This education is meant to prepare our students to thrive, to lead and to prepare them to achieve four Programme Educational Objectives (PEOs)

**PEO 1: Adaptability to industry:** Graduates of the programme will receive adequate academic input to adapt themselves in any aircraft and allied industries

**PEO 2: Successful Career Development:** Graduates of the programme will have successful technical and professional careers in Aeronautical and allied industries and management.

**PEO 3: Contribution to Aeronautical Field:** Graduates of the programme will have innovative ideas and potential to contribute for the development and current needs of the aeronautical industries.

**PEO 4: Sustainable interest for Lifelong learning:** Graduates of the programme will have sustained interest continuously to learn and adapt new technology and development to meet the changing industrial scenarios.

The Technology Program in Aeronautical Engineering attains the following student learning Program Outcomes:

a. Graduate will demonstrate strong basics in mathematics, science and engineering.

b. Graduate will demonstrate the ability to design and conduct experiments, as well as to analyze and interpret data.

c. Graduate will demonstrate the ability to design a system or a component to meet the design requirements with constraints exclusively meant for Aeronautical Engineering.

d. Graduate will become familiar with modern engineering tools and analyze the problems within the domains of Aeronautical Engineering as a member of multidisciplinary teams.

e. Graduate will acquire the capability to identify, formulate and solve complex engineering problems of Aeronautical Engineering.

f. Graduate will demonstrate an understanding of professional and ethical responsibility with reference to their career in the field of Aeronautical Engineering and other professional fields.

g. Graduate will be able to communicate effectively both in verbal and non verbal forms.

h. Graduate will be trained towards developing and understanding the importance of design and development of Airplanes from system integration point of view.
i. Graduate will be capable of understanding the value for life-long learning.

j. Graduate will exhibit the awareness of contemporary issues focusing on the necessity to develop new material, design, testing and solution for environmental problems pertaining to aircraft industry.

k. Graduate will be able to use the techniques, skills and modern engineering tools that are necessary for engineering practice in the field of Aeronautical Engineering.

l. Graduation Graduate will have a firm scientific, technological and communication base that helps them to find a placement in the Aircraft industry and R & D organisations related to Aero Engineering and other professional fields.

m. Graduate will be capable of doing higher studies and research in inter and multidisciplinary areas.

Mapping PEO with POs:

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### EMPLOYABILITY ENHANCEMENT COURSES (EEC)

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### SUMMARY

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COURSE DESCRIPTION:
This course aims at developing the language skills necessary for the first year students of Engineering and Technology.

OBJECTIVES:
- To develop the four language skills – Listening, Speaking, Reading and Writing.
- To improve the students’ communicative competence in English.
- To teach students the various aspects of English language usage.

CONTENTS

UNIT I GREETING AND INTRODUCING ONESELF 12
Listening – Types of listening – Listening to short talks, conversations; Speaking – Speaking about one’s place, important festivals etc. – Introducing oneself, one’s family/ friend; Reading – Skimming a passage– Scanning for specific information; Writing – Guided writing - Free writing on any given topic ( My favourite place/ Hobbies/ School life, writing about one’s leisure time activities, hometown, etc.); Grammar – Tenses (present and present continuous) -Question types - Regular and irregular verbs; Vocabulary – Synonyms and Antonyms.

UNIT II GIVING INSTRUCTIONS AND DIRECTIONS 12
Listening – Listening and responding to instructions; Speaking – Telephone etiquette - Giving oral instructions/ Describing a process – Asking and answering questions; Reading – Reading and finding key information in a given text - Critical reading - Writing –Process description( non-technical)- Grammar – Tense (simple past& past continuous) - Use of imperatives – Subject – verb agreement – Active and passive voice; Vocabulary – Compound words – Word formation – Word expansion (root words).

UNIT III READING AND UNDERSTANDING VISUAL MATERIAL 12
Listening - Listening to lectures/ talks and completing a task; Speaking –Role play/ Simulation – Group interaction; Reading – Reading and interpreting visual material; Writing- Jumbled sentences – Discourse markers and Cohesive devices – Essay writing (cause & effect/narrative); Grammar – Tenses (perfect). Conditional clauses –Modal verbs; Vocabulary –Cause and effect words; Phrasal verbs in context.

UNIT IV CRITICAL READING AND WRITING 12
Listening- Watching videos/ documentaries and responding to questions based on them; Speaking Informal and formal conversation; Reading –Critical reading (prediction & inference); Writing–Essay writing ( compare & contrast/ analytical) – Interpretation of visual materials; Grammar – Tenses (future time reference); Vocabulary – One word substitutes (with meanings) – Use of abbreviations & acronyms – Idioms in sentences.

UNIT V LETTER WRITING AND SENDING E-MAILS 12
Listening- Listening to programmes/broadcast/ telecast/ podcast; Speaking – Giving impromptu talks, Making presentations on given topics- Discussion on the presentation; Reading –Extensive reading; Writing- Poster making – Letter writing (Formal and E-mail) ; Grammar – Direct and Indirect speech – Combining sentences using connectives; Vocabulary –Collocation;
TEACHING METHODS:
Interactive sessions for the speaking module.
Use of audio – visual aids for the various listening activities.
Contextual Grammar Teaching.

EVALUATION PATTERN:
Internals – 50%
End Semester – 50%

TOTAL: 60 PERIODS

OUTCOMES:
- Students will improve their reading and writing skills
- Students will become fluent and proficient in communicative English
- Students will be able to improve their interpersonal communication

TEXTBOOK:

REFERENCES:

MA7151 MATHEMATICS – I
(Common to all branches of B.E. / B.Tech. Programmes in I Semester)

OBJECTIVES:
- The goal of this course is for students to gain proficiency in calculus computations. In calculus, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives, and integrals. Students will use these tools to solve application problems in a variety of settings ranging from physics and biology to business and economics.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.
UNIT I  DIFFERENTIAL CALCULUS  12
Representation of functions - New functions from old functions - Limit of a function - Limits at infinity - Continuity - Derivatives - Differentiation rules - Polar coordinate system - Differentiation in polar coordinates - Maxima and Minima of functions of one variable.

UNIT II  FUNCTIONS OF SEVERAL VARIABLES  12

UNIT III  INTEGRAL CALCULUS  12
Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT IV  MULTIPLE INTEGRALS  12

UNIT V  DIFFERENTIAL EQUATIONS  12
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.

TOTAL: 60 PERIODS

OUTCOMES:
- Understanding of the ideas of limits and continuity and an ability to calculate with them and apply them.
- Improved facility in algebraic manipulation.
- Fluency in differentiation.
- Fluency in integration using standard methods, including the ability to find an appropriate method for a given integral.
- Understanding the ideas of differential equations and facility in solving simple standard examples.

TEXTBOOKS:

REFERENCES:
PH7151 ENGINEERING PHYSICS
(Common to all branches of B.E / B.Tech programmes) 3 0 0 3

OBJECTIVE:
- To introduce the concept and different ways to determine moduli of elasticity and applications.
- To instill the concept of sound, reverberation, noise cancellation, and ultrasonic generation, detection and applications.
- To inculcate an idea of thermal properties of materials, heat flow through materials and quantum physics.
- To promote the basic understanding of interferometers, principles and applications of lasers, optical fibers and sensors.
- To establish a sound grasp of knowledge on the basics, significance and growth of single crystals.

UNIT I PROPERTIES OF MATTER
9

UNIT II ACOUSTICS AND ULTRASONICS
9

UNIT III THERMAL AND MODERN PHYSICS
9
UNIT IV  APPLIED OPTICS

UNIT V  CRYSTAL PHYSICS
Single crystalline, polycrystalline and amorphous materials – Single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices - interplanar distance for a cubic crystal - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - structure and significance of NaCl, CsCl, ZnS and graphite - crystal imperfections: point defects, line defects – Burger vectors, dislocations and stacking faults – Growth of single crystals: Bridgman and Czochralski methods.

OUTCOME:
• The students will understand different moduli of elasticity, their determination and applications.
• The students will gain knowledge on the properties of sound, noise cancellation, and production, detection and applications of ultrasonics
• The students will acquire sound knowledge on thermal expansion and thermal conductivity of materials. Further they will gain an idea of quantum physics.
• The students will gain knowledge on interferometers, lasers and fiber optics
• The students will secure knowledge on the basics of crystal structures and their significance. Further they gain basic ideas of growing single crystals.

TEXTBOOKS:

REFERENCES:
OBJECTIVES:

- To develop an understanding about fundamentals of polymer chemistry.
- Brief elucidation on surface chemistry and catalysis.
- To develop sound knowledge photochemistry and spectroscopy.
- To impart basic knowledge on chemical thermodynamics.
- To understand the basic concepts of nano chemistry.

UNIT I POLYMER CHEMISTRY

Introduction: Functionality-degree of polymerization. Classification of polymers - natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: Tg, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension.

UNIT II SURFACE CHEMISTRY AND CATALYSIS


UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY


UNIT IV CHEMICAL THERMODYNAMICS

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

UNIT V NANO CHEMISTRY


TOTAL: 45 PERIODS

OUTCOMES:

- Will be familiar with polymer chemistry, surface chemistry and catalysis.
- Will know the photochemistry, spectroscopy and chemical thermodynamics.
- Will know the fundamentals of nano chemistry.
TEXTBOOKS

REFERENCES

GE7152 ENGINEERING GRAPHICS

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) 1
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 HANDSKETCHING 14
Basic Geometrical constructions, Curves used in engineering practices-Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. 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 14
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 14
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to both the principal planes by rotating object method and auxiliary plane method.

21
UNIT IV  PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES

Sectioning of 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  ISOMETRIC 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.

OUTCOMES:
On Completion of the course the student will be able to
- Perform free hand sketching of basic geometrical shapes and multiple views of objects.
- Draw orthographic projections of lines, planes and solids
- Obtain development of surfaces.
- Prepare isometric and perspective views of simple solids.

TEXT BOOK:

REFERENCES:

Publication of Bureau of Indian Standards:

Special points applicable to University Examinations on Engineering Graphics:
1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

BS7161 BASIC SCIENCES LABORATORY
(Common to all branches of B.E. / B.Tech Programmes)

PHYSICS LABORATORY: (Any Seven Experiments)

OBJECTIVE:
- To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.
- To induce the students to familiarize with experimental determination of velocity of ultrasonic waves, band gap determination and viscosity of 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. Uniform bending – Determination of young’s modulus
4. Lee’s disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
     b) Compact disc- Determination of width of the groove using laser.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box -Determination of Band gap of a semiconductor.
13. Viscosity of liquids - Determination of co-efficient of viscosity of a liquid by Poiseuille’s flow

OUTCOME:
- To determine various moduli of elasticity and also various thermal and optical properties of materials.
- To determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.
CHEMISTRY LABORATORY:
(Minimum of 8 experiments to be conducted)

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-Phenan throline/thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
12. Pseudo first order kinetics-ester hydrolysis.
14. Determination of CMC.
15. Phase change in a solid.

TOTAL: 60 PERIODS

TEXTBOOKS

GE7162 ENGINEERING PRACTICES LABORATORY
(Common to all Branches of B.E. / B.Tech. Programmes)

OBJECTIVES
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 PRACTICES

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.
• Laying pipe connection to the delivery side of a pump.
• Practice in connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK
Sawing, planing and making joints like T-Joint, Mortise and Tenon joint and Dovetail joint.

STUDY
• Study of joints in door panels and wooden furniture
• Study of common industrial trusses using models.
2. ELECTRICAL ENGINEERING PRACTICES 15
• Basic household wiring using Switches, Fuse, Indicator and Lamp etc.,
• Stair case light wiring
• Tube – light wiring
• Preparation of wiring diagrams for a given situation.
• Study of Iron-Box, Fan Regulator and Emergency Lamp

GROUP – B (MECHANICAL AND ELECTRONICS) 15
3. MECHANICAL ENGINEERING PRACTICES
WELDING
• Arc welding of Butt Joints, Lap Joints, and Tee Joints
• Gas welding Practice.
• Basic Machining - Simple turning, drilling and tapping operations..
• Study and assembling of the following:
  a. Centrifugal pump
  b. Mixie
  c. Air Conditioner.

DEMONSTRATION ON FOUNDRY OPERATIONS.
4. ELECTRONIC ENGINEERING PRACTICES 15
• Soldering simple electronic circuits and checking continuity.
• Assembling electronic components on a small PCB and Testing.
• Study of Telephone, FM radio and Low Voltage Power supplies.

TOTAL: 60 PERIODS

OUTCOMES
• Ability to fabricate carpentry components and to lay pipe connections including plumbing works.
• Ability to use welding equipments to join the structures
• Ability to do wiring for electrical connections and to fabricate electronics circuits.

HS7251 TECHNICAL ENGLISH L T P C
4 0 0 4

OBJECTIVES
• To enable students acquire proficiency in technical communication.
• To enhance their reading and writing skills in a technical context.
• To teach various language learning strategies needed in a professional environment.

CONTENTS
UNIT I ANALYTICAL READING 12
Listening- Listening to informal and formal conversations; Speaking – Conversation Skills(opening, turn taking, closing )-explaining how something works-describing technical functions and applications; Reading –Analytical reading, Deductive and inductive reasoning; Writing- vision statement–structuring paragraphs.
UNIT II  
SUMMARISING  
Listening - Listening to lectures/ talks on Science & Technology; Speaking – Summarizing/ Oral Reporting, Reading – Reading Scientific and Technical articles; Writing - Extended definition – Lab Reports – Summary writing.

UNIT III  
DESCRIBING VISUAL MATERIAL  
Listening - Listening to a panel discussion; Speaking – Speaking at formal situations; Reading – Reading journal articles - Speed reading; Writing- data commentary-describing visual material-writing problem-process- solution-the structure of problem-solution texts-writing critiques

UNIT IV  
WRITING/ E-MAILING THE JOB APPLICATION  
Listening - Listening to/ Viewing model interviews; Speaking – Speaking at different types of interviews – Role play practice (mock interview); Reading – Reading job advertisements and profile of the company concerned; Writing- job application – cover letter – Résumé preparation.

UNIT V  
REPORT WRITING  
Listening - Viewing a model group discussion; Speaking – Participating in a discussion - Presentation; Reading – Case study - analyse - evaluate – arrive at a solution; Writing– Recommendations- Types of reports (feasibility report)- designing and reporting surveys- – Report format.- writing discursive essays.

TEACHING METHODS:  
Practice writing  
Conduct model and mock interview and group discussion.  
Use of audio – visual aids to facilitate understanding of various forms of technical communication.  
Interactive sessions.

EVALUATION PATTERN:  
Internals – 50%  
End Semester – 50%  
TOTAL:60 PERIODS

OUTCOMES  
- Students will learn the structure and organization of various forms of technical communication.  
- Students will be able to listen and respond to technical content.  
- Students will be able to use different forms of communication in their respective fields.

TEXTBOOK:  

REFERENCES:  
MA7251  MATHEMATICS - II  
(Common to all branches of B.E. / B.Tech. Programmes in II Semester)

OBJECTIVES:
- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- 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 the 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  MATRICES  12

UNIT II  VECTOR CALCULUS  12
Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III  ANALYTIC FUNCTION  12

UNIT IV  COMPLEX INTEGRATION  12
UNIT V  LAPLACE TRANSFORMS

TOTAL: 60 PERIODS

OUTCOMES:
• Upon successful completion of the course, students should be able to:
  • Evaluate real and complex integrals using the Cauchy integral formula and the residue theorem
  • Appreciate how complex methods can be used to prove some important theoretical results.
  • Evaluate line, surface and volume integrals in simple coordinate systems
  • Calculate grad, div and curl in Cartesian and other simple coordinate systems, and establish identities connecting these quantities
  • Use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.

TEXTBOOKS:

REFERENCES:

PH7251 MATERIALS SCIENCE
(Common to Manufacturing, Industrial, Mining, Aeronautical, Automobile and Production Engineering)

OBJECTIVE:
• To impart knowledge on the basics of binary phase diagrams and their applications
• To learn the phase diagram, effect of alloying elements and various transformations in the Fe-C system, and also the heat treatment of steels.
• To introduce various strengthening methods of materials, and also various mechanical properties and their measurement
• To instill the types, properties and applications of magnetic, dielectric and superconducting materials.
• To introduce the preparation, properties and applications of various new materials.
UNIT I  PHASE DIAGRAMS
Solid solutions - Hume Rothery’s rules - The phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions – free energy composition curves for binary systems - microstructural change during cooling.

UNIT II  FERROUS ALLOYS AND HEAT TREATMENT

UNIT III  MECHANICAL PROPERTIES

UNIT IV  MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS

UNIT V  NEW MATERIALS

TOTAL: 45 PERIODS

OUTCOME:
Upon completion of this course, the students will
- gain knowledge on the basics of binary phase diagrams and the use of lever rule
- learn about the Fe-C phase diagram, effect of alloying elements, TTT in the Fe-C system, and also the heat treatment of steels.
- understand the significance of dislocations, strengthening mechanisms, and tensile, creep, hardness and fracture behavior of materials
- acquire knowledge on the types, properties and applications of magnetic, dielectric and superconducting materials.
- get adequate understanding on the preparation, properties and applications of ceramics, composites, metallic glasses, shape-memory alloys and nanomaterials.
TEXTBOOKS:

REFERENCES:

GE7151 COMPUTING TECHNIQUES
(Common to all branches of Engineering and Technology) 3 0 0 3

OBJECTIVES:
• To learn programming using a structured programming language.
• To provide C programming exposure.
• To introduce foundational concepts of computer programming to students of different branches of Engineering and Technology.

UNIT I INTRODUCTION
Introduction to Computers – Computer Software – Computer Networks and Internet - Need for logical thinking – Problem formulation and development of simple programs - Pseudo code - Flow Chart and Algorithms.

UNIT II C PROGRAMMING BASICS

UNIT III ARRAYS AND STRINGS

UNIT IV POINTERS
Macros - Storage classes –Basic concepts of Pointers– Pointer arithmetic - Example Problems - Basic file operations

UNIT V FUNCTIONS AND USER DEFINED DATA TYPES

TOTAL : 45 PERIODS
OUTCOMES:
At the end of the course, the student should be able to:
• Write C program for simple applications
• Formulate algorithm for simple problems
• Analyze different data types and arrays
• Perform simple search and sort.
• Use programming language to solve problems.

TEXTBOOKS:

REFERENCES:

PR7251 PRODUCTION PROCESSES (Common to Aero/Auto/Rubber and Plastics) 3 0 0 3

OBJECTIVES:
• To impart the knowledge about the various production processes available
• To expose the student on the principle and applications of the processes
• To make a decision on a relevant process based on the merits and demerits.

UNIT I CASTING PROCESSES 10

UNIT II METAL FORMING PROCESSES 8
UNIT III  MACHINING PROCESSES
Machine and machine tool – construction, types operations in the following machines with block diagrams – Lathe, Milling, Drilling and Grinding – Concept of NC/CNC machines – Comparison of CNC with conventional machines – sample manual part programming for CNC Lathe and milling.

UNIT IV  WELDING PROCESSES

UNIT V  UNCONVENTIONAL MACHINING PROCESSES
Need for unconventional – Construction, working principle merits, demerits and applications with block diagram only for AJM, AWJM, USM, CHM, ECM, EDM, EBM, LBM, PAM and IBM.

TOTAL: 45 PERIODS

OUTCOMES:
- Has enough knowledge on the various processes available to make a part.
- Confident to select the process to based on cost of time and quantities.
- Can determine processes for new materials.

TEXT BOOKS
1. Serope Kalpakjian, Steven R. Schmid, Manufacturing Engineering and Technology - Anna University, 4/e, Pearson Education, 2014

REFERENCES:
OBJECTIVE:
- The objective of this course is to inculcate in the student the ability to analyze any problem in a simple and logical manner and to predict the physical phenomena and thus lay the foundation for engineering applications.

UNIT I  STATICS OF PARTICLES  12

UNIT II  EQUILIBRIUM OF RIGID BODIES  12

UNIT III  DISTRIBUTED FORCES  16
Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration , Theorems of Pappus-Guldinus, Distributed Loads on Beams, Center of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies , Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration , Polar Moment of Inertia , Radius of Gyration of an Area , Parallel-Axis Theorem , Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates , Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT IV  FRICTION  8

UNIT V  DYNAMICS OF PARTICLES  12

OUTCOME:
- Upon completion of this course, students will be able to construct meaningful mathematical models of physical problems and solve them.

TEXT BOOK
REFERENCES

PR7261 PRODUCTION PROCESSESS LABORATORY (Common to Aero/Auto/Rubber and Plastics) L T P C
0 0 4 2

OBJECTIVES:
- To get hands on experience in the machines for production
- To prepare the process planning sheets for all the operations and then follow the sequence during the machining processes.

LIST OF EXPERIMENTS:
1. Study of all the machining tools- identification of parts/mechanisms and position of tool and work piece.
2. Facing, plain turning/step turning operations in Lathe.
3. Tape Turning/Threading and knurling operations in Lathe.
5. Machining to make a cube using shaper
6. Machining to make a V-block using shaper.
7. Counter sinking, counter Boring and Tapping operations in a drilling machine.
8. Surfacing/pocket milling in a vertical milling machine.
9. Polygonal shape milling in a horizontal milling machine
10. Flat surface grinding and cylindrical grinding operations
11. Machining an internal spline in slotting machine.
12. To machine the given part drawing using Lathe and milling machines.

TOTAL: 60PERIODS

OUTCOMES:
- Enough experience to operate machines and processes commonly used in production of components.
- Enable interpretation of process plan sheets to be followed for the machining of products.
OBJECTIVES:
- To understand the basic programming constructs and articulate how they are used to develop a program with a desired runtime execution flow.
- To articulate where computer programs fit in the provision of computer-based solutions to real world problems.
- To learn to use user defined data structures.

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
10. Program using structures and unions.

OUTCOMES:
At the end of the course, the student should be able to:
- Write and compile programs using C programs.
- Write program with the concept of Structured Programming
- Identify suitable data structure for solving a problem
- Demonstrate the use of conditional statement.

LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS
30 Systems with C compiler

OBJECTIVES:
To introduce fundamental concepts in thermodynamics, heat transfer, and refrigeration and air conditioning. Apply Mathematical foundations, principles in solving thermodynamics problems.

UNIT I FIRST LAW OF THERMODYNAMICS
9 Concept of continuum-Macroscopic approach-thermodynamic systems-properties-state, path and process, quasi-static process- work and heat-zeroth law and first law of thermodynamics-internal energy-enthalpy- applications of first law of thermodynamics to closed and open system.

UNIT II SECOND LAW OF THERMODYNAMICS
10 Second law of thermodynamics-Kelvin's and Clausius statements of second law-reversibility and irreversibility-carnot theorem-carnot cycle- reversed carnot cycle- clausius inequality-concept of entropy-principle of energy-availability and unavailability-Exergy for closed and an open systems.
UNIT III PROPERTIES OF PURE SUBSTANCES AND POWER CYCLE 8

UNIT IV AIR STANDARD CYLCEs AND IC ENGINES 9

UNIT V REFRIGERATION, AIR CONDITIONING AND PSYCHROMETRY 9

TOTAL: 45 PERIODS

OUTCOME:
- This course provides the basic knowledge about thermodynamic laws and relations, and their application to various processes.

TEXT BOOKS:

REFERENCES:

AE7302 PRINCIPLES OF FLIGHT L T P C 3 0 0 3

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

UNIT I HISTORY OF FLIGHT 8
Balloon flight-ornithopers-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.
UNIT II  AIRCRAFT CONFIGURATIONS AND ITS CONTROLS  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 III  BASICS OF AERODYNAMICS  9
Physical Properties and structures of the Atmosphere, Temperature, pressure and altitude
relationships, Newton’s Law of Motions applied to Aeronautics-Evolution of lift, drag and moment.
Aerofoils, Mach number, Maneuvers.

UNIT IV  BASICS OF PROPULSION  9
Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust
production- Comparative merits, Principle of operation of rocket, types of rocket and typical
applications, Exploration into space.

UNIT V  BASICS OF AIRCRAFT STRUCTURES  9
General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical
wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium,
stainless steel and composite materials. Stresses and strains-Hooke’s law- stress-strain diagrams-
elastic constants-Factor of Safety.

OUTCOME:
- On completion of the course, the students will understand the basic concepts of Aerospace,
  their power plants and the Mechanics of its flight.

TEXT BOOKS

REFERENCES

AE7351  ENGINEERING FLUID MECHANICS AND MACHINERY  L T P C  3 0 0 3

OBJECTIVE:
- The student is introduced to the mechanics of fluids through a thorough understanding of the
  properties of the fluids. The dynamics of fluids is introduced through the control volume
  approach which gives an integrated understanding of the transport of mass, momentum and
  energy. The applications of the conservation laws to flow though pipes and hydraulics
  machines are studied.

UNIT I  INTRODUCTION  8
Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific
gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow
characteristics – concept of control volume - application of continuity equation, energy equation
and momentum equation.
UNIT II  FLOW THROUGH CIRCULAR CONDUITS  9
Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli-
Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation - friction
factor- Moody diagram- commercial pipes- minor loses – Flow through pipes in series and parallel.

UNIT III  DIMENSIONAL ANALYSIS  8
Need for dimensional analysis – methods of dimensional analysis – Similitude – types of similitude -
Dimensionless parameters- application of dimensionless parameters – Model analysis.

UNIT IV  TURBINES  10
Impact of jets - Euler’s equation - Theory of roto-dynamic machines-Classification of turbines –
heads and efficiencies – velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel,
Francis turbine and Kaplan turbines- working principles - work done by water on the runner –. Specific speed - unit quantities – performance curves for turbines .

UNIT V  PUMPS  10
Various efficiencies– velocity components at entry and exit of the rotor- velocity triangles -
Centrifugal pumps- working principle - work done by the impeller - performance curves -
Reciprocating pump- working principle – Rotary pumps –classification.

TOTAL: 45 PERIODS

OUTCOME:
• On completion of the course, students will be familiar with all the basic concepts of fluids
and fluid flow phenomenon, conservation equations and their applications to simple
problems.

TEXT BOOKS:
Delhi, Ninth edition, 2015.

REFERENCES:
2006 edition (1 December 2010)

AE7353 SOLID MECHANICS  L  T  P  C  3  0  0  3

OBJECTIVE:
• To introduce various behavior of structural components under various loading conditions. Also to introduce about the deflection of beams, stresses and strains in torsional members.

UNIT I  STRESS-STRAIN – AXIAL LOADING  9
Definition of stress and strain- Stress-Strain relation- Relation between material constants.-Bar
under axial loading- Statically determinate and indeterminate cases – Thermal stress-Impact
Loading
UNIT II  STRESSES IN BEAMS  9
Types of beams and loadings – Relation between shear force and bending moment - Shear force and bending moment diagrams – Euler beam theory - Bending stress in beams – Shear stress in beam – Composite beam.

UNIT III  DEFLECTION OF BEAM  9

UNIT IV  TORSION – SPRINGS  9
Shear stress and twist relation for circular section – Comparison of hollow shaft and solid shaft – Compound shaft – Power transmission by circular shafts – Springs – Deflection expression for close coiled helical spring – Stress in springs.

UNIT V  BIAXIAL STRESS  9
Thin walled cylinder under internal pressure – Principal stresses for general biaxial stress field – Mohr’s circle - Stresses in combined loading

OUTCOMES:
At the end of the course
- Students will be familiarizing with the fundamentals of deformation, stresses, and strains in structural elements and pressure vessels.
- Students will be familiarizing the beam of different cross sections for shear force, bending moment, slope and deflection.

TEXT BOOKS:

REFERENCES:

EE7151  BASIC 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  9
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

OUTCOME:
• Ability to use the various electrical machines like AC/ DC, electronic components and applications of analog circuits

REFERENCES:

MA7354  NUMERICAL METHODS
L T P C
4 0 0 4

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 EIGENVALUE PROBLEMS  12

UNIT II  INTERPOLATION AND APPROXIMATION  12
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  12

UNIT IV  INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS  12

UNIT V  BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS  12
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.

TOTAL: 60 PERIODS

OUTCOMES:
Upon completion of this course, the students will be able to:
- Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.
- Apply numerical methods to obtain approximate solutions to mathematical problems.
- Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- Analyse and evaluate the accuracy of common numerical methods.

TEXT BOOKS:

REFERENCES:

EE7261 ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

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 motor
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: 60 PERIODS

OUTCOMES:
• Ability to perform speed characteristic of different electrical machine
• Ability to use of diodes, transistors for rectifiers
• Ability to use of operational amplifiers

ME7362 MECHANICAL SCIENCES LABORATORY

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: 60 PERIODS

OUTCOME:
• Upon completion of this course, the students can able to apply determine the strength materials and thermal properties.

AE7401 AERODYNAMICS - I

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.
• Also to introduce the basics of viscous flow.

UNIT I REVIEW OF BASIC FLUID MECHANICS

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 8
Vortex Filament, Biot - Savart Law, Bound Vortex and trailing Vortex, Horse Shoe Vortex, Lifting Line Theory and its limitations.

UNIT V INTRODUCTION TO LAMINAR AND TURBULENT FLOW 10
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, Prandtl’s mixing length hypothesis, Free shear layers.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course students will have
- An ability to apply airfoil theory to predict air foil perform
- A knowledge of incompressible flow
- An explosive to Boundary layer theory

TEXTBOOKS:

REFERENCES:

AE7402 AIRCRAFT STRUCTURES – I L T P C 3 0 0 3

OBJECTIVES:
- To provide the students an understanding on the linear static analysis of determinate and indeterminate aircraft structural components.
- To provide the design process using different failure theories.

UNIT I ANALYSIS OF TRUSSES AND BEAMS 9
Plane truss analysis, plane frame analysis, analysis of a 3-D truss, analysis of continuous beams using Clapeyron’s 3-moment equation.

UNIT II ENERGY METHODS OF ANALYSIS 9
Energy expression for various loadings and its application to statically determinate and indeterminate beams, trusses, frames and rings.

UNIT III BUCKLING OF COLUMNS 9
Buckling of Long column and short column- inelastic buckling- columns with different end conditions, empirical methods, the Southwell plot, use of Energy methods, imperfections in columns, stresses and deflections in a beam-column.
UNIT IV   FAILURE ANALYSIS  9
Failure of Ductile and brittle materials, Theories of failure and their Failure envelopes, Introduction to fatigue failure and fracture mechanics of materials.

UNIT V   DESIGN OF JOINTS  9
Types of joints and rivets. Failure of joints. Design of bolted joints. Stresses in bolts and nuts due to various loadings - Axial load, shear load and combined loading. Types of welded joints. Strength of welded joints for various loadings

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

AE7403   AIRCRAFT SYSTEMS AND INSTRUMENTS
L T P C
3 0 0 3

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  9

UNIT II   AIRPLANE CONTROL SYSTEMS  10

UNIT III   ENGINE SYSTEMS  9
Piston and Jet Engines- Fuel systems – Components - Multi-engine fuel systems, lubricating systems – Starting and Ignition systems.
UNIT IV  AIRCONDITIONING AND PRESSURIZING SYSTEM  8

UNIT V  AIRCRAFT INSTRUMENTS  9

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

TEXT BOOKS

REFERENCES

AE7404  PROPULSION- I  L T P C  3 0 0 3

OBJECTIVE:
- To understand the principles of operation and design of aircraft powerplants. Also to introduce about the types, operation and performance of various parts of the aircraft engines.

UNIT I  FUNDAMENTALS OF GAS TURBINE ENGINES  8

UNIT II  INLETS  9

UNIT III  COMBUSTION CHAMBERS  9
Classification of combustion chambers – Important factors affecting combustion chamber design – Combustion process – Combustion chamber performance – Effect of operating variables on


UNIT IV NOZZLES

UNIT V COMPRESSORS

TOTAL: 45 PERIODS

OUTCOME:
- Upon completion of the course, the students will have the Ability to identify the engine components of jet propelled engines. Also the gain knowledge in the operation and performance of the engine parts.

TEXT BOOKS:

REFERENCES:

MA7358 TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS L T P C
4 0 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

UNIT II
FOURIER SERIES
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.

UNIT III
APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION
Method of separation of variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in cartesian coordinates.

UNIT IV
FOURIER TRANSFORM

UNIT V
Z–TRANSFORM AND DIFFERENCE EQUATIONS

OUTCOME:
- The students can able to solve the partial differential equations, find the Fourier series analysis and solve the problems by using Fourier transform and Z transform techniques.

TEXTBOOKS:

REFERENCES:
OBJECTIVE:
- To understand the basic concepts of mechanisms and machinery.

UNIT I  MECHANISMS

UNIT II  FRICTION
Types of friction – friction in screw and nut – screw jack – pivot, collar and thrust bearings – plate and cone clutch – belt (Flat and V) and rope drives – creep in belts – open and crossed belt drives – Ratio of tensions – Effect of centrifugal and initial tensions – condition for maximum power transmission.

UNIT III  GEARS AND CAMS

UNIT IV  VIBRATION

UNIT V  BALANCING
Static and dynamic balancing – single and several masses in different planes – primary and secondary balancing of reciprocating masses – Balancing of single and multi cylinder engines – Governors and Gyroscopic effects.

OUTCOME:
- The student shall be able to apply the kinematics and dynamics of machinery in design and analysis of engineering problems.

TEXT BOOKS:

REFERENCES:
AE7411  AERODYNAMICS LABORATORY  L T P C  0 0 4 2

OBJECTIVES:
- To predict different aerodynamic propulsion used in aero application
- To make the student familiarize with the experiments in aerodynamics on wings, bodies and calibration of supersonic wind tunnel.

LIST OF EXPERIMENTS
1. Calibration of a Subsonic Wind tunnel
2. Pressure distribution over a circular cylinder.
3. Pressure distribution over a cambered aerofoil.
4. Flow visualization studies in subsonic flows.
5. Pressure distribution over a finite wing of cambered aerofoil section
6. Pressure distribution over a Nose cone model.
7. Determination of Base drags of a missile model.
8. Determination of profile drag of bodies by wake survey method.
9. Study of flow field over a backward facing step
11. Flow visualization studies in supersonic flows.
12. Force measurements on Aircraft models

Only 10 experiments will be conducted

TOTAL: 60 PERIODS

OUTCOMES:
At the end of the course students will be able
- To use the fundamental dynamic principle in aircraft application
- To calibrate subsonic and supersonic wind tunnel
- The students will be able to determine lift for the given airfoil sections.
- The students will be able to identify of pressure distribution over the various bodies.
- They will have a practical exposure on flow visualization techniques pertaining to subsonic

AE7412  AIRCRAFT COMPONENT DRAWING LABORATORY  L T P C  0 0 4 2

OBJECTIVE:
- To introduce the concept of design of basic aircraft structural components and to draft both manually. Also to get hands on training in designing the structural components using modeling package.

LIST OF EXPERIMENTS:
1. Design of riveted joints (Lap joint).
2. Design of riveted joints (Butt joint with single and double straps).
3. Design of welded joints.
4. Design of bolted joints.
5. Design of empennage.
7. Computer aided modeling of typical fuselage structure.
8. Computer aided modeling of landing gear
9. Three view diagram of a typical aircraft
10. Layout of control systems.

TOTAL: 60 PERIODS

OUTCOME:
- At the end of the course, students will be familiarize with the basic aircraft and its components, 3-Dimensional Design of typical aircraft & its components, assembly of aircraft components

AE7501    AERODYNAMICS-II  L T P C
3 0 0 3

OBJECTIVE:
- 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  8
Compressibility, Continuity, Momentum and energy equation for steady one dimensional flow-compressible Bernoulli’s equation-Calorically perfect gas, Mach Number, Speed of sound, Area – Mach number – Velocity relation, Mach cone, Mach angle, One dimensional isentropic flow through variable area duct, Static and Stagnation properties, Critical conditions, Characteristic Mach number, Area-Mach number relation, Maximum discharge velocity.

UNIT II  SHOCK AND EXPANSION WAVES  12

UNIT III  TWO DIMENSIONAL COMPRESSIBLE FLOW  9
Potential equation for 2-dimensional compressible flow, Linearization of potential equation, perturbation potential, Linearized Pressure Coefficient, Linearized subsonic flow, Prandtl-Glauert rule, Linearized supersonic flow, Method of characteristics.

UNIT IV  HIGH SPEED FLOW OVER AIRFOILS, WINGS AND AIRPLANE CONFIGURATION  8
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 aircrafts.
UNIT V  CHARACTERIZATION OF HIGH SPEED FLOWS  8

TOTAL: 45 PERIODS

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 behaviors.

TEXTBOOKS:

REFERENCES:

AE7502  AIRCRAFT STRUCTURES – II  L T P C
3 0 0 3

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 OF BEAMS  9
Unsymmetrical bending of beams – different methods of analysis (neutral axis method, ‘k’ method, and the principal axis method), stresses and deflections in beams under unsymmetrical bending.

UNIT II  SHEAR FLOW IN OPEN SECTIONS  9
Definition and expression for shear flow due to bending, shear flow in thin-walled Open sections with and without stiffening elements, torsion of thin-walled Open sections, the shear center of symmetric and unsymmetrical open sections, structural idealization.

UNIT III  SHEAR FLOW IN CLOSED SECTIONS  9
Shear flow due to bending and torsion in single-cell and multi-cell structures, the shear center of symmetric and unsymmetrical closed sections, effect of structural idealization, shear flow in a tapered beam, stress analysis of thin-webbed beams using Wagner’s theory.
UNIT IV BUCKLING OF PLATES
Behaviour of a rectangular plate under compression, governing equation for plate buckling, buckling analysis of sheets and stiffened panel under compression, concept of the effective sheet width, buckling due to shear and combined loading, crippling.

UNIT V AIRCRAFT STRESS ANALYSIS
Loading and analysis of aircraft wing, fuselage, and tail unit. Use of V-n diagram for sizing the aircraft wing, fuselage, and tail unit.

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

TEXT BOOKS:

REFERENCES

AE7503 FLIGHT MECHANICS

OBJECTIVE:
- To make the student understand the performance of airplanes under various flight conditions like 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 Reynold's 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.

UNIT III STEADY LEVEL FLIGHT
General equation of motion of an airplane. Steady level flight, Thrust required and Power required, Thrust available and Power available for propeller driven and jet powered aircraft. Effect of altitude, maximum level flight speed, conditions for minimum drag and minimum power required, Effect of
drag divergence on maximum velocity, Range and Endurance of Propeller and Jet aircrafts. Effect of wind on range and endurance.

UNIT IV  GLIDING AND CLIMBING FLIGHT  9
Shallow and steep angles of climb, Rate of climb, Climb hodograph, Maximum Climb angle and Maximum Rate of climb- Effect of design parameters for propeller jet and glider aircrafts, Absolute and service ceiling, Cruise climb, Gliding flight, Glide hodograph

UNIT V  ACCELERATED FLIGHT  9
Estimation of take-off and landing distances, Methods of reducing landing distance, level turn, minimum turn radius, maximum turn rate, bank angle and load factor, Constraints on load factor, SST and MSTR. Pull up and pull down maneuvers, V-n diagram.

TOTAL: 45 PERIODS

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:

AE7504  PROPULSION – II  L T P C  3 0 0 3

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  TURBINES FOR JET ENGINES  8
UNIT II  RAMJET PROPULSION

UNIT III  HYPersonic Airbreathing Propulsion

UNIT IV  CHEMICAL ROCKET PROPULSION

UNIT V  ADVANCED PROPULSION TECHNIQUES
Introduction to nozzleless propulsion and basic concepts - Electric rocket propulsion – Ion propulsion – Nuclear rocket – comparison of performance of these propulsion systems with chemical rocket propulsion systems - Solar sail.

TOTAL: 45 PERIODS

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:
for composite laminates.

LIST OF EXPERIMENTS
1. Determination of Flexural strength of materials.
2. Deflection of Beams
3. Verification of Maxwell’s Reciprocal Theorem
4. Buckling Load estimation of Slender Eccentric Columns
5. Acoustic emission techniques for composites specimen.
6. Unsymmetrical Bending of a Cantilever Beam
7. Combined bending and Torsion of a Hollow Circular Tube
8. Experiment using Photo elastic setup
9. Shear Centre of a Channel Section
10. Shear centre for unsymmetrical section.
11. Fabrication of a Composite Laminate.
12. Determination of characteristics for a Composite Specimen.

Total: 60 periods

OUTCOMES:
At the end of the course
- students can understand the behavior of materials subjected to various types of loadings
- Students will be in a position to fabricate a composite laminates.

AE7512 PROPULSION LABORATORY

OBJECTIVES:
- 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 flow behavior of jets.

LIST OF EXPERIMENTS
1. Study of aircraft piston engines and gas turbine engines
2. Velocity profiles of free jets
3. Velocity profiles of wall jets
4. Wall pressure measurements of a turbine blade passage
5. Burn rate measurements of solid propellants
6. Cascade testing of compressor blades
7. Prediction of potential core length in co-axial jets
8. Flow visualization of secondary injection in a supersonic cross flow
9. Wall pressure distribution in subsonic diffusers
10. Wall pressure measurements in supersonic nozzles

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
OBJECTIVE:

- To make the student understand the concepts of stable and nonstable configuration of airplanes. Also to introduce the concepts 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.

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
Aircraft Equations of motion, 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.

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 time 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.

TEXT BOOKS:

REFERENCES:

AE7602 COMPUTATIONAL FLUID DYNAMICS 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 SOLUTION OF FLUID FLOW EQUATIONS 9
Introduction to boundary layer equations and their solution - Discretization of the boundary layer equations and illustration of solution– Solution methods for elliptic, parabolic and hyperbolic equations-velocity potential equation.

UNIT III 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 IV TIME DEPENDENT METHODS 9
Introduction to time dependent methods - Explicit time dependent 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 -artificial diffusion.

TOTAL: 45 PERIODS

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:

AE7603 FINITE ELEMENT METHODS

OBJECTIVE:
• To give exposure to 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
Review of various approximate methods – Raleigh Ritz’s, Galerkin and finite difference methods- Governing equation and convergence criteria of finite element method.
UNIT II  DISCRETE ELEMENTS  10
Bar elements, uniform section, mechanical and thermal loading, varying section, truss analysis.
Beam element with various loadings and boundary conditions - longitudinal and lateral vibration.
Use of local and natural coordinates.

UNIT III  CONTINUUM ELEMENTS  8
Plane stress, Plane strain and axisymmetric problems, constant and linear strain triangular elements, stiffness matrix, axisymmetric load vector.

UNIT IV  ISOPARAMETRIC ELEMENTS  10
Definitions, Shape function for 4, 8 and 9 nodal quadrilateral elements, Stiffness matrix and consistent load vector, Gaussian integration

UNIT V  FIELD PROBLEM  9
Heat transfer problems, Steady state fin problems, Derivation of element matrices for two dimensional problems, Torsion problems

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

GE7251  ENVIRONMENTAL SCIENCE AND ENGINEERING  L T P C  3 0 0 3

OBJECTIVES:
To the study of nature and the facts about environment.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
• To study the dynamic processes and understand the features of the earth’s interior and surface.
• To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I  ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY
Definition, scope and importance of environment—need for public awareness—concept of an ecosystem—structure and function of an ecosystem—producers, consumers and decomposers—energy flow in the ecosystem—ecological succession—food chains, food webs and ecological pyramids—Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)—Introduction to biodiversity definition: genetic, species and ecosystem diversity—bio geographical classification of India—value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values—Biodiversity at global, national and local levels—India as mega diversity nation—hot-spots of biodiversity—threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts—endangered and endemic species of India—conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. 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, dam 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: Lands are source and 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 environment at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions.
- Development and improvement in standard of living has lead to serious environmental disasters.

TEXT BOOKS:

REFERENCES:

AE7611 AEROMODELLING L T P C 0 0 4 2

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

LIST OF EXPERIMENTS:
1. Model Building and working with Materials such as balsa wood, Coro plast, foam.
2. Power system integration including setting of thrust line.
3. Command and control system procedure.
4. Basic RF Experiments.
5. Flight Simulator Training.
7. Quad rotor stabilization (rotary).
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 an UAV airframe of own design and integrate with Autopilot system.

TOTAL: 60 PERIODS

OUTCOME:
- On completion of Aeromodelling course, students will be in a position to design UAV’s. Students will get hands on training in flying an UAV.

AE7612 AIRCRAFT DESIGN PROJECT I

OBJECTIVE:
- To make the student work in groups and understand the Concepts involved in Aerodynamic design, Performance analysis and stability aspects of airplanes assigned.

LIST OF EXPERIMENTS:
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.

TOTAL: 60 PERIODS

OUTCOME:
- On completion of Aircraft design project I the students are in a position to carry out the aerodynamic design of airplanes.

AE7701 COMPOSITE MATERIALS AND STRUCTURES

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

63
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.

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:

REFERENCES:

AE7702  EXPERIMENTAL AERODYNAMICS  L T P C  3 0 0 3

OBJECTIVE:
• To provide extensive treatment of the operating principles and limitations of pressure and temperature measurements. To cover both operating and application procedures of hot wire anemometer. To describe flow visualization techniques and to highlight in depth discussion of analog methods.

UNIT I  BASIC MEASUREMENTS IN FLUID MECHANICS  7
UNIT II WIND TUNNEL MEASUREMENTS 10

UNIT III FLOW VISUALIZATION AND ANALOGUE METHODS 9

UNIT IV PRESSURE, VELOCITY AND TEMPERATURE MEASUREMENTS 9
Pitot - static tube characteristics - Velocity measurements - Hot-wire anemometry – Constant current and Constant temperature Hot-Wire anemometer – Pressure measurement techniques - Pressure transducers – Temperature measurements.

UNIT V SPECIAL FLOWS AND UNCERTAINTY ANALYSIS 10

TOTAL: 45 PERIODS

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

TEXT BOOKS:

AE7703 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 8
UNIT II CONVECTION

UNIT III RADIATION

UNIT IV NUMERICAL METHODS

UNIT V CASE STUDIES IN AEROSPACE ENGINEERING
Numerical treatment of heat transfer problems pertaining to Aerospace Engineering like in gas turbines, rocket thrust chambers, Aerodynamic heating and Ablative heat transfer in thermal protection systems.

TOTAL: 45 PERIODS

OUTCOME:
- At the end of the course, students can be able to understand and apply different heat transfer principles of different applications.

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
- To give exposure on important topics like rocket aerodynamics and staging and control of rockets to students to enrich their knowledge in the area of launch vehicles.

UNIT I  CLASSIFICATION OF ROCKETS AND LAUNCH VEHICLES  9
Various methods of classification of missiles and rockets-Basic Aerodynamics characteristics of launch vehicle configurations-Examples of various Indian space launch vehicles-Current status of Indian rocket programme with respect to international scenario.

UNIT II  AERODYNAMICS OF ROCKETS AND LAUNCH VEHICLES  10

UNIT III  ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD  10
One dimensional and two-dimensional rocket motions in free space and homogeneous gravitational fields – description of vertical, inclined and gravity turn trajectories – determination of range and altitude – simple approximations to burn out velocity and altitude – estimation of culmination time and altitude.

UNIT IV  STAGING OF ROCKETS AND LAUNCH VEHICLES  8
Design philosophy behind multistaging of launch vehicles– multistage vehicle optimization – stage separation techniques in atmosphere and in space – stage separation dynamics and lateral separation characteristics.

UNIT V  CONTROL OF ROCKETS AND LAUNCH VEHICLES  8
Introduction to aerodynamic control and jet control methods- thrust control methods – various types of thrust vector control methods including secondary injection thrust vector control for launch vehicles.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course
- Knowledge in types of rockets and launch vehicles with respect to Indian & international scenario.
- Gaining information on aerodynamics of rocket and launch vehicles.
- Knowledge on stages and remote control of rockets.

TEXT BOOKS:

REFERENCE:
AE7711  AIRCRAFT DESIGN PROJECT II  L T P C  0 0 0 4 2

OBJECTIVE:
Each group of students is assigned to continue the structural design part of the airplane.

LIST OF EXPERIMENTS
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

OUTCOME:
• On completion of Aircraft design project II the students are in a position to carry out the aerodynamics and structural design of Airplanes.

HS7561  COMMUNICATION SKILLS AND SOFT SKILLS  L T P C  1 0 2 2

COURSE DESCRIPTION
This course aims to help engineering students acquire the employability skills necessary for the workplace. It also attempts to meet the expectations of the employers by giving special attention to presentation skills, group discussion skills and soft skills. This aim will be achieved through expert guidance and teaching activities focusing on the above listed skills and language skills in the Language Laboratory.

OBJECTIVES:
• To enhance the employability skills of students with a special focus on presentation skills, group discussion skills and interview skills and soft skills.
• To help them improve their writing skills necessary for the workplace situation.

CONTENTS

UNIT I  WRITING SKILLS
Preparing job applications – writing the cover letter and resume – applying for jobs online – e-mail etiquette – writing reports – collecting, analyzing and interpreting data.
UNIT II  SOFT SKILLS

UNIT III  PRESENTATION SKILLS
Preparing slides using the computer—structuring the content (parts of a presentation)—body language—answering questions—individual presentation practice — mini presentation (practice sessions)

UNIT IV  GROUP DISCUSSION SKILLS
Participating in group discussions – understanding group dynamics – brainstorming – questioning and clarifying – GD strategies (expressing opinions, accepting or refusing others opinions, turn taking) – activities to improve GD skills – viewing recorded GD – mock GD.

UNIT V  INTERVIEW SKILLS
Interview etiquette—technical Interview/HR Interview/body language—mock interview—attending job interviews – Types of interviews—telephone/skype interview—stress interview, one to one/panel interview — FAQs related to job interview.

TOTAL: 45 PERIODS

OUTCOMES:
• Students will be able to make presentations and participate in group discussions with confidence.
• Students will be able to perform well in interviews.
• They will have adequate writing skills.

REFERENCES:

EXTENSIVE READERS

WEB RESOURCES
1. www.humanresources.about.com
2. www.careerride.com
OBJECTIVE:

- To impart practical knowledge to students on various maneuvers of flight and different modes of stability such as dutch roll, phugoid motion etc.,

LIST OF EXPERIMENTS

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 stall, Phugoid motion and Dutch roll

OUTCOME:

- Upon completion of the course students will be in a position to do carry out preliminary design of a simple mini aircraft. These experiments will be conducted by the students during the flight training programme at IIT- Kanpur and evaluation is also done by the faculty of IIT- Kanpur.

TOTAL: 60 PERIODS

AE7812 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.

OUTCOMES:

- The students will be able to think innovatively.
- The students will be able to works 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.

TOTAL: 300 PERIODS
OBJECTIVE:

- To make the student understand the various aero elasticity phenomenon like divergence flutter and control reversal and its effects on airplane design.

UNIT I AERO ELASTICITY PHENOMENA 8
Vibration of beams due to coupling between bending and torsion - The aero-elastic triangle of forces - Stability versus response problems – Aeroelasticity in Aircraft Design – Vortex induced vibration – Introduction to aero servo elasticity.

UNIT II DIVERGENCE OF A LIFTING SURFACE 10

UNIT III STEADY STATE AEROELASTIC PROBLEMS 9
Loss and reversal of aileron control – Critical aileron reversal speed – Aileron efficiency – Semi rigid theory and successive approximations – Lift distributions – Rigid and elastic wings.

UNIT IV FLUTTER ANALYSIS 10

UNIT V EXAMPLES OF AEROELASTIC PROBLEMS 8
Galloping of transmission lines and flow induced vibrations of tall slender structures and suspension bridges – Aircraft wing flutter- Vibrational problems in Helicopters.

TOTAL: 45 PERIODS

OUTCOMES:

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:

AE7002 AEROSPACE MATERIALS

OBJECTIVE:
- To impart knowledge to students on the mechanical behaviors of various materials that are used in aircraft and its characteristics.

UNIT I ELEMENTS OF AEROSPACE MATERIALS
9

UNIT II MECHANICAL BEHAVIOUR OF MATERIALS
9
Linear and non linear elastic properties – Yielding, strain hardening, fracture, Bauchinger’s effect – Notch effect testing and flaw detection of materials and components – Comparative study of metals, ceramics plastics and composites.

UNIT III CORROSION & HEAT TREATMENT OF METALS AND ALLOYS
10

UNIT IV CERAMICS AND COMPOSITES
9

UNIT V HIGH TEMPERATURE MATERIALS CHARACTERIZATION
8
Classification, production and characteristics – Methods and testing – Determination of mechanical and thermal properties of materials at elevated temperatures – Application of these materials in Thermal protection systems of Aerospace vehicles – super alloys – High temperature material characterization.

TOTAL: 45 PERIODS
OUTCOMES:
- Upon completion of this course, students will understand the advanced concepts of aerospace materials to the engineers and to provide the necessary mathematical knowledge that are needed in understanding their significance and operation. The students will have an exposure on various topics such elements of aerospace materials, mechanical behavior of materials, ceramics and composites and will be able to deploy these skills effectively in the understanding of aerospace materials.

REFERENCES

AE7003 AIRCRAFT DESIGN

OBJECTIVE:
- 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

TEXT BOOKS:

REFERENCES:

AE7004 AIRCRAFT ENGINE REPAIRS AND MAINTENANCE L T P C 3 0 0 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 troubleshooting - 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 super charger - Checks and inspection procedures.

UNIT II
Propeller theory - operation, construction assembly and installation -Pitch change mechanism-Propeller axially system- Damage and repair criteria - General Inspection procedures - Checks on constant speed propellers - Pitch setting, Propeller Balancing, Blade cuffs, Governor/Propeller operating conditions – Damage and repair criteria.
UNIT III

UNIT IV
Types of jet engines – Fundamental principles – Bearings and seals - Inlets - compressors-turbines-exhaust section – classification and types of lubrication and fuels- Materials used - Details of control, starting around running and operating procedures – Inspection and Maintenance-permissible limits of damage and repair criteria of engine components- internal inspection of engines- compressor washing- field balancing of compressor fans- Component maintenance procedures - Systems maintenance procedures - use of instruments for online maintenance - Special inspection procedures-Foreign Object Damage - Blade damage.

UNIT V
Engine Overhaul - Overhaul procedures - Inspections and cleaning of components - Repairs schedules for overhaul - Balancing of Gas turbine components. Trouble Shooting: Procedures for trouble shooting - Condition monitoring of the engine on ground and at altitude - engine health monitoring and corrective methods.

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:
OBJECTIVE:
- 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  8
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  7
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  10
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  8
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  12
Flight testing of (Series) aircraft for issue of C of A; Fight 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 permit; Procedure for issue of type approval of aircraft components and equipment including instruments.

TOTAL: 45 PERIODS
OUTCOMES:

- Knowledge of Airworthiness requirements for transport, military, gliders and micro light aircrafts.
- Understanding of Defect recording, reporting, investigation, rectification and analysis
- Knowledge of procedure for holding examinations, proficiency checks etc. for Defense 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.

AE7006 AIRCRAFT SYSTEMS ENGINEERING

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

UNIT II DESIGN AND DEVELOPMENT PROCESS
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

UNIT IV PRACTICAL CONSIDERATIONS AND CONFIGURATION CONTROL
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:

AE7007  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  
9
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  
9
PLASTICS IN AIRCRAFT: Review of types of plastics used in airplanes - Maintenance and repair of plastic components - Repair of cracks, holes etc., and 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  
9
UNIT IV  REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM  10
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  8

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 programme.
• 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.

TEXT BOOKS:

REFERENCES:

AE7008  APPROXIMATE METHODS IN STRUCTURAL MECHANICS  L T P C  3 0 0 3

OBJECTIVE:
• To understand the various approximate methods for solving both boundary value and initial value problems involved in structural mechanics.

UNIT I  ANALYTICAL AND NUMERICAL METHODS  7
Review of analytical methods for solving ordinary differential equations related to structural mechanics problems, boundary conditions, initial conditions, Need for approximate methods, different forms of approximate solution, Numerical integration, Elementary study on calculus of variation.
UNIT II APPROXIMATE METHODS

UNIT III STATIC, DYNAMIC AND STABILITY ANALYSIS
Application to statically determinate and indeterminate structures: bar, beam, torsional member. Free vibration and stability analysis, Improvement of solution accuracy.

UNIT IV FINITE DIFFERENCE METHOD
Application to statically determinate and indeterminate structures: bar, beam, torsional member. Free vibration and stability analysis.

UNIT V CODE DEVELOPMENT
Numerical integration; Solution of simultaneous algebraic equations; Code generation for structural mechanics problems using approximate methods.

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:

AE7009 AVIONICS L T P C
3 0 0 3

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  
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  

UNIT III  FLIGHT DECKS AND COCKPITS  
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  

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:

REFERENCES:

AE7010  BOUNDARY LAYER THEORY  
OBJECTIVE:
- 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 VISCOS 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  10
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 – Pohlhausen method – Thermal boundary layer calculations

UNIT IV  TURBULENT BOUNDARY LAYER  10
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  BOUNDARY LAYER CONTROL  7
Boundary layer control in laminar flow-Methods of Boundary layer control: Motion of the solid wall-Acceleration of the boundary layer-Suction- Injection of different gas-Prevention of transition-Cooling of the wall-Boundary layer suction-Injection of a different gas.

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:

AE7011  COMBUSTION IN AEROSPACE VEHICLES  L T P C
3 0 0 3

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  

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:
OBJECTIVE:

• To impart knowledge to students on 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 8
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 9
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 10
Engine Component Design-Fan and Compressor Aerodynamics-Diffusion factor-Aerofoil
geometry-Flow path dimension-Radial variation-Turbine Aerodynamics- Constant axial velocity-
adiabatic-selected Mach number-Mean line stage Design-stage pressure ratio-Airfoil geometry-
radial variation-turbine cooling-range of turbine parameter-Engine life-Design Example-fan-
compressor-turbine.

UNIT IV COMBUSTION CHAMBER DESIGN 9
Engine Component Design: Combustion system components- Combustion- Chemical reactor
theory. Combustor Stability map-Stirring and mixing-Total pressure loss-Fuels-Ignition-Combustion
Systems of Main Burner Design: Air partitioning-Main burner component Design: Diffuser-types of
burner-inner and outer casing Design-Fuel-nozzle-Dome and liner-Primary zone-swirler-
Secondary holes-Dilution holes-Transition duct-Example Design calculation: Design of
Afterburners-Design parameters-Components-Diffuser-Fuel injection-Ignition-Flame stabilization-
Flame spread and after burner length-Examples design calculation.

UNIT V INLET AND NOZZLE DESIGN 9
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

TOTAL: 45 PERIODS

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.
TEXT BOOKS:

REFERENCES:

AE7013 FATIGUE AND FRACTURE MECHANICS L T P C
3 0 0 3

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
Strength of cracked bodies - Potential energy and surface energy - Griffith’s theory - Irwin - Orwin extension of Griffith’s theory to ductile materials - stress analysis of cracked bodies - Effect of thickness on fracture toughness - stress intensity factors for typical geometries.

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 analyse the fracture due to fatigue

TEXT BOOKS:

REFERENCES:

AE7014 FUNDAMENTALS OF CONTROL ENGINEERING

OBJECTIVES:
- 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.

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

TEXT BOOKS:

REFERENCES:

AE7015 HELICOPTER AERODYNAMICS
L T P C
3 0 0 3

OBJECTIVE:
- To impart knowledge to the students and fundamental aspects of helicopter aerodynamics, performance of helicopters, stability and control aspects and also to expose them basic and aerodynamic design aspects

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
Dynamic model of the rotor, Motion of the rigid blades, flapping motion, lagging motion, feathering motion, Properties of vibrating system, phenomenon of vibration, fuselage response, vibration

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:

AE7016 HYPersonic AERODYNAMICS

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
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

UNIT III VISCOUS HYPERSONIC FLOW THEORY

UNIT IV VISCOUS INTERACTIONS IN HYPERSONIC FLOWS
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
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:

AE7017 MISSILE AERODYNAMICS

OBJECTIVE:
- Upon completion of the course, Students will learn the concept of high speed aerodynamics and Configurations of missiles.

UNIT I BASICS ASPECTS OF MISSILE AERODYNAMICS
Classification of missiles-Aerodynamics characteristics and requirements of air to air missiles, air to surface missiles and surface to air missiles-Missile trajectories-fundamental aspects of hypersonic aerodynamics.

UNIT II MISSILE CONFIGURATIONS AND DRAG ESTIMATION
Types of Rockets and missiles-various configurations-components-forces on the vehicle during atmospheric flight-nose cone design and drag estimation

UNIT III AERODYNAMICS OF SLENDER AND BLUNT BODIES
Aerodynamics of slender and blunt bodies, wing-body interference effects-Asymmetric flow separation and vortex shedding-unsteady flow characteristics of launch vehicles- determination of aero elastic effects.

UNIT IV AERODYNAMIC ASPECTS OF LAUNCHING PHASE
Booster separation-cross wind effects-specific considerations in missile launching-missile integration and separation-methods of evaluation and determination- Wind tunnel tests – Comparison with CFD Analysis.
UNITIV  STABILITY AND CONTROL OF MISSILES
Forces and moments acting on missiles-Lateral, rolling and longitudinal moments-missile
dispersion-stability aspects of missile configuration-Aerodynamic control methods-Jet control
methods-Stability derivatives.

TOTAL: 45 PERIODS

OUTCOME:
- On completion of the course, students will be able to understand the aerodynamics of
  slender and blunt bodies, various aspects of launching phase and stability & control of
  missiles.

REFERENCES:
   edition, 2006

AE7018  NUMERICAL HEAT TRANSFER

OBJECTIVE:
- Students will learn the concepts of various computation methods that are applicable to
  conduction, convection and radiation problems.

UNIT I  INTRODUCTION
Finite Difference Method-Introduction-Taylor’s series expansion-Discretisation Methods Forward,
backward and central differencing scheme for first order and second order Derivatives – Types of
partial differential equations-Types of errors. Solution to algebraic equation-Direct Method and
Indirect Method-Types of boundary condition.FDM - FEM - FVM.

UNIT II  CONDUCTIVE HEAT TRANSFER
General 3D-heat conduction equation in Cartesian, cylindrical and spherical coordinates.
Computation(FDM) of One –dimensional steady state heat conduction with Heat generation-
without Heat generation- 2D-heat conduction problem with different boundary conditions-
Numerical treatment to 1D-steady heat conduction using FEM.

UNIT III  TRANSIENT HEAT CONDUCTION
Introduction to Implicit, explicit Schemes and crank-Nicolson Schemes Computation(FDM) of One
– dimensional un-steady heat conduction –with heat Generation-without Heat generation - 2D-
transient heat conduction problem with different boundary conditions using Implicit, explicit
Schemes. Importance of Courant number. Analysis for I-D,2-D transient heat Conduction
problems.

UNIT IV  CONVECTIVE HEAT TRANSFER
Convection- Numerical treatment (FDM) of steady and unsteady 1 -D and 2-d heat convection-
diffusion steady-unsteady problems- Computation of thermal and Velocity boundary layer flows.
Upwind scheme.Stream function-vorticity approach-Creeping flow.
UNIT V  RADIATIVE HEAT TRANSFER  9

OUTCOME:
• Upon completion of the course, students will learn the concepts of computation applicable to heat transfer for practical applications.

REFERENCES:

AE7019  SATELLITE TECHNOLOGY  L T P C
3 0 0 3

OBJECTIVE:
• 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  9
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  9
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  9
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  9
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  9
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.

TEXT BOOKS:

REFERENCES:

AE7020  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  8
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 10

UNIT III SATELLITE INJECTION AND SATELLITE PERTURBATIONS 10

UNIT IV INTERPLANETARY TRAJECTORIES 8

UNIT V BALLISTIC MISSILE TRAJECTORIES 9

TOTAL: 45 PERIODS

OUTCOMES:
• Ability to perform satellite injection, satellite perturbations and trajectory control.
• Apply orbital mechanics to control ballistic missile.

TEXT BOOKS:

REFERENCES:

AE7021 STRUCTURAL DYNAMICS L T P C
3 0 0 3

OBJECTIVE:
• To study the effect of periodic and aperiodic forces on mechanical systems with matrix approach and also to get the natural characteristics of large sized problems using approximate methods.

UNIT I FORCE DEFLECTION PROPERTIES OF STRUCTURES 9
UNIT II PRINCIPLES OF DYNAMICS
Free and forced vibrations of systems with finite degrees of freedom – Response to periodic excitation – Impulse Response Function – Convolution Integral

UNIT III NATURAL MODES OF VIBRATION

UNIT IV ENERGY METHODS

UNIT V APPROXIMATE METHODS
Approximate methods of evaluating the Eigen frequencies and Eigen vectors by reduced, subspace, Lanczos, Power, Matrix condensation and QR methods.

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:

AE7022 THEORY OF ELASTICITY
L T P C
3 0 0 3

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

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

TEXT BOOKS:

REFERENCES:

AE7023 THEORY OF PLATES AND SHELLS

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

UNIT I CLASSICAL PLATE THEORY
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
Rayleigh – Ritz, Galerkin Methods – Finite Difference Method – Application to Rectangular Plates for Static, Free Vibration and Stability Analysis. 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:

AE7024  THEORY OF VIBRATIONS  L T P C
3 0 0 3

OBJECTIVES:
• To study the effect of time dependent forces on mechanical systems and to get the natural characteristics of system with more degree of freedom systems.
• To study the aeroelastic effects of aircraft wing.
UNIT I SINGLE DEGREE OF FREEDOM SYSTEMS


UNIT II MULTI DEGREES OF FREEDOM SYSTEMS

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

Vibration of elastic bodies - Vibration of strings – Longitudinal, Lateral and Torsional vibrations.

UNIT IV APPROXIMATE METHODS

Approximate methods - Rayleigh’s method - Dunkerlay’s method – Rayleigh-Ritz method, Matrix Iteration method.

UNIT V ELEMENTS OF AEROELASTICITY

Coupled flexural–Torsional oscillation of beam- Aeroelastic problems - Collars triangle - Wing Divergence - Aileron Control reversal – Flutter – Buffeting. – Elements of servo elasticity

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:


AE7025 UAV SYSTEM DESIGN

L T P C 3 0 0 3

OBJECTIVE:

- The objective of this course is to learn and understand the low cost UAV SYSTEMS which is suitable for generating variety of datas’ to verify and validate the different types of algorithms developed by the researchers and Scientists working on MINI UAV’s and MAV’s.
UNIT I  INTRODUCTION TO UAV
History of UAV – classification – Introduction to Unmanned Aircraft Systems – models and prototypes – System Composition - applications

UNIT II  THE DESIGN OF UAV SYSTEMS

UNIT III  AVIONICS HARDWARE
Autopilot – AGL-pressure sensors- servos - accelerometer – gyros – actuators- power supply- processor, integration, installation, configuration, and testing

UNIT IV  COMMUNICATION PAYLOADS AND CONTROLS
Payloads- Telemetry- tracking- Aerial photography- controls- PID feedback- radio control frequency range – modems- memory system- simulation- ground test- analysis- trouble shooting

UNIT V  DEVELOPMENT OF UAV SYSTEMS
Waypoints navigation- ground control software- System Ground Testing- System In-flight Testing- Future Prospects and Challenges- Case Studies – Mini and Micro UAVs.

TOTAL: 45 PERIODS

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

REFERENCES:

AE7026  WIND ENGINEERING  L T P C
3 0 0 3

OBJECTIVES:
• Apply fundamental principles of wind engineering theory to determine wind effects on civil engineering structures.
• Apply wind loading codes for structural design.
• Apply experimental methods for determining wind effects on buildings and structures
UNIT I  THE ATMOSPHERE  6
Atmospheric Circulation - Stability of atmospheres - definitions & implications - Effects of friction - atmospheric motion - Local winds, Building codes, Terrains different types.

UNIT II  ATMOSPHERIC BOUNDARY LAYER  9
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  10
Governing equations Boundary layers and separations - Wake and Vortex formation two dimensional- StroUhal Numbers, Reynolds numbers-Separation and Reattachments Oscillatory Flow, patterns Vortex shedding flows -Time varying forces to Wind velocity in turbulent flow - Structures in three dimensional

UNIT IV  WIND LOADING:  10

UNIT V  AERO ELASTIC PHENOMENA:  10
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 dibble’s', Wind loads &. Turbulent effects on tall. Structure - 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:

REFERENCES:

AE7027  WIND TUNNEL TECHNIQUES  L T P C
3 0 0 3

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

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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 nonintrusive 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

OUTCOME:
• Ability to use various techniques of Aerodynamic data generation.

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

REFERENCES:
2. Bradshaw Experimental Fluid Mechanics. Short term course on Flow visualization techniques, NAL , 2009
3. Lecture course on Advanced Flow diagnostic techniques 17-19 September 2008 NAL, Bangalore

AE7071  EXPERIMENTAL STRESS ANALYSIS  L T P C
3 0 0 3

OBJECTIVE:
• To study the various experimental techniques involved for measuring displacements, stresses, strains in structural components.

UNIT I  EXTENSOMETERS AND DISPLACEMENT SENSORS  8
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  12
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  11
Two dimensional photo elasticity, Photo elastic materials, Concept of light - photoelastic effects, stress optic law, Transmission photoelasticity, Jones calculus, plane and circular polariscopes, 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  7
Relation between stresses in coating and specimen, use of failure theories in brittle coating, Moire method of strain analysis.

UNIT V  NON–DESTRUCTIVE TESTING  7

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:

GE7071  DISASTER MANAGEMENT  L T P C
3 0 0 3

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 Processess 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.

TOTAL: 45 PERIODS

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, Scenarious in the Indian context, Disaster damage assessment and management.

TEXTBOOKS:


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

GE7073       FUNDAMENTALS OF NANO SCIENCE       L T P C
                                3 0 0 3

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

UNIT I       INTRODUCTION
8
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       GENERAL METHODS OF PREPARATION
9
Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III       NANOMATERIALS
12
Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, 92 Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO₂,MgO, ZrO₂, NiO, nanoalumina, CaO, AgTiO₂, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dots preparation, properties and applications

UNIT IV       CHARACTERIZATION TECHNIQUES
9
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

UNIT V       APPLICATIONS
7

TOTAL : 45 PERIODS
OUTCOMES:
Upon completing this course, the students
- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS

REFERENCES

GE7074 HUMAN RIGHTS L T P C
3 0 0 3

OBJECTIVE:
- 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:

GE7072 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT

OBJECTIVES:
- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them into design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT

UNIT II REQUIREMENTS AND SYSTEM DESIGN

UNIT III DESIGN AND TESTING

105
UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:
- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

TEXTBOOKS:
1. Book specially prepared by NASSCOM as per the MoU.

REFERENCES: