board on Indian registered aircraft; Procedure for issue of taxi permi; Procedure for issue of type approval of aircraft components and equipment including instruments.

OUTCOMES:
- Knowledge of Airworthiness requirements for transport, military, gliders and micro light aircrafts

TOTAL: 45 PERIODS
- Understanding of Defect recording, reporting, investigation, rectification and analysis
- Knowledge of procedure for holding examinations, proficiency checks etc. for Defence personnel to fulfill the requirements for grant of civil licenses.

- Understanding of procedure relating to registration of aircraft
- Knowledge of Issue/validation and renewal of Certificate of Airworthiness
- Understanding of Airworthiness of ageing aircraft

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

AE8005 AIRCRAFT SYSTEMS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:
- To make the students familiarise with the fundamental operating principles of aircraft flight instruments.
- To make the students understand functioning of the various subsystems of aircraft and the interaction of the subsystem.

UNIT I INTRODUCTION TO SYSTEMS ENGINEERING 9

UNIT II DESIGN AND DEVELOPMENT PROCESS 9
Product Life Cycle –Concept Phase-Definition Phase-Design Phase-Build, Test, Operate and Disposal Phase-Whole Life Cycle Tasks-Systems Analysis- Design Drivers in the Project, Product, Operating Environment-Interfaces with the Subsystems

UNIT III SYSTEM ARCHITECTURES AND INTEGRATION 9

UNIT IV PRACTICAL CONSIDERATIONS AND CONFIGURATION CONTROL 9
Stake holders-Communications-Criticism- Configuration Control Process-Portrayal of a System-Varying Systems Configurations- Compatibility-Factors Affecting Compatibility – Systems Evolution Considerations and Integration of Aircraft Systems

UNIT V SYSTEMS RELIABILITY AND MAINTAINABILITY 9
Systems and Components-Analysis-Influence, Economics, Design for Reliability-Fault and Failure Analysis-Case Study-Maintenance Types-Program-Planning and Design

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to
- Understand the basic working principle of hydraulic and pneumatic systems and their components
- Identify the types of control systems namely conventional and modern systems and the need to choose them for specific aircraft application
• Understand the different types of fuel system used for piston engine and jet engines

REFERENCES:

AE8006 AIRFRAME REPAIR AND MAINTENANCE L T P C 3 0 0 3

OBJECTIVE:
• To make the students to understand the Airframe components and the tools used to maintain the components. Defect investigation, methods to carry out investigation and the detailed maintenance and practice procedures.

UNIT I WELDING IN AIRCRAFT STRUCTURAL COMPONENTS
Equipments used in welding shop and their maintenance - Ensuring quality welds - Welding jigs and fixtures - Soldering and brazing.

SHEET METAL REPAIR AND MAINTENANCE:
Selection of materials; Repair schemes; Fabrication of replacement patches; Tools - power/hand; Repair techniques; Close tolerance fasteners; Sealing compounds; forming/shaping; Calculation of weight of completed repair; Effect of weight - change on surrounding structure. Sheet metal inspection - N.D.T. Testing. Riveted repair design - Damage investigation - Reverse engineering.

UNIT II PLASTICS AND COMPOSITES IN AIRCRAFT
PLASTICS IN AIRCRAFT: Review of types of plastics used in airplanes - Maintenance and repair of plastic components - Repair of cracks, holes etc., various repairs schemes - Scopes.
ADVANCED COMPOSITES IN AIRCRAFT:
Cleaning of fibre reinforced plastic (FRP) materials prior to repair; Break test - Repair Schemes; FRP/honeycomb sandwich materials; laminated FRP structural members and skin panels; Tools/equipment; Vacuum-bag process. Special precautions – Autoclaves

UNIT III AIRCRAFT JACKING, ASSEMBLY AND RIGGING

UNIT IV REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM
Trouble shooting and maintenance practices - Service and inspection - Inspection and maintenance of landing gear systems. - Inspection and maintenance of air-conditioning and pressurization system, water and waste system. Installation and maintenance of Instruments - handling - Testing - Inspection. Inspection and maintenance of auxiliary systems - Fire protection systems - Ice protection system - Rain removal system -Position and warning system - Auxiliary Power Units (APUs).

UNIT V SAFETY PRACTICES

TOTAL: 45 PERIODS

OUTCOMES:
Students who successfully complete this course will be able to:
• Identify and apply the principles of function and safe operation to aircraft as per FAA
• Understand general airframe structural repairs, the structural repair manual and structural control programmes.
Understand the nature of airframe structural component inspection, corrosion repair and non-destructive inspection
• Understand aircraft component disassembly, reassembly and troubleshooting
• Know about aircraft adhesives, sealants, bonding techniques, repair procedures and the types and detection of defects in aircraft composite materials
• Identify, install, inspect, fabricate and repair aircraft sheet metal and synthetic material structures

OUTCOMES:
Students will be able
• To understand the definition and the need for the approximate methods.
To understand the principle and procedure related to variational approach and weighted residual method and their applications.
To do static and stability analysis of 1-D problems,
To apply numerical methods like finite difference scheme and finite element approach.
To develop code related to the implementation of the approximate methods.

**TEXT BOOKS:**

**REFERENCES:**

**AE8008 AVIONICS SYSTEMS**

**OBJECTIVES:**
- To introduce the basic of avionics and its need for civil and military aircrafts
- To impart knowledge about the avionic architecture and various avionics data buses
- To gain more knowledge on various avionics subsystems

**UNIT I  INTRODUCTION TO AVIONICS** 9
Need for avionics in civil and military aircraft and space systems – Integrated avionics and weapon systems – Typical avionics subsystems, design, technologies – Introduction to Digital Computer and memories.

**UNIT II  DIGITAL AVIONICS ARCHITECTURE** 9

**UNIT III  FLIGHT DECKS AND COCKPITS** 9
Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.

**UNIT IV  INTRODUCTION TO NAVIGATION SYSTEMS** 9
UNIT V AIR DATA SYSTEMS AND AUTO PILOT

Air data quantities – Altitude, Air speed, Vertical speed, Mach Number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to build Digital avionics architecture
- Ability to Design Navigation system
- Ability to design and perform analysis on air system

TEXT BOOKS:
1. Albert Helfrick D., Principles of Avionics, Avionics Communications Inc., 2004

REFERENCES:

AE8009 BOUNDARY LAYER THEORY

OBJECTIVES

- To make the student understand the importance of viscosity and boundary layer in fluid flow. To introduce the theory behind laminar and turbulent boundary layers.

UNIT I FUNDAMENTAL EQUATIONS OF VISCOUS FLOW

Fundamental equations of viscous flow, Conservation of mass, Conservation of Momentum-Navier-Stokes equations, Energy equation, Mathematical character of basic equations, Dimensional parameters in viscous flow, Non-dimensionalising the basic equations and boundary conditions, vorticity considerations, creeping flow, boundary layer flow

UNIT II SOLUTIONS OF VISCOUS FLOW EQUATIONS

Solutions of viscous flow equations, Couette flows, Hagen-Poisuelle flow, Flow between rotating concentric cylinders, Combined Couette-Poiseuille Flow between parallel plates, Creeping motion, Stokes solution for an immersed sphere, Development of boundary layer, Displacement thickness, momentum and energy thickness.
UNIT III LAMINAR BOUNDARY LAYER EQUATIONS
Laminar boundary layer equations, Flat plate Integral analysis of Karman – Integral analysis of energy equation – Laminar boundary layer equations – boundary layer over a curved body-Flow separation- similarity solutions, Blasius solution for flat-plate flow, Falkner–Skan wedge flows, Boundary layer temperature profiles for constant plate temperature –Reynold's analogy, Integral equation of Boundary layer – Pohiausen method – Thermal boundary layer calculations

UNIT IV TURBULENT BOUNDARY LAYER
Turbulence-physical and mathematical description, Two-dimensional turbulent boundary layer equations — Velocity profiles – The law of the wall – The law of the wake – Turbulent flow in pipes and channels – Turbulent boundary layer on a flat plate – Boundary layers with pressure gradient, Eddy Viscosity, mixing length , Turbulence modelling

UNIT V COMPRESSIBLE BOUNDARY LAYERS
Compressible boundary layer equations, Recovery factor, similarity solutions, laminar supersonic Cone rule, shock-boundary layer interaction

TOTAL: 45 PERIODS

OUTCOMES:
- To introduce the fundamental equations of the viscous flow and practical examples
- To expose students to solve methods of the viscous flow
- To make the students to understand the importance of viscosity and shear flow adjacent to the airframe of the aerospace vehicles
- To demonstrate the laminar boundary layer concepts and solution methods
- To make the students to understand the importance of turbulence boundary layer in an aerospace engineering problem

TEXT BOOKS:

REFERENCES:

AE8010 COMBUSTION IN AEROSPACE VEHICLES

OBJECTIVES:
- To impart knowledge to students in the combustion mechanism of various aircraft engines including piston and gas turbine engines. Advanced concepts like supersonic combustion will be helpful in understanding hypersonic propulsion.
- Combustion mechanism of rockets will be useful for the study of rocket propulsion.

UNIT I FUNDAMENTAL CONCEPTS IN COMBUSTION, CHEMICAL KINETICS AND FLAMES
UNIT II COMBUSTION IN AIRCRAFT PISTON ENGINES
Introduction to combustion in aircraft piston engines – various factors affecting the combustion efficiency - fuels used for combustion in aircraft piston engines and their selection – detonation in piston engine combustion and the methods to prevent the detonation

UNIT III COMBUSTION IN GAS TURBINE AND RAMJET ENGINES

UNIT IV SUPersonic COMBUSTION
Introduction to supersonic combustion – supersonic combustion controlled by diffusion, mixing and heat convection – analysis of reactions and mixing processes - supersonic burning with detonation shocks - various types of supersonic combustors – high intensity combustors.

UNIT V COMBUSTION IN SOLID, LIQUID AND HYBRID ROCKETS

TOTAL: 45 PERIODS

OUTCOMES:
- The student will be in a position to understand the detailed mechanism of Aerospace Vehicles and Aircraft Engines.
- The student will be able to analyse and impart the combustion processes that occur in Aircraft Engines and Rocket Vehicles

TEXT BOOKS:

REFERENCES:

AE8011 DESIGN OF GAS TURBINE ENGINE COMPONENTS

OBJECTIVE:
- At the end of the course, the students are expected to understand what constitutes the design, how the gas turbine engine components namely inlets, compressor, combustion chamber, turbine and nozzles are designed.
UNIT I  GAS TURBINE ENGINE DESIGN FUNDAMENTALS
Design Process- compressible flow relationship; Constrain Analysis- Concept-Design tools-preliminary estimates; Mission analysis-Concept- design tools-Aircraft weight and fuel consumption data-Example problems on Constrain analysis, Mission analysis

UNIT II  ON DESIGN AND OFF-DESIGN PARAMETRIC ANALYSIS
Total and static properties-corrected mass flow rate-Engine Cycle Design- One-Dimensional Through flow Area-Flow path force on components- aircraft constraint analysis, aircraft mission analysis, engine parametric (design point) analysis, engine performance (off-design) analysis, engine installation drag and sizing

UNIT III  DESIGN OF ROTATING COMPONENTS

UNIT IV  COMBUSTION CHAMBER DESIGN

UNIT V  INLET AND NOZZLE DESIGN
Inlets and Exhaust Nozzles Design: Elements of a Successful Inlet-Engine Integration Program- Definition of Subsonic Inlet-Engine Operational Requirements- Definition of Supersonic Inlet-Engine Operational Requirements- Engine Impact on Inlet Design- Inlet Impact on Engine Design- Validation of Inlet-Engine System-Exhaust nozzle design-Nozzle types and their design -Jet control methods for reduction of infrared signature-Simple design problem on dimensional nozzle flow

OUTCOMES:
• Upon successful completion of the course, the student will be able to perform design calculations of a Gas Turbine Engine from System Engineering point of view.
• The student will be able to match performances of a various sub systems of a Gas Turbine Engine.
• The student will be able to complete the preliminary design of an axial flow Jet Engine.

TOTAL: 45 PERIODS

TEXT BOOKS:
REFERENCES:

AE8012 ELEMENTS OF HEAT TRANSFER

OBJECTIVE:
• To impart knowledge on various modes of heat transfer and methods of solving problems. Also to give exposure to numerical methods employed to solve heat transfer problems.

UNIT I CONDUCTION

UNIT II CONVECTION

UNIT III RADIATION

UNIT IV NUMERICAL METHODS

UNIT V PROBLEMS IN AEROSPACE ENGINEERING
Heat transfer problems in gas turbines, rocket thrust chambers- Aerodynamic heating – Ablative heat transfer

TOTAL: 45 PERIODS

OUTCOMES:
• Upon completion of this course, the students can able to apply the Students can able to understand and apply different heat transfer principles of different applications.

TEXT BOOKS:
OUTCOMES:
- Knowledge on measurement techniques in aerodynamic flow.
- Acquiring basics of wind tunnel measurement systems
- Specific instruments for flow parameter measurement like pressure, velocity

REFERENCES:

REFERENCES:
2. NAL-UNI Lecture Series 12: Experimental Aerodynamics, NAL SP 98 01 April 1998
3. Lecture course on Advanced Flow diagnostic techniques 17-19 September 2008
   NAL, Bangalore
OBJECTIVE:
- To understand the basic concepts involved in fatigue analysis and to study the importance of fracture mechanics in aerospace applications.

UNIT I  FATIGUE OF STRUCTURES  7

UNIT II  STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR  10
Low cycle and high cycle fatigue - Coffin - Manson's relation - Transition life - cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques - Cumulative damage - Miner’s theory - Other theories.

UNIT III  PHYSICAL ASPECTS OF FATIGUE  10
Phase in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations - fatigue fracture surfaces.

UNIT IV  FRACTURE MECHANICS  10

UNIT V  FATIGUE DESIGN AND TESTING  8
Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in aerospace structures - Application to composite materials and structures.

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to apply mathematical knowledge to define fatigue behaviors
- Ability to perform fatigue design
- Ability to analyze the fracture due to fatigue

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
- To introduce the mathematical modeling of systems, open loop and closed loop systems and analyses in time domain and frequency domain.
- To impart the knowledge on the concept of stability and various methods to analyze stability in both time and frequency domain.
- To introduce sampled data control system.

OUTCOMES:
- Ability to apply mathematical knowledge to model the systems and analyse the frequency domain
- Ability to check the stability of the both time and frequency domain

UNIT I  INTRODUCTION
Historical review, Simple pneumatic, hydraulic and thermal systems, Series and parallel system, Analogies, mechanical and electrical components, Development of flight control systems.

UNIT II  OPEN AND CLOSED LOOP SYSTEMS
Feedback control systems – Control system components - Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs, Output to input ratios.

UNIT III  CHARACTERISTIC EQUATION AND FUNCTIONS
Laplace transformation, Response of systems to different inputs viz., Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.

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

UNIT V  SAMPLED DATA SYSTEMS
Z-Transforms Introduction to digital control system, Digital Controllers and Digital PID controllers

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
- To introduce fundamental concepts and features peculiar to hypersonic flow to students to familiarize them with the aerodynamical aspects of hypersonic vehicles and the general hypersonic flow theory.

UNIT I FUNDAMENTALS OF HYPersonic AERODYNAMICS 9
Introduction to hypersonic aerodynamics – differences between hypersonic aerodynamics and supersonic aerodynamics - concept of thin shock layers and entropy layers – hypersonic flight paths – hypersonic similarity parameters – shock wave and expansion wave relations of inviscid hypersonic flows.

UNIT II SIMPLE SOLUTION METHODS FOR HYPersonic INVISCID FLOWS 9

UNIT III VISCous HYpersonic FLow THEوري 9
Boundary layer equations for hypersonic flow – hypersonic boundary layers – self similar and non self similar boundary layers – solution methods for non self similar boundary layers – aerodynamic heating and its adverse effects on airframe.

UNIT IV VISCous INTERacTIONS IN HYPersonic FLOWS 9
Introduction to the concept of viscous interaction in hypersonic flows - Strong and weak viscous interactions - hypersonic viscous interaction similarity parameter – introduction to shock wave boundary layer interactions.

UNIT V HIGH TEMPERATURE EFFECTS in HYPersonic FLOWS 9
Nature of high temperature flows – chemical effects in air – real and perfect gases – Gibb’s free energy and entropy - chemically reacting boundary layers – recombination and dissociation.

TOTAL: 45 PERIODS

OUTCOMES:
- Knowledge in basics of hypersonic and supersonic aerodynamics
- Acquiring knowledge in theory of hypersonic flow.
- Understanding of boundary layers of hypersonic flow and viscous interaction
- Role of chemical and temperature effects in hypersonic flow.

TEXT BOOKS:

REFERENCES:
OBJECTIVE:

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

UNIT I  ATMOSPHERE
Types of winds, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows.

UNIT II  WIND ENERGY COLLECTORS
Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory.

UNIT III  VEHICLE AERODYNAMICS
Power requirements and drag coefficients of automobiles, Effects of cut back angle, Aerodynamics of trains and Hovercraft.

UNIT IV  BUILDING AERODYNAMICS
Pressure distribution on low rise buildings, wind forces on buildings. Environmental winds in city blocks, Special problems of tall buildings, Building codes, Building ventilation and architectural aerodynamics.

UNIT V  FLOW INDUCED VIBRATIONS
Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, Galloping and stall flutter.

TOTAL: 45 PERIODS

OUTCOMES:

- Use of aerodynamics for non-aerodynamics such as vehicle, building.
- Solve the problems and able to analyse vibrations during flow

TEXT BOOKS:


REFERENCES:


OBJECTIVE:

- To make the student familiarize with the principles involved in helicopters and to study the performance and stability aspects of helicopter under different operating conditions.

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

UNIT III  POWER PLANTS 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.

UNIT IV  STABILITY AND CONTROL

Physical description of effects of disturbances, Stick fixed Longitudinal and lateral dynamic stability, lateral stability characteristics, control response. Differences between stability and control of airplane and helicopter.

UNIT V  ROTOR VIBRATIONS


TOTAL: 45 PERIODS

OUTCOMES:
- To perform the Aerodynamics calculation of Rotor blade
- To perform stability and control characteristics of Helicopter
- To perform and control Rotor vibration

TEXT BOOKS:

REFERENCES:
1. Joseph Schafer, Basic Helicopter Maintenance, Jeppesen 1980
2. RW Prouty, Helicopter Aerodynamics.

AE8019  ROCKETS AND MISSILES  L T P C
3 0 0 3

OBJECTIVE:
- To give exposure on important topics like rocket motion, rocket aerodynamics and staging & control of rockets to students to enrich their knowledge in the area of missile flight.

UNIT I  CLASSIFICATION OF ROCKETS AND MISSILES

Various methods of classification of missiles and rockets – Basic aerodynamic characteristics of surface to surface, surface to air, air to surface and air to air missiles – Examples of various Indian space launch vehicles and missiles – Current status of Indian rocket programme with respect to international scenario

UNIT II  AERODYNAMICS OF ROCKETS AND MISSILES

OUTCOMES:

- Knowledge in types of rockets and missiles with respect to Indian & international scenario
- Gaining informations on aerodynamics of rocket and missiles
- Knowledge on stages and remote control of rockets missiles

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
OUTCOMES:

- To understand the concept of orbital mechanics, satellite system, their configuration and control and make the students eligible to enter into R&D organization.

UNIT I: INTRODUCTION TO SATELLITE SYSTEMS

Common satellite applications and missions – Typical spacecraft orbits – Definitions of spin the three axis stabilization-Space environment – Launch vehicles – Satellite system and their functions (structure, thermal, mechanisms, power, propulsion, guidance and control, bus electronics).

UNIT II: ORBITAL MECHANICS

Fundamental of flight dynamics – Time and coordinate systems – Orbit determination and prediction – Orbital maneuvers – GPS systems and application for satellite/orbit determination – Ground station network requirements.

UNIT III: SATELLITE STRUCTURES & THERMAL CONTROL

Satellite mechanical and structural configuration: Satellite configuration choices, launch loads, separation induced loads, deployment requirements – Design and analysis of satellite structures – Structural materials and fabrication – The need of thermal control: externally induced thermal environment – internally induced thermal environment - Heat transfer mechanism: internal to the spacecraft and external heat load variations – Thermal control systems: active and passive methods.

UNIT IV: SPACECRAFT CONTROL

Control requirements: attitude control and station keeping functions, type of control maneuvers – Stabilization schemes: spin stabilization, gravity gradient methods, 3 axis stabilization – Commonly used control systems: mass expulsion systems, momentum exchange systems, gyro and magnetic torque - Sensors star and sun sensors, earth sensor, magnetometers and inertial sensors

UNIT V: POWER SYSTEM AND BUS ELECTRONICS

Solar panels: Silicon and Ga-As cells, power generation capacity, efficiency – Space battery systems – battery types, characteristics and efficiency parameters – Power electronics. Telemetry and telecommand systems: Tm & TC functions, generally employed communication bands (UHF/VHF, S, L, Ku, Ka etc), their characteristics and applications- Coding Systems – Onboard computer- Ground checkout Systems.

TOTAL: 45 PERIODS

OUTCOMES:

- Aware of the mission, configuration and applications of satellites.
- Understand the concepts of Orbits and their mechanics
- Understand the concepts of Bus electronics and power subsystem
- Understand the concepts of structural design, analyzing techniques and various types of loads in satellite structural subsystem
- Understand the importance of thermal control subsystem and its design studies.
- Understand the concepts of satellite sensors and actuators that needed for Attitude control subsystem development
- Acquired the knowledge of satellite attitude as well as orbital dynamics in order to design the satellite control subsystem
- Graduate will able to understand the concepts of Space Research and have interest to do research in R&D organizations.
OUTCOMES:

- Ability to perform satellite injection, satellite perturbations, and trajectory control
- Apply orbital mechanics to control ballistic missiles

TEXT BOOKS:

REFERENCES:

AE8021

SPACE MECHANICS

L T P C

3 0 0 3

OBJECTIVE:

- To introduce concepts of satellite injection and satellite perturbations, trajectory computation for interplanetary travel and flight of ballistic missiles based on the fundamental concepts of orbital mechanics.

UNIT I SPACE ENVIRONMENT

Peculiarities of space environment and its description—effect of space environment on materials of spacecraft structure and astronauts—manned space missions—effect on satellite life time

UNIT II BASIC CONCEPTS AND THE GENERAL N-BODY PROBLEM

The solar system—reference frames and coordinate systems—terminology related to the celestial sphere and its associated concepts—Kepler’s laws of planetary motion and proof of the laws—Newton’s universal law of gravitation—the many body problem—Lagrange-Jacobi identity—the circular restricted three body problem—libration points—the general N-body problem—two body problem—relations between position and time.

UNIT III SATELLITE INJECTION AND SATELLITE PERTURBATIONS

General aspects of satellite injection—satellite orbit transfer—various cases—orbit deviations due to injection errors—special and general perturbations—Cowell’s method and Encke’s method—method of variations of orbital elements—general perturbations approach.

UNIT IV INTERPLANETARY TRAJECTORIES

Two-dimensional interplanetary trajectories—fast interplanetary trajectories—three-dimensional interplanetary trajectories—launch of interplanetary spacecraft—trajectory estimation about the target planet—concept of sphere of influence—Lambert’s theorem

UNIT V BALLISTIC MISSILE TRAJECTORIES

Introduction to ballistic missile trajectories—boost phase—the ballistic phase—trajectory geometry—optimal flights—time of flight—re-entry phase—the position of impact point—influence coefficients.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to perform satellite injection, satellite perturbations and trajectory control
- Apply orbital mechanics to control ballistic missile

TEXT BOOKS:

REFERENCES:
OUTCOMES:

- Knowing various options of mathematical modeling of structures
- Method of evaluating the response of structures under various dynamically loaded conditions
- Knowledge in natural modes of vibration of structures
- Gaining knowledge in numerical and approximate methods of evaluating natural modes of vibration.

TEXT BOOKS:


REFERENCES:

OBJECTIVE:
- Gives exposure to formulation of governing equations, various types of analyses plate problems and the methods of solution.

UNIT I  CLASSICAL PLATE THEORY  8
Assumptions – Governing Equation – Boundary Conditions – Methods of Solution

UNIT II  RECTANGULAR PLATES  10
Navier’s Method of Solution for Simply Supported Rectangular Plates – Levy’s Method of Solution for Rectangular Plates under Different Boundary Conditions and loadings.

UNIT III  CIRCULAR PLATES  9
Governing equation. Boundary conditions. Bending of circular and annular plates for different support conditions and loading cases.

UNIT IV  STABILITY AND FREE VIBRATION ANALYSIS  8
Governing equation for buckling of plates. Buckling analysis of simply supported plates for different loadings. Governing equation for free vibration of rectangular plates. Natural frequency for rectangular plates for different boundary conditions.

UNIT V  APPROXIMATE METHODS  10

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to
- Understand the basic theory related to the analysis of plate.
- apply various exact methods used for the static analysis of rectangular plates.
- use governing equation and solution to circular plate bending problems.
- comprehend stability and basic dynamic analysis of plates.
- Understand the use of various approximate methods for solving plate bending problems.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
- To make the students to understand the basic concepts of UAV systems design.

OUTCOMES:
- Ability to design UAV system
- Ability to identify different hardware for UAV

REFERENCES:
UNIT I THE ATMOSPHERE
Atmospheric Circulation - Stability of atmospheres - definitions & implications - Effects of friction ~ Atmospheric motion - Local winds, Building codes, Terrains different types.

UNIT II ATMOSPHERIC BOUNDARY LAYER
Governing Equations - Mean velocity profiles, Power law, logarithmic law wind speeds, Atmospheric Turbulence profiles - Spectral density function -. Length scale of turbulence, . Roughness parameters simulation techniques in wind tunnels.

UNIT III BLUFF BODY AERODYNAMICS
Governing equations Boundary layers and Flow separation - Wake and Vortex formation two dimensional- Strouhal Numbers, Reynold’s numbers . “Separation and Reattachments Oscillatory Flow patterns Vortex shedding flow Time varying forces to Wind velocity in turbulent flow ^ Structures in three dimensional

UNIT IV WIND LOADING
Introduction, Analysis and synthesis-loading coefficients, local & global coefficients- pressure shear stress coefficients, force and moment coefficients - Assessment methods - Quasi steady method - Peak factor method - Extreme value method

UNIT V AERO ELASTIC PHENOMENA:
Vortex shedding and lock in phenomena in turbulent flows across wind^galloping wake galloping Torsional divergence, along wind galloping of circular cables, cross wind galloping of circular dible’S', Wind loads &. Turbulent effects on tall. Structures - Launch vehicles

TOTAL: 45 PERIODS

OUTCOMES:
• Upon completion of the course the student will be in a position to design wind turbines for production of wind power on alternative energy source.
• Also the student will be able to carry out structural analysis of various industrial structural units which are subjected to wind loads.

TEXT BOOKS:
1. EMIL SIMIU & ROBERT H SCANLAN, "Wind effects of structures fundamentals and applications to design; John Wiley & Sons INC New York, 1996.

REFERENCES:
OBJECTIVE:
- The students are exposed to various types and techniques of Aerodynamic data generation on aerospace vehicle configurations in the aerospace industry.

UNIT I  PRINCIPLES OF MODEL TESTING  6
Buckingham Theorem – Non dimensional numbers – Scale effect – Geometric Kinematic and Dynamic similarities.

UNIT II  TYPES AND FUNCTIONS OF WIND TUNNELS  6
Classification and types – special problems of testing in subsonic, transonic, supersonic and hypersonic speed regions – Layouts – sizing and design parameters.

UNIT III  CALIBRATION OF WIND TUNNELS  9

UNIT IV  CONVENTIONAL MEASUREMENT TECHNIQUES  12
Force measurements and measuring systems – Multi component internal and external balances – Pressure measurement system – Steady and Unsteady Pressure- single and multiple measurements – Velocity measurements – Intrusive and Non-intrusive methods – Flow visualization techniques – surface flow, oil and tuft - flow field visualization, smoke and other optical and nonintrinsic techniques

UNIT V  SPECIAL WIND TUNNEL TECHNIQUES  12
Intake tests – store carriage and separation tests – Unsteady force and pressure measurements – wind tunnel model design

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to use various techniques of Aerodynamic data generation.

TEXT BOOKS:
2. NAL-UNI Lecture Series 12: Experimental Aerodynamics, NAL SP 98 01 April 1998

REFERENCES:
2. Bradshaw, Experimental Fluid Mechanics. 1985
3. Short term course on Flow visualization techniques, NAL, 2009
4. Lecture course on Advanced Flow diagnostic techniques 17-19 September 2008 NAL, Bangalore
OBJECTIVE:
- To study the various experimental techniques involved for measuring displacements, stresses, strains in structural components.

UNIT I  EXTENSOMETERS AND DISPLACEMENT SENSORS
Principles of measurements, Accuracy, Sensitivity and range of measurements, Mechanical, Optical, Acoustical and Electrical extensometers and their uses, Advantages and disadvantages, Capacitance gauges, Laser displacement sensors.

UNIT II  ELECTRICAL RESISTANCE STRAIN GAUGES
Principle of operation and requirements, Types and their uses, Materials for strain gauges, Calibration and temperature compensation, cross sensitivity, Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators, Rosette analysis, stress gauges, load cells, Data acquisition, six component balance.

UNIT III  PHOTOELASTICITY
Two dimensional photo elasticity, Photo elastic materials, Concept of light - photoelastic effects, stress optic law, Transmission photoelasticity, Jones calculus, plane and circular polarscopes, Interpretation of fringe pattern, Calibration of photoelastic materials, Compensation and separation techniques, Introduction to three dimensional photo elasticity.

UNIT IV  BRITTLE COATING AND MOIRE TECHNIQUES
Relation between stresses in coating and specimen, use of failure theories in brittle coating, Moire method of strain analysis.

UNIT V  NON – DESTRUCTIVE TESTING

TOTAL: 45 PERIODS

OUTCOMES:
- Knowledge of stress and strain measurements in loaded components.
- Acquiring information’s the usage of strain gauges and photo elastic techniques of measurement.
- Knowledge in NDT in stress analysis

TEXT BOOKS:

REFERENCES:
OBJECTIVES:

- To learn about basis of nanomaterial science, preparation method, types and application

UNIT I INTRODUCTION
Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II PREPARATION METHODS
Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES
Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

UNIT IV PREPARATION ENVIRONMENTS
Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

UNIT V CHARACTERISATION TECHNIQUES
X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

TOTAL: 45 PERIODS

OUTCOMES:

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS

REFERENCES
OBJECTIVES

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

OUTCOMES:

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

REFERENCE:


WEB SOURCES:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org
AIM
To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

OBJECTIVES
- To understand the various principles, practices of TQM to achieve quality.
- To learn the various statistical approaches for Quality control.
- To understand the TQM tools for continuous process improvement.
- To learn the importance of ISO and Quality systems

UNIT I  INTRODUCTION

UNIT II  TQM PRINCIPLES
Quality statements - Customer focus –Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Continuous process improvement – PDCA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III  TQM TOOLS & TECHNIQUES I

UNIT IV  TQM TOOLS & TECHNIQUES II

UNIT V  QUALITY SYSTEMS

OUTCOMES:
- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK:

REFERENCE BOOKS:
OUTCOMES:
• Upon completion of the course, students will be able to apply the reliability concepts to basic aerospace systems such as rotorshaft, compressors, turbines and aircraft control systems.

REFERENCES:
OBJECTIVES:
- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don’ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR)
Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT
Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA
Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS
Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

OUTCOMES:
The students will be able to
- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

TOTAL: 45 PERIODS
TEXTBOOK:

REFERENCES
1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005

GE8073 HUMAN RIGHTS L T P C
3 0 0 3

OBJECTIVES:
- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I

UNIT II

UNIT III
Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV
Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V

TOTAL : 45 PERIODS

OUTCOME:
- Engineering students will acquire the basic knowledge of human rights.

REFERENCES: