PROGRAMME EDUCATIONAL OBJECTIVES:
The graduates after completion of the degree will be able to
1. Apply knowledge in emerging and varied areas of Aerospace Engineering for higher studies, research, employment and product development.
2. Communicate their skills and have a sense of responsibility to protect the environment and have ethical conduct towards their profession and commitment to serve the society.
3. Exhibit managerial skills and leadership qualities while understanding the need for lifelong learning to be competent professionals

PROGRAMME OUTCOMES:
a. Ability to solve the engineering problems of mathematics, science and engineering
b. An engineering acumen in identifying, formulating, analyzing and solving complex engineering problems.
c. Developing processes, solutions to the problems which are safe socially, culturally and environmentally.
d. Ability to model, analyze and simulate operations of aircraft components and parts.
e. Capability of exhibiting sound theoretical and practical knowledge in core domains like aircraft structures, aerodynamics and propulsion and are able to solve problems related to airflow over fixed and rotary wing aircrafts.
f. Understanding of the impact of engineering solutions in a global, economic, environmental, and societal context
g. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
h. Commitment to professional ethics and responsibilities and norms as prescribed by the Aviation bodies such as DGCA .
i. Ability to work in team and have practical exposure in modeling of UAV, hovercrafts.
j. Ability to communicate effectively with the aerospace community using reports, presentations and documentations.
k. Ability to manage the projects in various aerospace fields of structure, propulsion, avionics.
l. A readiness to engage in lifelong learning and understanding of contemporary issues in aviation industry.

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|             | Control Engineering                 | √ | √ | √ | √ | √ | √ |
|             | Open Elective - I                   | √ | √ | √ | √ | √ | √ |
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|             | Propulsion Laboratory               | √ | √ | √ | √ | √ | √ |
|             | Professional Communication          | √ | √ | √ | √ | √ | √ |

<p>| SEM VI      | Finite Element Methods              | √ | √ | √ | √ | √ | √ |
|             | Experimental Aerodynamics           | √ | √ | √ | √ | √ | √ |
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### ANNA UNIVERSITY, CHENNAI
### AFFILIATED INSTITUTIONS
### B.E. AERONAUTICAL ENGINEERING
### REGULATIONS – 2017
### CHOICE BASED CREDIT SYSTEM
### I TO VIII SEMESTERS CURRICULA AND SYLLABI

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## Semester VII, Electives – II

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<td>Rockets and Missiles</td>
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### SEMESTER VIII, ELECTIVES – V

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### EMPLOYABILITY ENHANCEMENT COURSES (EEC)

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### SUMMARY

#### B.E. AERONAUTICAL ENGINEERING

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8. Non Credit/Mandatory
COMMUNICATIVE ENGLISH  

OBJECTIVES:
- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY & FRIENDS 12

UNIT II GENERAL READING AND FREE WRITING 12
Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)- inductive reading short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register- Writing - paragraph writing- topic sentence main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures -Listening- telephonic conversations. Speaking - sharing information of a personal kind—greeting – taking leave Language development – prepositions, conjunctions Vocabulary development- guessing meanings of words in context.

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 12
Reading- short texts and longer passages (close reading) Writing- understanding text structure-use of reference words and discourse markers-coherence-jumbled sentences Listening – listening to longer texts and filling up the table- product description- narratives from different sources. Speaking- asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs.

UNIT IV READING AND LANGUAGE DEVELOPMENT 12
Reading- comprehension-reading longer texts- reading different types of texts- magazines Writing-letter writing, informal or personal letters-e-mails-conventions of personal email- Listening-listening to dialogues or conversations and completing exercises based on them. Speaking- speaking about oneself- speaking about one’s friend Language development- Tenses- simple present-simple past present continuous and past continuous Vocabulary development- synonyms-antonyms- phrasal verbs

UNIT V EXTENDED WRITING 12

TOTAL: 60 PERIODS
OUTCOMES: At the end of the course, learners will be able to:

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English
- Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:

REFERENCES
3. Redston, Chris & Gillies Cunningham Face2Face (Pre-intermediate Student’s Book&Workbook) Cambridge University Press, New Delhi: 2005

MA8151 ENGINEERING MATHEMATICS – I

OBJECTIVES:
The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I DIFFERENTIAL CALCULUS
Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT II FUNCTIONS OF SEVERAL VARIABLES

UNIT III INTEGRAL CALCULUS
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
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area
enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double
and triple integrals.

UNIT V              DIFFERENTIAL EQUATIONS  12
Higher order linear differential equations with constant coefficients - Method of variation of
parameters – Homogenous equation of Euler’s and Legendre’s type – System of simultaneous
linear differential equations with constant coefficients - Method of undetermined coefficients.

TOTAL : 60 PERIODS

OUTCOMES :
After completing this course, students should demonstrate competency in the following skills:

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of
  Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar
  coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions
  and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent
  improper integrals.
- Apply various techniques in solving differential equations.

TEXT BOOKS :
   2014.
   Delhi, 2015. [For Units I & III - Sections 1.1, 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8,
   3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change
   theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES :
OBJECTIVES:
- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I PROPERTIES OF MATTER

UNIT II WAVES AND FIBER OPTICS

UNIT III THERMAL PHYSICS

UNIT IV QUANTUM PHYSICS

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 - inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

TOTAL: 45 PERIODS

OUTCOMES:
- the students will gain knowledge on the basics of properties of matter and its applications,
- the students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
- the students will understand the basics of crystals, their structures and different crystal growth techniques.
TEXT BOOKS:

REFERENCES:

CY8151  ENGINEERING CHEMISTRY  
L  T  P  C  
3  0  0  3

OBJECTIVES:
- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

UNIT I  WATER AND ITS TREATMENT  

UNIT II  SURFACE CHEMISTRY AND CATALYSIS  

UNIT III  ALLOYS AND PHASE RULE  

UNIT IV  FUELS AND COMBUSTION  
UNIT V  ENERGY SOURCES AND STORAGE DEVICES

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H₂-O₂ fuel cell.

TOTAL: 45 PERIODS

OUTCOMES:
• The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

TEXT BOOKS:

REFERENCES:

GE8151  PROBLEM SOLVING AND PYTHON PROGRAMMING

OBJECTIVES:
• To know the basics of algorithmic problem solving
• To read and write simple Python programs.
• To develop Python programs with conditionals and loops.
• To define Python functions and call them.
• To use Python data structures – lists, tuples, dictionaries.
• To do input/output with files in Python.

UNIT I  ALGORITHMIC PROBLEM SOLVING
Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II  DATA, EXPRESSIONS, STATEMENTS
Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III  CONTROL FLOW, FUNCTIONS
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.
UNIT IV  LISTS, TUPLES, DICTIONARIES  9
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V  FILES, MODULES, PACKAGES  9
Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of the course, students will be able to
- Develop algorithmic solutions to simple computational problems
- Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python Programs.

REFERENCES:

TEXT BOOKS:

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

CONCEPTS AND CONVENTIONS (Not for Examination)
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.
UNIT I  PLANE CURVES AND FREEHAND SKETCHING 7+12
Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects

UNIT II  PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12
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 traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III  PROJECTION OF SOLIDS 5+12
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV  PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5+12
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

UNIT V  ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12
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 - Perspective projection of simple solids- Prisms, pyramids and cylinders by visual ray method.

TOTAL: 90 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
- familiarize with the fundamentals and standards of Engineering graphics
- perform freehand sketching of basic geometrical constructions and multiple views of objects.
- project orthographic projections of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- visualize and to project isometric and perspective sections of simple solids.

TEXT BOOKS:

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.

GE8161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY L T P C

OBJECTIVES:
- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

LIST OF PROGRAMS
1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton’s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

PLATFORM NEEDED
Python 3 interpreter for Windows/Linux

OUTCOMES:
Upon completion of the course, students will be able to
- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

TOTAL :60 PERIODS
OBJECTIVES:

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

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young’s modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser
(b) Determination of acceptance angle in an optical fiber.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

apply principles of elasticity, optics and thermal properties for engineering applications.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

OBJECTIVES:

To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.

To acquaint the students with the determination of molecular weight of a polymer by viscometry.

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

OUTCOMES:

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

TOTAL: 30 PERIODS

TEXTBOOKS:

OBJECTIVES:
The Course prepares second semester Engineering and Technology students to:
• Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
• Foster their ability to write convincing job applications and effective reports.
• Develop their speaking skills to make technical presentations, participate in group discussions.
• Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialisation.

UNIT I  INTRODUCTION TECHNICAL ENGLISH  12

UNIT II  READING AND STUDY SKILLS  12
Listening- Listening to longer technical talks and completing exercises based on them-Speaking – describing a process-Reading – reading longer technical texts- identifying the various transitions in a text- paragraphing- Writing- interpreting charts, graphs- Vocabulary Development-vocabulary used in formal letters/emails and reports Language Development- impersonal passive voice, numerical adjectives.

UNIT III  TECHNICAL WRITING AND GRAMMAR  12
Listening- Listening to classroom lectures/ talks on engineering/technology -Speaking – introduction to technical presentations- Reading – longer texts both general and technical, practice in speed reading; Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words. Language Development- embedded sentences

UNIT IV  REPORT WRITING  12

UNIT V  GROUP DISCUSSION AND JOB APPLICATIONS  12
Listening- TED/Ink talks; Speaking –participating in a group discussion -Reading– reading and understanding technical articles Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- verbal analogies Language Development- reported speech

OUTCOMES: At the end of the course learners will be able to:
• Read technical texts and write area- specific texts effortlessly.
• Listen and comprehend lectures and talks in their area of specialisation successfully.
• Speak appropriately and effectively in varied formal and informal contexts.
• Write reports and winning job applications.
TEXT BOOKS:

REFERENCES

Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading.

MA8251 ENGINEERING MATHEMATICS – II L T P C

OBJECTIVES:
This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

UNIT I MATRICES

UNIT II VECTOR CALCULUS
Gradient and directional derivative – Divergence and curl - Vector identities – 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 FUNCTIONS
Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c$, $cz^n$, $\frac{1}{z}$, $z^2$ - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION

UNIT V LAPLACE TRANSFORMS

TOTAL: 60 PERIODS
OUTCOMES:
After successfully completing the course, the student will have a good understanding of the following topics and their applications:

- Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
- Gradient, divergence and curl of a vector point function and related identities.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green’s theorems and their verification.
- Analytic functions, conformal mapping and complex integration.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

TEXT BOOKS:

REFERENCES:

MATERIALS SCIENCE
(Common to courses offered in Faculty of Mechanical Engineering Except B.E. Materials Science and Engineering )

PH8251

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

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
UNIT III  MECHANICAL PROPERTIES


UNIT IV  MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS


UNIT V  NEW MATERIALS


TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course,

- the students will have knowledge on the various phase diagrams and their applications
- the students will acquire knowledge on Fe-Fe₃C phase diagram, various microstructures and alloys
- the students will get knowledge on mechanical properties of materials and their measurement
- the students will gain knowledge on magnetic, dielectric and superconducting properties of materials
- the students will understand the basics of ceramics, composites and nanomaterials.

TEXT BOOKS:

REFERENCES
UNIT I  ELECTRICAL CIRCUITS  9

UNIT II  AC CIRCUITS  9
Introduction to AC circuits – waveforms and RMS value – power and power factor, single phase and three-phase balanced circuits – Three phase loads - housing wiring, industrial wiring, materials of wiring

UNIT III  ELECTRICAL MACHINES  9
Principles of operation and characteristics of DC machines, Transformers (single and three phase) , Synchronous machines, three phase and single phase induction motors.

UNIT IV  ELECTRONIC DEVICES & CIRCUITS  9

UNIT V  MEASUREMENTS & INSTRUMENTATION  9
Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect and Mechanical - Classification of instruments - Types of indicating Instruments - multimeters –Oscilloscopes- – three-phase power measurements– instrument transformers (CT and PT)

TOTAL : 45 PERIODS

OUTCOMES:
Ability to
- Understand electric circuits and working principles of electrical machines
- Understand the concepts of various electronic devices
- Choose appropriate instruments for electrical measurement for a specific application

TEXT BOOKS

REFERENCES
OBJECTIVES:
- To study the nature and facts about environment.
- To finding and implementing 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 14
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 – biogeographical 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 a 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 8
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 – solid 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 10
Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7
From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT


TOTAL: 45 PERIODS

OUTCOMES:

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS:

REFERENCES:

GE8292 ENGINEERING MECHANICS 3 2 0 4

OBJECTIVES:

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

UNIT I STATICS OF PARTICLES 9+6

UNIT II EQUILIBRIUM OF RIGID BODIES 9+6
Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon’s theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions
UNIT III PROPERTIES OF SURFACES AND SOLIDS 9+6

UNIT IV DYNAMICS OF PARTICLES 9+6

UNIT V FRICTION AND RIGID BODY DYNAMICS 9+6
Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TOTAL : 45+30=75 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
- illustrate the vectorial and scalar representation of forces and moments
- analyse the rigid body in equilibrium
- evaluate the properties of surfaces and solids
- calculate dynamic forces exerted in rigid body
- determine the friction and the effects by the laws of friction

REFERENCES:
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 & MECHANICAL)

I  CIVIL ENGINEERING PRACTICE  13

Buildings:
(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:
(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
   (c) Preparation of plumbing line sketches for water supply and sewage works.
   (d) Hands-on-exercise:
      Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
   
   (e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:
(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
   Wood work, joints by sawing, planing and cutting.

II  MECHANICAL ENGINEERING PRACTICE  18

Welding:
(a) Preparation of butt joints, lap joints and T-joints by Shielded metal arc welding.
(b) Gas welding practice

Basic Machining:
(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:
(a) Forming & Bending:
(b) Model making – Trays and funnels.
(c) Different type of joints.

Machine assembly practice:
(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:
(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and V– fitting models.
GROUP B (ELECTRICAL & ELECTRONICS)

III  ELECTRICAL ENGINEERING PRACTICE  13
1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
5. Measurement of energy using single phase energy meter.

IV  ELECTRONICS ENGINEERING PRACTICE  16
1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
- fabricate carpentry components and pipe connections including plumbing works.
- use welding equipments to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundary and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL
1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. 15 Sets.
2. Carpentry vice (fitted to work bench) 15 Nos.
4. Models of industrial trusses, door joints, furniture joints 5 each
5. Power Tools: (a) Rotary Hammer 2 Nos
   (b) Demolition Hammer 2 Nos
   (c) Circular Saw 2 Nos
   (d) Planer 2 Nos
   (e) Hand Drilling Machine 2 Nos
   (f) Jigsaw 2 Nos

MECHANICAL
1. Arc welding transformer with cables and holders 5 Nos.
2. Welding booth with exhaust facility 5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc. 5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit. 2 Nos.
5. Centre lathe 2 Nos.
6. Hearth furnace, anvil and smithy tools 2 Sets.
7. Moulding table, foundry tools 2 Sets.
9. Study-purpose items: centrifugal pump, air-conditioner One each.

**ELECTRICAL**

1. Assorted electrical components for house wiring 15 Sets
2. Electrical measuring instruments 10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp 1 each
4. Megger (250V/500V) 1 No.
5. Power Tools: (a) Range Finder 2 Nos  
   (b) Digital Live-wire detector 2 Nos

**ELECTRONICS**

1. Soldering guns 10 Nos.
2. Assorted electronic components for making circuits 50 Nos.
3. Small PCBs 10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply

**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 generator
2. Load test on Single phase Transformer
3. Load test on Induction motor
4. Verification of Circuit Laws
5. Verification of Circuit Theorems
6. Measurement of three phase power
7. Load test on DC shunt motor.
8. Diode based application circuits
9. Transistor based application circuits
10. Study of CRO and measurement of AC signals
11. Characteristics of LVDT
12. Calibration of Rotometer
13. RTD and Thermistor

Minimum of 10 Experiments to be carried out :-

**TOTAL:** 60 PERIODS

**OUTCOMES:**
- Ability to determine the speed characteristic of different electrical machines
- Ability to design simple circuits involving diodes and transistors
- Ability to use operational amplifiers
LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

<table>
<thead>
<tr>
<th>S.No.</th>
<th>NAME OF THE EQUIPMENT</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>D. C. Motor Generator Set</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>D.C. Shunt Motor</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Single Phase Transformer</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Single Phase Induction Motor</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Ammeter A.C and D.C</td>
<td>20</td>
</tr>
<tr>
<td>6</td>
<td>Voltmeters A.C and D.C</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>Watt meters LPF and UPF</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Resistors &amp; Breadboards</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>Cathode Ray Oscilloscopes</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>Dual Regulated power supplies</td>
<td>6</td>
</tr>
<tr>
<td>11</td>
<td>A.C. Signal Generators</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>Transistors (BJT, JFET)</td>
<td>-</td>
</tr>
</tbody>
</table>

MA8353 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C 4 0 0 4

OBJECTIVES:
- To introduce the basic concepts of PDE for solving standard partial differential equations.
- 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 series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12
Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange’s linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 12

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12
Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

UNIT IV FOURIER TRANSFORMS 12
UNIT V  Z - TRANSFORMS AND DIFFERENCE EQUATIONS


TOTAL : 60 PERIODS

OUTCOMES:
Upon successful completion of the course, students should be able to:

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS :

REFERENCES :

ME8392 MANUFACTURING TECHNOLOGY

OBJECTIVE:
- The automobile components such as piston, connecting rod, crankshaft, engine block, front axle, frame, body etc., are manufactured by various types of production processes involving casting, welding, machining, metal forming, power metallurgy etc. Hence B.E. Automobile Engineering students must study this course Production Technology.

UNIT I CASTING
Casting types, procedure to make sand mould, types of core making, moulding tools, machine moulding, special moulding processes – CO2 moulding; shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting, casting defects.
UNIT II WELDING

UNIT III MACHINING
General principles (with schematic diagrams only) of working and commonly performed operations in the following machines: Lathe, Shaper, Planer, Horizontal milling machine, Universal drilling machine, Cylindrical grinding machine, Capstan and Turret lathe. Basics of CNC machines. General principles and applications of the following processes: Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining, Electron beam machining and Laser beam machining.

UNIT IV FORMING AND SHAPING OF PLASTICS

UNIT V METAL FORMING AND POWDER METALLURGY
Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning, Powder metallurgy – Principal steps involved advantages, disadvantages and limitations of powder metallurgy.

TOTAL: 45 PERIODS

OUTCOME:
- The Students can able to use different manufacturing process and use this in industry for component production

REFERENCES

AE8301 AERO ENGINEERING THERMODYNAMICS

OBJECTIVES:
- Aero Thermodynamics study includes quantitative analysis of machine and processes for transformation of energy and between work and heat.
- Laws of thermodynamics would be able to quantify through measurement of related properties, to these energies and their interactions.
- To develop basic concept of air cycle, gas turbine engines and heat transfer.
UNIT I  FUNDAMENTAL CONCEPT AND FIRST LAW  9
Concept of continuum, macroscopic approach, thermodynamic systems – closed, open and isolated. Property, state, path and process, quasi-static process, work, internal energy, enthalpy, specific heat capacities and heat transfer, SFEE, application of SFEE to jet engine components, First law of thermodynamics, relation between pressure, volume and temperature for various processes, Zeroth law of thermodynamics.

UNIT II  SECOND LAW AND ENTROPY  9

UNIT III  AIR STANDARD CYCLES  8
Otto, Diesel, Dual, Ericsson, Atkinson, Stirling and Brayton cycles - air standard efficiency - mean effective pressure.

UNIT IV  FUNDAMENTALS OF VAPOUR POWER CYCLES  9
Properties of pure substances – solid, liquid and vapour phases, phase rule, p-v, p-T, T-v, T-s, h-s diagrams, p-v-T surfaces, thermodynamic properties of steam - calculations of work done and heat transfer in non-flow and flow processes - standard Rankine cycle, Reheat and Regeneration cycle. Heat rate, Specific steam consumption, Tonne of refrigeration.

UNIT V  BASICS OF PROPULSION AND HEAT TRANSFER  10
Classification of jet engines - basic jet propulsion arrangement – Engine station number, thrust equation – Specific thrust, SFC, TSFC, specific impulse, actual cycles, isentropic efficiencies of jet engine components, polytropic efficiency, conduction in parallel, radial and composite wall, basics of convective and radiation heat transfer.

TOTAL: 45 PERIODS

OUTCOMES
- Able to relate laws of thermodynamics to jet engine components.
- Understands principle operation of piston engine and jet engines.
- Able to identify efficient cycle of air and jet engines.
- Capable to illustrate condition of working medium.
- Eligible to recognize and calculate heat transfer in complex systems involving several heat transfer mechanisms.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
- The properties of fluids and concept of control volume are studied
- The applications of the conservation laws to flow through pipes are studied.
- To understand the importance of dimensional analysis
- To understand the importance of various types of flow in pumps.
- To understand the importance of various types of flow in turbines.

UNIT I  FLUID PROPERTIES AND FLOW CHARACTERISTICS  12
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  12

UNIT III  DIMENSIONAL ANALYSIS  12
Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.

UNIT IV  PUMPS  12

UNIT V  TURBINES  12

TOTAL: 60 PERIODS

OUTCOMES:
Upon completion of this course, the students will be able to
- Apply mathematical knowledge to predict the properties and characteristics of a fluid.
- Can analyse and calculate major and minor losses associated with pipe flow in piping networks.
- Can mathematically predict the nature of physical quantities
- Can critically analyse the performance of pumps
- Can critically analyse the performance of turbines.

TEXT BOOK:
OBJECTIVES:

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the stresses and deformations induced in thin and thick shells.

UNIT I  STRESS, STRAIN AND DEFORMATION OF SOLIDS  9

UNIT II  TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM  9

UNIT III  TORSION  9
Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts – Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

UNIT IV  DEFLECTION OF BEAMS  9
Double Integration method – Macaulay’s method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell’s reciprocal theorems.

UNIT V  THIN CYLINDERS, SPHERES AND THICK CYLINDERS  9
Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame’s theorem.

TOTAL: 45 Periods

OUTCOMES:
Students will be able to

- Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.
- Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
- Apply basic equation of simple torsion in designing of shafts and helical spring
- Calculate the slope and deflection in beams using different methods.
- Analyze and design thin and thick shells for the applied internal and external pressures.

TEXT BOOKS:
REFERENCES:

AE8302 ELEMENTS OF AERONAUTICAL ENGINEERING L T P C
3 0 0 3

OBJECTIVES:
- Understand the Historical evaluation of Airplanes
- Study the different component systems and functions
- Understand the basic properties and principles behind the flight
- Study the different structures & construction
- Study the various types of power plants used in aircrafts

UNIT I HISTORY OF FLIGHT
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
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

UNIT IV BASICS OF PROPULSION
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

TOTAL : 45 PERIODS

OUTCOMES:
- Learn the history of aircraft & developments over the years
- Ability to identify the types & classifications of components and control systems
- Understand the basic concepts of flight & Physical properties of Atmosphere
- An ability to differentiate the types of fuselage and constructions.
- Different types of Engines and principles of Rocket
TEXT BOOKS

REFERENCE

CE8381 STRENGTH OF MATERIALS AND FLUID MECHANICS & MACHINERY LABORATORY

OBJECTIVES:
- To study the mechanical properties of materials when subjected to different types of loading.
- To verify the principles studied in Fluid Mechanics theory by performing experiments in lab.

STRENGTH OF MATERIALS

LIST OF EXPERIMENTS
1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminum rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
10. Tempering- Improvement Mechanical properties Comparison
    (i) Unhardened specimen
    (ii) Quenched Specimen and
    (iii) Quenched and tempered specimen.
11. Microscopic Examination of
    (i) Hardened samples and
    (ii) Hardened and tempered samples.

OUTCOME:
- Ability to perform Tension, Torsion, Hardness, Compression, and Deformation test on Solid materials.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>NAME OF THE EQUIPMENT</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Universal Tensile Testing machine with double 1 shear attachment – 40 Ton Capacity</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Torsion Testing Machine (60 NM Capacity)</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Impact Testing Machine (300 J Capacity)</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Brinell Hardness Testing Machine</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Rockwell Hardness Testing Machine</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Spring Testing Machine for tensile and compressive loads (2500 N)</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Metallurgical Microscopes</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>Muffle Furnace (800 C)</td>
<td>1</td>
</tr>
</tbody>
</table>
FLUID MECHANICS AND MACHINES LABORATORY

LIST OF EXPERIMENTS
1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump / submergible pump
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

TOTAL: 60 PERIODS

OUTCOMES:
Upon completion of this course, the students will be able to:
- Perform Tension, Torsion, Hardness, Compression, and Deformation test on Solid materials.
- Use the measurement equipments for flow measurement.
- Perform test on different fluid machinery.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>NAME OF THE EQUIPMENT</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Orifice meter setup</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Venturi meter setup</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Rotameter setup</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Pipe Flow analysis setup</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Centrifugal pump/submergible pump setup</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Reciprocating pump setup</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Gear pump setup</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Pelton wheel setup</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Francis turbine setup</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Kaplan turbine setup</td>
<td>1</td>
</tr>
</tbody>
</table>

AE8311 THERMODYNAMICS LABORATORY

LIST OF EXPERIMENTS
1. Performance test on a 4-stroke engine
2. Valve timing of a 4 – stroke engine and port timing of a 2 stroke engine
3. Determination of effectiveness of a parallel flow heat exchanger
4. Determination of effectiveness of a counter flow heat exchanger
5. Determination of heating value of a fuel
6. Determination of specific heat of solid
7. Determination of thermal conductivity of solid.
8. Determination of thermal resistance of a composite wall.
9. COP test on a vapour compression refrigeration test rig
10. COP test on a vapour compression air-conditioning test rig

TOTAL: 60 PERIODS
OUTCOMES:

- Ability to perform test on diesel/petrol engine
- Ability to explain the characteristics of the diesel/Petrol engine
- Ability to determine the properties of the fuels.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Details of Equipments</th>
<th>Qty Req</th>
<th>Experiment No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>4 stroke twin cylinder diesel engine</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>Cut section model of 4 stroke diesel engine and cut section model of 2 stroke petrol engine</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>Parallel and counter flow heat exchanger test rig</td>
<td>1</td>
<td>3,4</td>
</tr>
<tr>
<td>4.</td>
<td>Bomb Calorimeter</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>5.</td>
<td>Vapour compression refrigeration test rig</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>6.</td>
<td>Vapour compression air-conditioning test rig</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>7.</td>
<td>Conductive heat transfer set up</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>8.</td>
<td>Composite wall</td>
<td>1</td>
<td>8</td>
</tr>
</tbody>
</table>

HS8381 INTERPERSONAL SKILLS/LISTENING & SPEAKING

OBJECTIVES:
The Course will enable learners to:
- Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities.
- Improve general and academic listening skills
- Make effective presentations.

UNIT I
Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.

UNIT II
Listen to a process information- give information, as part of a simple explanation - conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.

UNIT III
Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist- listen for detail

UNIT IV
Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures conversational speech listening to and participating in conversations - persuade.
UNIT V
Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.

TOTAL: 30 PERIODS

OUTCOMES: At the end of the course Learners will be able to:
- Listen and respond appropriately.
- Participate in group discussions
- Make effective presentations
- Participate confidently and appropriately in conversations both formal and informal

TEXT BOOKS:

REFERENCES

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

UNIT II INTERPOLATION AND APPROXIMATION 12
Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines - Difference operators and relations - Interpolation with equal intervals - Newton's forward and backward difference formulae.
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 second order 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 successful completion of the course, students should be able to:

• Understand the basic concepts and techniques of solving algebraic and transcendental equations.
• Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.
• Apply the numerical techniques of differentiation and integration for engineering problems.
• Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
• Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXT BOOKS :

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

UNIT I    INTRODUCTION TO LOW SPEED FLOW  
Euler equation, incompressible bernoulli’s equation, circulation and vorticity, green’s lemma and stoke’s theorem, barotropic flow, kelvin’s theorem, streamline, stream function, irrotational flow, potential function, equipotential lines, elementary flows and their combinations.

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  
Cauchy-riemann relations, complex potential, methodology of conformal transformation, kutta-joukowski transformation and its applications, thin airfoil theory and its applications.

UNIT IV    SUBSONIC WING THEORY  
Vortex filament, biot and savart law, bound vortex and trailing vortex, horse shoe vortex, lifting line theory and its limitations.

UNIT V    INTRODUCTION TO BOUNDARY LAYER THEORY  
Boundary layer and boundary layer thickness, displacement thickness, momentum thickness, energy thickness, shape parameter, boundary layer equations for a steady, two dimensional incompressible flow, boundary layer growth over a flat plate, critical reynolds number, blasius solution, basics of turbulent flow.

TOTAL: 45 PERIODS

OUTCOMES
- An ability to apply airfoil theory to predict airfoil performance
- Analyze and optimize wing performance
- A knowledge of incompressible flow
- A knowledge of subsonic wing theory
- Apply propeller theory to predict blade performance
- An exposure to Boundary layer theory

REFERENCES:
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

UNIT II  AIRPLANE CONTROL SYSTEMS

UNIT III  ENGINE SYSTEMS
Piston and Jet Engines- Fuel systems – Components - Multi-engine fuel systems, lubricating systems – Starting and Ignition systems.

UNIT IV  AIRCONDITIONING AND PRESSURIZING SYSTEM

UNIT V  AIRCRAFT INSTRUMENTS

TOTAL: 45 PERIODS

OUTCOMES:
- Compare the features of various flight control systems.
- Describe the principle and working of different aircraft systems.
- Analyze the performance of various aircraft engine systems.
- Acquire and interpret data from various aircraft instruments.
- Identify the various cockpit controls.

TEXT BOOKS

REFERENCES
OBJECTIVES:
- To understand the principles in the formation of mechanisms and their kinematics.
- To understand the effect of friction in different machine elements.
- To understand the importance of balancing and vibration.

UNIT I KINEMATICS OF MACHINES

UNIT II GEAR AND GEAR TRAINS

UNIT III FRICTION
Types of friction – Friction Drives -friction in screw threads – bearings – Friction clutches – Belt drives

UNIT IV BALANCING and MECHANISM FOR CONTROL
Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines -Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines- Governors and Gyroscopic effects.

UNIT V VIBRATION

TOTAL: 45 PERIODS

OUTCOMES:
Student will be able to
- Understand the principles in the formation of mechanisms and their kinematics.
- Understand the construction features of Gears and Gear Trains.
- Understand the effect of friction in different machine elements.
- Understand the importance of balancing.
- Understand the importance of Governors and Gyroscopic effects.
- Understand the importance of vibration.

TEXT BOOKS:
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  STATICALLY DETERMINATE & INDETERMINATE STRUCTURES  9+6

UNIT II  ENERGY METHODS  9+6

UNIT III  COLUMNS  9+6
Euler’s column curve – inelastic buckling – effect of initial curvature – Southwell plot – columns with eccentricity – use of energy methods – theory of beam columns – beam columns with different end conditions – stresses in beam columns.

UNIT IV  FAILURE THEORIES  9+6

UNIT V  INDUCED STRESSES  9+6
Thermal stresses – impact loading – Fatigue – Creep - Stress Relaxation

TOTAL :75 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
- Calculate the response of statically indeterminate structures under various loading conditions.
- Calculate the reactions of structures using strain energy concept.
- Create a structure to carry the given load.
- Examine the structural failures using failure theories

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
- To establish fundamental approach and application of jet engine components. Also analysis of flow phenomenon and estimation of thrust developed by jet engine.

UNIT I PRINCIPLES OF AIR BREATHING ENGINES 9+6

UNIT II JET ENGINE INTAKES AND EXHAUST NOZZLES 9+6

UNIT III JET ENGINE COMBUSTION CHAMBERS 9+6

UNIT IV JET ENGINE COMPRESSORS 9+6
Euler’s turbo machinery equation, Principle operation of centrifugal compressor, Principle operation of axial flow compressor– Work done and pressure rise – velocity diagrams – degree of reaction – free vortex and constant reaction designs of axial flow compressor – performance parameters axial flow compressors– stage efficiency

UNIT V JET ENGINE TURBINES 9+6

TOTAL : 75 PERIODS

OUTCOMES:
- To be able to apply control volume and momentum equation to estimate the forces produced by aircraft propulsion systems
- To be able to describe the principal figures of merit for aircraft engine
- To be able to describe the principal design parameters and constraints that set the performance of gas turbine engines.
- To apply ideal and actual cycle analysis to a gas turbine engine to relate thrust and fuel burn to component performance parameters.
- Understanding the workings of multistage compressor or turbine, and to be able to use velocity triangles and the Euler Turbine Equation to estimate the performance of a compressor or turbine stage.

TEXT BOOK:
REFERENCES:

ME8381 COMPUTER AIDED MACHINE DRAWING

OBJECTIVES:
- To make the students understand and interpret drawings of machine components
- To prepare assembly drawings both manually and using standard CAD packages
- To familiarize the students with Indian Standards on drawing practices and standard components
- To gain practical experience in handling 2D drafting and 3D modeling software systems.

UNIT I DRAWING STANDARDS & FITS AND TOLERANCES 12

UNIT II INTRODUCTION TO 2D DRAFTING 16
- Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed drawing.
- Bearings - Bush bearing, Plummer block
- Valves – Safety and non-return valves.

UNIT III 3D GEOMETRIC MODELING AND ASSEMBLY 32
- Couplings – Flange, Universal, Oldham’s, Muff, Gear couplings
- Joints – Knuckle, Gib & cotter, strap, sleeve & cotter joints
- Engine parts – Piston, connecting rod, cross-head (vertical and horizontal), stuffing box, multi-plate clutch
- Miscellaneous machine components – Screw jack, machine vice, tail stock, chuck, vane and gear pump

TOTAL: 60 PERIODS

Note: 25% of assembly drawings must be done manually and remaining 75% of assembly drawings must be done by using any CAD software. The above tasks can be performed manually and using standard commercial 2D / 3D CAD software

OUTCOMES:
Upon the completion of this course the students will be able to
CO1 Follow the drawing standards, Fits and Tolerances
CO2 Re-create part drawings, sectional views and assembly drawings as per standards

TEXT BOOK:
REFERENCES:

AE8411 AERODYNAMICS LABORATORY L T P C
0 0 2 1

OBJECTIVE:
- To predict different aerodynamic propulsion used in aero application

LIST OF EXPERIMENTS
1. Calibration of a subsonic Wind tunnel.
2. Determination of lift for the given airfoil section.
3. Pressure distribution over a smooth circular cylinder.
4. Pressure distribution over a rough circular cylinder.
5. Pressure distribution over a symmetric aerofoil.
6. Pressure distribution over a cambered aerofoil.
7. Force measurement using wind tunnel balancing set up.
8. Flow over a flat plate at different angles of incidence.
10. Flow visualization studies in low speed flows over airfoil with different angle of incidence.

TOTAL: 30 PERIODS

OUTCOMES:
- Describe the fundamental aerodynamic and geometrical properties related to external flows over airfoils, wings, and bluff bodies.
- Calculate the aerodynamic forces and moments experienced by airfoils, wings and bluff bodies.
- Use thin aerofoil theory to evaluate the performance of thin airfoils and the effects of angle of attack and camber.
- Use wind tunnel instrumentation to measure flow velocity and lift and drag.
- Visualize the flow and pressure distribution over 2D and 3D bodies by water flow and smoke methods.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Equipment</th>
<th>Quantity</th>
<th>Experiment No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Subsonic Wind tunnel</td>
<td>1</td>
<td>1,2,4,5,6,7,8,9,10</td>
</tr>
<tr>
<td>2</td>
<td>Models(aerofoil, rough and smooth cylinder, flat plate)</td>
<td>2</td>
<td>5,6,7,8,9,10</td>
</tr>
<tr>
<td>3</td>
<td>Angle of incidence changing mechanism</td>
<td>1 No.</td>
<td>8,10</td>
</tr>
<tr>
<td>4</td>
<td>Multi tube Manometer</td>
<td>1 No.</td>
<td>2,3,4,5,6</td>
</tr>
<tr>
<td>5</td>
<td>Pitot-Static Tubes</td>
<td>1 No.</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Cylinder models (Rough and Smooth)</td>
<td>2 Nos.</td>
<td>3,4</td>
</tr>
<tr>
<td>7</td>
<td>Wind Tunnel balances (3 or 6 components)</td>
<td>1 No.</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>Smoke Generator</td>
<td>1 No.</td>
<td>8,9,10</td>
</tr>
<tr>
<td>9</td>
<td>Water flow channel</td>
<td>1 No.</td>
<td>8,9,10</td>
</tr>
</tbody>
</table>
OBJECTIVE:  
To study the performance of airplanes under various operating conditions and the static and dynamic response of aircraft for both voluntary and involuntary changes in flight conditions.

UNIT I  CRUISING FLIGHT PERFORMANCE  
Forces and moments acting on a flight vehicle - Equation of motion of a rigid flight vehicle - Different types of drag – estimation of parasite drag co-efficient by proper area method - Drag polar of vehicles from low speed to high speeds - Variation of thrust, power with velocity and altitudes for air breathing engines - Performance of airplane in level flight - Power available and power required curves. Maximum speed in level flight - Conditions for minimum drag and power required.

UNIT II  MANOEUVERING FLIGHT PERFORMANCE  
Range and endurance - Climbing and gliding flight (Maximum rate of climb and steepest angle of climb, minimum rate of sink and shallowest angle of glide)  – Takeoff and landing - Turning performance (Turning rate turn radius). Bank angle and load factor – limitations on turn - V-n diagram and load factor.

UNIT III  STATIC LONGITUDINAL STABILITY  
Degree of freedom of rigid bodies in space - Static and dynamic stability - Purpose of controls in airplanes - Inherently stable and marginal stable airplanes – Static, Longitudinal stability - Stick fixed stability - Basic equilibrium equation - Stability criterion - Effects of fuselage and nacelle - Influence of CG location - Power effects - Stick fixed neutral point - Stick free stability-Hinge moment coefficient - Stick free neutral points-Symmetric maneuvers - Stick force gradients - Stick force per ‘g’ - Aerodynamic balancing.

UNIT IV  LATERAL AND DIRECTIONAL STABILITY  
Dihedral effect - Lateral control - Coupling between rolling and yawing moments - Adverse yaw effects - Aileron reversal - Static directional stability - Weather cocking effect - Rudder requirements - One engine inoperative condition - Rudder lock.

UNIT V  DYNAMIC STABILITY  
Introduction to dynamic longitudinal stability: - Modes of stability, effect of freeing the stick - Brief description of lateral and directional. dynamic stability - Spiral, divergence, Dutch roll, auto rotation and spin.

TOTAL : 75 PERIODS

OUTCOMES:
- Know about the forces and moments that are acting on an aircraft, the different types of drag, drag polar, ISA, variation of thrust, power, SFC with velocity and altitude.
- Have understanding about performance in level flight, minimum drag and power required, climbing, gliding and turning flight, V-n diagram and load factor.
- Knowledge about degrees of stability, stick fixed and stick free stability, stability criteria, effect of fuselage and CG location, stick forces, aerodynamic balancing.
- Understanding about lateral control, rolling and yawing moments, static directional stability, rudder and aileron control requirements and rudder lock.
- Understanding about dynamic longitudinal stability, stability derivatives, modes and stability criterion, lateral and directional dynamic stability.

TEXT BOOKS:
REFERENCES:

AE8502 AIRCRAFT STRUCTURES - II

OBJECTIVES:
- To provide the behavior of loads experience of aircraft indigenous components.
- To provide the students adopt with various methods for analysis of aircraft wings and fuselage.
- To provide conception design of major aircraft structural components.
- To provide the better understand the low weight structures.

UNIT I UNSYMMETRICAL BENDING 9+6
Bending of symmetric beams subject to skew loads - bending stresses in beams of unsymmetrical sections – generalized k-method, neutral axis method, principal axis method, Advantages and Disadvantages of three methods.

UNIT II SHEAR FLOW IN OPEN SECTIONS 9+6
Thin walled beams – concept of shear flow – the shear centre and its determination – shear flow distribution in symmetrical and unsymmetrical thin-walled sections – structural idealization – shear flow variation in idealized sections-Applications of shear flow calculations.

UNIT III SHEAR FLOW IN CLOSED SECTIONS 9+6
Bredt - Batho theory – single-cell and multi-cell tubes subject to torsion – shear flow distribution in thin-walled single & multi-cell structures subject to combined bending and torsion – with walls effective and ineffective in bending-Importance of shear flow & shear center determination.

UNIT IV BUCKLING OF PLATES 9+6

UNIT V STRESS ANALYSIS OF WING AND FUSELAGE 9+6
Aircraft loads- classification – the V-n diagram – shear force and bending moment distribution over the aircraft wing and fuselage – shear flow in thin-webbed beams with parallel and non-parallel flanges – complete tension field beams – semi-tension field beam theory.

TOTAL : 75 PERIODS

OUTCOMES
- Ability to understand loads acting an aircraft.
- Ability to identify& resolve the structural design& its limitations .
- Ability to improvise distribution their loads on aircraft member with safer limits.
- Ability to understand the design of low weight to high strength panel member.
- Ability to analyze the aircraft real structural components such as wings and fuselage.

TEXT BOOKS:
REFERENCES:

OBJECTIVES:

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

UNIT I ONE DIMENSIONAL COMPRESSIBLE FLOW
10
Energy, Momentum, continuity and state equations, velocity of sound, adiabatic steady state flow equations, Flow through convergent- divergent passage, Performance under various back pressures.

UNIT II NORMAL AND OBLIQUE SHOCKS
12
Prandtl equation and Rankine – Hugoniot relation, Normal shock equations, Pitot static tube, corrections for subsonic and supersonic flows, Oblique shocks and corresponding equations, Hodograph and pressure turning angle, shock polar, flow past wedges and concave corners, strong, weak and detached shocks,

UNIT III EXPANSION WAVES AND METHOD OF CHARACTERISTICS
8

UNIT IV DIFFERENTIAL EQUATIONS OF MOTION FOR STEADY COMPRESSIBLE FLOWS
7
Small perturbation potential theory, solutions for supersonic flows, Mach waves and Mach angles, Prandtl-Glauert rule - affine transformation relations for subsonic flows, Linearised two dimensional supersonic flow theory - Lift, drag, pitching moment and center of pressure of supersonic profiles.

UNIT V TRANSONIC FLOW OVER WING
8
Lower and upper critical Mach numbers, Lift and drag, divergence, shock induced separation, Characteristics of swept wings, Effects of thickness, camber and aspect ratio of wings, Transonic area rule. Introduction to Hypersonic Aerodynamics.

TOTAL: 45 PERIODS

OUTCOMES:
- Calculate the compressible flow through a duct of varying cross section.
- Use quasi one-dimensional theory to analyze compressible flow problems.
- Estimate fluid properties in Rayleigh and Fanno type flows.
- Estimate the properties across normal and oblique shock waves.
- Predict the properties of hypersonic flows.

TEXT BOOKS:
REFERENCES

AE8504  PROPULSION – II  L T P C
3 0 0 3

OBJECTIVE:
• To impart make students understand theory in non air-breathing and hypersonic propulsion methods to students so that they are familiar with various propulsion technologies associated with space launch vehicles, missiles and space probes.

UNIT I  RAMJET AND SCRAMJET PROPULSION  8

UNIT II  CHEMICAL ROCKET PROPULSION  9

UNIT III  SOLID ROCKET PROPULSION  10

UNIT IV  LIQUID AND HYBRID ROCKET PROPULSION  10

UNIT V  ADVANCED PROPULSION SYSTEMS  8
Electric rocket propulsion– types of electric propulsion techniques - Ion propulsion – Nuclear rocket – comparison of performance of these propulsion systems with chemical rocket propulsion systems – future applications of electric propulsion systems - Solar sail – current scenario of advanced propulsion projects worldwide.

TOTAL: 45 PERIODS

OUTCOMES
• Understanding ramjet and hypersonic air breathing propulsion systems.
• To get familiarity in rocket propulsion systems.
• Knowing the applications and principles of liquid and solid-liquid propulsion systems.
• To gain knowledge about the advanced propulsion technique used for interplanetary mission.
TEXT BOOKS:

REFERENCE:

AE8505       CONTROL ENGINEERING       L   T   P   C
                   3   0   0   3

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

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

UNIT V     SAMPLED DATA SYSTEMS
Z-Transforms Introduction to digital control system, Digital Controllers and Digital PID controllers
TOTAL: 45 PERIODS

OUTCOMES:
- Ability to apply mathematical knowledge to model the systems and analyse the frequency domain
- Ability to check the stability of the both time and frequency domain
- Ability to solve simple pneumatic, hydraulic and thermal systems, Mechanical and electrical component analogies based problems.
- Ability to solve the Block diagram representation of control systems, Reduction of block diagrams, Signal flow graph and problems based on it.
- Ability to understand the digital control system, Digital Controllers and Digital PID Controllers.

TEXT BOOKS:
REFERENCES:

AE8511 AIRCRAFT STRUCTURES LABORATORY

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

LIST OF EXPERIMENTS
1. Deflection of Beams
2. Verification of superposition theorem
3. Verification of Maxwell’s reciprocal theorem
4. Buckling load estimation of slender eccentric columns
5. Determination of flexural rigidity of composite beams
6. Unsymmetrical Bending of a Cantilever Beam
7. Combined bending and Torsion of a Hollow Circular Tube
8. Material Fringe Constant of a Photo elastic Models
9. Shear Centre of a Channel Section
10. Free Vibration of a Cantilever Beam
11. Forced Vibration of a cantilever Beam
12. Fabrication of a Composite Laminate.
15. Tension field beam
Any 10 experiments can be chosen

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.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Equipment</th>
<th>Quantity</th>
<th>Experiment No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100 kN Universal Testing Machine</td>
<td>1</td>
<td>13,14</td>
</tr>
<tr>
<td>2</td>
<td>Beams with weight hangers and dial gauges</td>
<td>6</td>
<td>1,2,3</td>
</tr>
<tr>
<td>3</td>
<td>Column set up with dial gauges</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Photo elasticity set up</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>Vibration set up with accessories</td>
<td>1</td>
<td>10,11</td>
</tr>
<tr>
<td>6</td>
<td>Wagner beam</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>Unsymmetrical bending set up</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>Set up for combined bending and torsion</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>
OBJECTIVES:
- To explore practically components of aircraft piston and gas turbine engines and their working principles.
- To impart practical knowledge of flow phenomenon of subsonic and supersonic jets.
- To determine practically thrust developed by rocket propellants.

LIST OF EXPERIMENTS
1. Study of aircraft piston and gas turbine engines
2. Velocity profiles of free jets.
3. Velocity profiles of wall jets.
4. Wall pressure measurements of a subsonic diffusers and ramjet ducts.
5. Flame stabilization studies using conical and hemispherical flame holders.
6. Cascade testing of compressor blades.
7. Velocity and pressure measurements high speed jets.
8. Wall Pressure measurements of supersonic nozzle.
10. Study experiments

TOTAL: 30 PERIODS

OUTCOMES
- Capable to identify components and information of piston and gas turbine engine.
- Able to analyze behavior of flow through ducts and jet engine components.
- Ability to visualize flow phenomenon in supersonic flow.
- Recognizes performance parameters of rocket propellants.
- To be able to distinguish subsonic and supersonic flow characteristics.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Name of the Equipment</th>
<th>Quantity</th>
<th>Experiment No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jet engine</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Piston engine</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Jet facility with compressor and storage tank</td>
<td>1</td>
<td>2,3, 8, 9, 10</td>
</tr>
<tr>
<td>4</td>
<td>Multitube manometer</td>
<td>3</td>
<td>2, 3, 4, 6, 8, 9</td>
</tr>
<tr>
<td>5</td>
<td>Wind tunnel</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>0-5 bar pressure transducer with pressure indicator OR DSA pressure scanner</td>
<td>8, 1</td>
<td>8, 9</td>
</tr>
<tr>
<td>7</td>
<td>Ramjet facility</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Conical flame holder model</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>Hemispherical flame holder model</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>Water flow channel</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>11</td>
<td>Compressor blade set</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>12</td>
<td>Schlieren or Shadowgraph set up</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>13</td>
<td>Convergent nozzle</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>14</td>
<td>Convergent divergent nozzle</td>
<td>1</td>
<td>7, 8, 9, 10</td>
</tr>
<tr>
<td>15</td>
<td>Thruster with load cells</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>
OBJECTIVES: The course aims to:

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

UNIT I
Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs

UNIT II
Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentations

UNIT III
Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic — questioning and clarifying –GD strategies- activities to improve GD skills

UNIT IV
Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview – FAQs related to job interviews

UNIT V
Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes

TOTAL : 30 PERIODS

OUTCOMES: At the end of the course Learners will be able to:

- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

Recommended Software
1. Globearena
2. Win English

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

UNIT I INTRODUCTION
Review of various approximate methods – variational approach and weighted residual approach-application to structural mechanics problems. finite difference methods- governing equation and convergence criteria of finite element method.

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

UNIT III CONTINUUM ELEMENTS
Plane stress, plane strain and axisymmetric problems. Derivation of element matrices for constant and linear strain triangular elements and axisymmetric element.

UNIT IV ISOPARAMETRIC ELEMENTS
Definitions, Shape function for 4, 8 and 9 nodal quadrilateral elements, stiffness matrix and consistent load vector, evaluation of element matrices using numerical integration.

UNIT V FIELD PROBLEM AND METHODS OF SOLUTIONS
Heat transfer problems, steady state fin problems, derivation of element matrices for two dimensional problems, torsion problems. bandwidth- elimination method and method of factorization for solving simultaneous algebraic equations – Features of software packages, sources of error.

TOTAL (L:45): 45 PERIODS

OUTCOMES:
- Write flow chart of finite element steps and understand the convergence of the problem
- Solve stiffness matrix for bar, beam and frame problems using suitable boundary condition.
- Plane stress and plane strain condition are used to understand 2d structures.
- Modelling of 2d and 3d structures using isoparametric elements
- Apply the concepts of finite element methods to solve fluid flow and heat transfer problems.

TEXT BOOKS:

REFERENCES:
AE8602 EXPERIMENTAL AERODYNAMICS

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.
- Use measurement techniques involved in Aerodynamic testing.
- Analyze the model measurements, Lift and drag measurements through various techniques and testing of different models.
- Apply the Wind tunnel boundary corrections and Scale effects

TEXT BOOKS:

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

UNIT I  MICROMECHANICS  10

UNIT II  MACROMECHANICS  10

UNIT III  LAMINATED PLATE THEORY  10
Governing differential equation for a laminate. stress – strain relations for a laminate. different types of laminates. in plane and flexural constants of a laminate. hygrothermal stresses and strains in a laminate. failure analysis of a laminate. impact resistance and interlaminar stresses. netting analysis

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

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

TOTAL: 45 PERIODS

OUTCOMES
- Understanding the mechanics of composite materials
- Ability to analyse the laminated composites for various loading eases
- Knowledge gained in manufacture of composites.
- Should analyze sandwich and laminated plates
- Should be able to construct and analysis different composite technique

TEXT BOOKS:

REFERENCES:
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 6
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 9

UNIT III POWER PLANT SELECTION 10
Choices available, comparative merits, Location of power plants, Functions dictating the locations.

UNIT IV DESIGN OF WING, FUSELAGE AND EMPHANAGE 10
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 10

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:

REFERENCE:
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
Fundamentals of NDT, Acoustic Emission Technique, Radiography, Thermography, Ultrasonics, Eddy Current testing, Fluorescent Penetrant Testing,

TOTAL: 45 PERIODS

OUTCOMES
- Knowledge of stress and strain measurements in loaded components.
- Acquiring information's the usage of strain gauges and photo elastic techniques of measurement.
- Formulate and solve general three dimensional problems of stress-strain analysis especially fundamental problems of elasticity.
- Analyze the strain gauge data under various loading condition by using gauge rosette method.
- Experimentally evaluate the location and size of defect in solid and composite materials by using various Non-destructive Testing methods.

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
- To introduce the knowledge of the maintenance and repair procedures followed for overhaul of aero engines.

LIST OF EXPERIMENTS
1. Dismantling and reassembling of an aircraft piston engine.
2. Study of Camshaft operation, firing order and magneto, valve timing
3. Study of lubrication and cooling system
4. Study of auxiliary systems, pumps and carburetor
5. Aircraft wood gluing-single & double scarf joints
7. Fabric & Riveted Patch repairs
8. Tube bending and flaring
9. Sheet metal forming
10. Preparation of glass epoxy of composite laminates and specimens.

TOTAL: 60 PERIODS

OUTCOME:
- Ability to maintain and repair the aero engines.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Equipments</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aircraft Piston engines</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Set of basic tools for dismantling and assembly</td>
<td>1 set</td>
</tr>
<tr>
<td>3</td>
<td>NDT equipment</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Micrometers, depth gauges, vernier calipers</td>
<td>2 sets</td>
</tr>
<tr>
<td>5</td>
<td>Valve timing disc</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Shear cutter pedestal type</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Drilling Machine</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Bench Vices</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Radius Bend bars</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Pipe Flaring Tools</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Welding machine</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>Glass fibre, epoxy resin</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>Strain gauges and strain indicator</td>
<td>1</td>
</tr>
</tbody>
</table>

OBJECTIVE:
- To make the students familiarize with computational fluid dynamics and structural analysis software tools. By employing these tools for Aerospace applications students will have an opportunity to expose themselves to simulation software.

LIST OF EXPERIMENTS
1. Grid independence study and convergence test using any simple case like pipe flow, diffuser flow, flow over a cylinder, aero foil etc.
2. Simulation of flow over backward facing step.
3. Simulation of Karman vortex trail (vortex shedding) using circular cylinder.
5. Internal flow simulation of subsonic, sonic and supersonic flow through a CD nozzle.
6. Structural analysis of bar, beam and truss.
7. Structural analysis of tapered wing.
8. Structural analysis of fuselage structure.
OUTCOMES:
- Ability to Mesh various geometries and to do grid independence study.
- Simulate and analyze fluid flow for internal and external flow problems.
- Analyze the basic mechanism of different structural elements behavior.
- Analyze the variation of mechanical properties over a composite beam.
- Analyze the apparent stress distribution over structural component

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Equipments</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Internal server (or) Work station</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Computers</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>Standard Modelling and analysis packages</td>
<td>30 licenses</td>
</tr>
<tr>
<td>4</td>
<td>UPS</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Printer</td>
<td>1</td>
</tr>
</tbody>
</table>

AE8613 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 different types of airplanes

1. Comparative studies of different types of airplanes and their specifications and performance details with reference to the design work under taken.
2. Preliminary weight estimation, Selection of design parameters, power plant selection, aerofoil selection, fixing the geometry of Wing, tail, control surfaces Landing gear selection.
3. Preparation of layout drawing, construction of balance and three view diagrams of the airplane under consideration.

TOTAL : 30 PERIODS

OUTCOME:
- Upon completion of the Aircraft Design Project I students will be in a position to design aircraft and demonstrate the performance of the design.

GE8077 TOTAL QUALITY MANAGEMENT

OBJECTIVE:
- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION

UNIT II TQM PRINCIPLES
Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.
UNIT III  TQM TOOLS AND TECHNIQUES I  9
The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV  TQM TOOLS AND TECHNIQUES II  9
Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V  QUALITY MANAGEMENT SYSTEM  9

TOTAL: 45 PERIODS

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

TEXT BOOK:

REFERENCES:
4. ISO 9001-2015 standards

AE8751  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  9
Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies – Introduction to digital computer and memories.

UNIT II  DIGITAL AVIONICS ARCHITECTURE  9

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

UNIT V  AIR DATA SYSTEMS AND AUTO PILOT  9
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 built Digital avionics architecture
- Ability to Design Navigation system
- Ability to design and perform analysis on air system.
- Integrate avionics systems using data buses.
- Analyze the performance of various cockpit display technologies.
- Design autopilot for small aircrafts using MATLAB

REFERENCES:


ME8093  COMPUTATIONAL FLUID DYNAMICS  9

L  T  P  C
3  0  0  3

OBJECTIVES:

- To introduce Governing Equations of viscous fluid flows
- To introduce numerical modeling and its role in the field of fluid flow and heat transfer
- To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
- To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.

UNIT I  GOVERNING EQUATIONS AND BOUNDARY CONDITIONS  9

UNIT II  FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION  9
UNIT III  FINITE VOLUME METHOD FOR CONVECTION DIFFUSION
Steady one-dimensional convection and diffusion – Central, upwind differencing schemes
properties of discretization schemes – Conservativeness, Boundedness, Transportiveness,
Hybrid, Power-law, QUICK Schemes.

UNIT IV  FLOW FIELD ANALYSIS
Finite volume methods -Representation of the pressure gradient term and continuity
equation – Staggered grid – Momentum equations – Pressure and Velocity corrections –
Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

UNIT V  TURBULENCE MODELS AND MESH GENERATION
Turbulence models, mixing length model, Two equation (k-ε) models – High and low
Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh
refinement – Adaptive mesh – Software tools.

TOTAL: 45 PERIODS

OUTCOMES:
Upon the completion of this course the students will be able to
CO1 Derive the governing equations and boundary conditions for Fluid dynamics
CO2 Analyze Finite difference and Finite volume method for Diffusion
CO3 Analyze Finite volume method for Convective diffusion
CO4 Analyze Flow field problems
CO5 Explain the Turbulence models and Mesh generation techniques

TEXT BOOKS:
2. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics:

REFERENCES:
1. Anil W. Date "Introduction to Computational Fluid Dynamics" Cambridge University Press,
   2005.
   2004

TOTAL: 60 PERIODS

OBJECTIVE:
- To train the students “ON HAND” experience in maintenance of various air frame systems
  in aircraft and rectification of common snags.

LIST OF EXPERIMENTS
1. Aircraft “Jacking Up” procedure
2. Aircraft “Levelling” procedure
3. Control System “Rigging check” procedure
4. Aircraft “Symmetry Check” procedure
5. “Flow test” to assess of filter element clogging
6. “Pressure Test” To assess hydraulic External/Internal Leakage
7. “Functional Test” to adjust operating pressure
8. “Pressure Test” procedure on fuel system components
9. “Brake Torque Load Test” on wheel brake units
10. Maintenance and rectification of snags in hydraulic and fuel systems.
OUTCOME:
- Ability to understand to procedure involved in maintenance of various air frame systems

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

<table>
<thead>
<tr>
<th>S.No</th>
<th>Items</th>
<th>Quantity</th>
<th>Experiment No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Serviceable aircraft with all above systems</td>
<td>1</td>
<td>1,2,3,4,5,6,7,8,9,10</td>
</tr>
<tr>
<td>2.</td>
<td>Hydraulic Jacks (Screw Jack)</td>
<td>5</td>
<td>1,2,4,8</td>
</tr>
<tr>
<td>3.</td>
<td>Trestle adjustable</td>
<td>5</td>
<td>1,2,4,8</td>
</tr>
<tr>
<td>4.</td>
<td>Spirit Level</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>5.</td>
<td>Levelling Boards</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>6.</td>
<td>Cable Tensiometer</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>7.</td>
<td>Adjustable Spirit Level</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>8.</td>
<td>Plumb Bob</td>
<td>1</td>
<td>8</td>
</tr>
</tbody>
</table>

AE8712 FLIGHT INTEGRATION SYSTEMS AND CONTROL LABORATORY

OBJECTIVE:
- This laboratory is to train students, to study about basic digital electronics circuits, various microprocessor applications in Control surface, Displays fault tolerant computers, to study the stability analysis and design using MATLAB.

LIST OF EXPERIMENTS
1. Addition/Subtraction of 8 bit and 16 bit data for control surface deflection.
2. Sorting of Data in Ascending & Descending order for voting mechanism.
3. Sum of a given series with and without carry for identifying flap data.
4. Greatest in a given series & Multi-byte addition in BCD mode.
5. Addition/Subtraction of binary numbers using adder and Subtractor circuits.
6. Multiplexer & Demultiplexer Circuits
7. Encoder and Decoder circuits.
9. Design of lead, lag and lead –lag compensator for aircraft dynamics.

TOTAL: 60 PERIODS

OUTCOMES:
- Ability to understand digital electronics circuits.
- Ability to use microprocessor in Flight control
- Ability to perform stability analysis

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

<table>
<thead>
<tr>
<th>S.No</th>
<th>Details of Equipments</th>
<th>Quantity</th>
<th>Experiment Nos.</th>
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<tbody>
<tr>
<td>1.</td>
<td>Microprocessor 8085 Kit</td>
<td>10</td>
<td>1,2,3,4</td>
</tr>
<tr>
<td>2.</td>
<td>Adder/Subtractor Binary bits Kit</td>
<td>10</td>
<td>5</td>
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<tr>
<td>3.</td>
<td>Encoder Kit</td>
<td>10</td>
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<td>4.</td>
<td>Decoder Kit</td>
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<tr>
<td>5.</td>
<td>Multiplexer Kit</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>6.</td>
<td>Demultiplexer Kit</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>7.</td>
<td>computers</td>
<td>10</td>
<td>8,9,10</td>
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<tr>
<td>8.</td>
<td>Regulated power supply</td>
<td>10</td>
<td>5,6,7</td>
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<tr>
<td>9.</td>
<td>Standard Mathematical analysis software</td>
<td>-</td>
<td>8,9,10</td>
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</table>
OBJECTIVES:
Each group of students is assigned to continue the structural design part of the airplane. The following are the assignments to be carried out.

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

TOTAL: 30 PERIODS

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

AE8811  PROJECT WORK  L T P C  0 0 20 10

OBJECTIVE:
- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

OUTCOME:
- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.
OBJECTIVES:

- This course aims at introducing the students to the basic concepts of engineering design and product development with focus on the front end processes.
- At the end of this course the student is expected to demonstrate an understanding of the overview of all the product development processes and knowledge of concept generation and selection tools.

UNIT I INTRODUCTION

Need for developing products – the importance of engineering design – types of design – the design process – relevance of product lifecycle issues in design – designing to codes and standards- societal considerations in engineering design – generic product development process – various phases of product development-planning for products – establishing markets- market segments- relevance of market research

UNIT II CUSTOMER NEEDS

Identifying customer needs – voice of customer – customer populations- hierarchy of human needs- need gathering methods – affinity diagrams – needs importance- establishing engineering characteristics- competitive benchmarking- quality function deployment- house of quality- product design specification-case studies

UNIT III CREATIVE THINKING


UNIT IV DECISION MAKING AND PRODUCT ARCHITECTURE


UNIT V DESIGN AND COST ANALYSIS


TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
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.
- Estimate the trajectory/orbit of a space vehicle or a satellite in a suitable coordinate system.
- Calculate the delta-v required for transferring a spacecraft from one orbit to another.
- Perform orbit perturbation analysis for satellite orbits.

TEXT BOOKS:

REFERENCE:
OBJECTIVE

To teach the students about the basic concepts of aircraft general engineering and maintenance practices.

UNIT I      AIRCRAFT GROUND HANDLING AND SUPPORT EQUIPMENT  9

UNIT II     GROUND SERVICING OF VARIOUS SUB SYSTEMS  9
Air conditioning and pressurization – Oxygen and oil systems – Ground units and their maintenance.

UNIT III    MAINTENANCE OF SAFETY AND AIRCRAFT SYSTEM PROCESSES  9
Shop safety – Environmental cleanliness – Precautions- Hand tools – Precision instruments – Special tools and equipments in an airplane maintenance shop – Identification terminology

UNIT IV     INSPECTION  9

UNIT V      AIRCRAFT HARDWARE, MATERIALS, SYSTEM PROCESSES  9
Specification and correct use of various aircraft hardware (i.e. nuts, bolts, rivets, screws) – American and British systems of specifications – Threads, gears, bearings, – Drills, tapes and reamers – Identification of all types of fluid line fittings. Materials, metallic and non-metallic Plumbing connectors – Cables – Swaging procedures, tests, Advantages of swaging over splicing.

TOTAL :45 PERIODS

OUTCOMES

- Knowledge in various ground support system for aircraft operations
- Ability to carryout ground servicing of critical aircraft systems
- Knowledge in specifications standards of aircraft hardware systems.
- Grasp the ground handling procedures and types of equipments with special maintenance
- Ability to do shop safety, Environment cleanliness in an aircraft materials shop
- Understand the FAA airworthiness regulations and the checklist involved in each inspection of aircraft

TEXT BOOK


REFERENCES

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
Governing equation in cartesian, cylindrical and spherical coordinates. 1-D steady state heat conduction with and without heat generation. composite wall- electrical analogy – critical thickness of insulation – heat transfer from extended surface – effect of temperature on conductivity- 1-D transient analysis

UNIT II CONVECTION
12

UNIT III RADIATION
9

UNIT IV NUMERICAL METHODS IN HEAT TRANSFER
12

UNIT V HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING
4
Heat transfer problems in gas turbines, rocket thrust chambers- aerodynamic heating – ablative heat transfer

TOTAL: 45 PERIODS

OUTCOMES:
- Understand the difference between various modes of Heat Transfer and the Resistance Concept used in Heat Conduction.
- Learn to use the basic methods in Conduction. Understand the concept of Lump Parameter analysis and when it is applicable and earn the concepts of boundary layer.
- Learn to apply various correlation used in Convective Heat Transfer and Understand the concepts of Black Body, Grey Body, View factor, Radiation shielding.
- Design/size Heat Exchanger and understand the concept of Mass transfer, its types & laws associated with it.
- Learn to apply various technique used for high speed flow heat transfer.

TEXT BOOKS:

REFERENCES:

**OBJECTIVE:**
- To give an idea about IPR, registration and its enforcement.

**UNIT I**  
**INTRODUCTION**  
Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO – TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

**UNIT II**  
**REGISTRATION OF IPRs**  
Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

**UNIT III**  
**AGREEMENTS AND LEGISLATIONS**  

**UNIT IV**  
**DIGITAL PRODUCTS AND LAW**  

**UNIT V**  
**ENFORCEMENT OF IPRs**  
Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

**TOTAL :45 PERIODS**

**OUTCOME:**
- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

**TEXT BOOKS**

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

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

UNIT II GENERAL METHODS OF PREPARATION
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

UNIT IV CHARACTERIZATION TECHNIQUES

UNIT V APPLICATIONS

TOTAL : 45 PERIODS

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

TEXT BOOKS :

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

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

UNIT II  AERODYNAMICS OF ROTOR BLADE
Aerofoil characteristics in forward flight, Hovering and Vortex ring state, Blade stall, maximum lift of the helicopter calculation of Induced Power, High speed limitations; parasite drag, power loading, ground effect.

UNIT III  POWER PLANTS AND FLIGHT PERFORMANCE
Piston engines, Gas turbines, Ramjet principle, Comparative performance, Horsepower required, Range and Endurance, Rate of Climb, Best Climbing speed, Ceiling in vertical climb, Autorotation.

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

UNIT V  ROTOR VIBRATIONS

TOTAL: 45 PERIODS

OUTCOMES:
- To perform the Aerodynamics calculation of Rotor blade
- To perform stability and control characteristics of Helicopter
- To perform and control Rotor vibration
- Apply Momentum and simple blade element theories to helicopter’s rotor blades.
- Analyze the power requirements in forward flight and associated stability problems of helicopter.

TEXT BOOKS:

REFERENCES:
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  PISTON ENGINES  9
- Carburation and Fuel injection systems for small and large engines - Ignition system components - spark plug detail - Engine operating conditions at various altitudes – Engine power measurements – Classification of engine lubricants and fuels – Induction, Exhaust and cooling system - Maintenance and inspection check to be carried out. Inspection and maintenance and trouble shooting - Inspection of all engine components - Daily and routine checks - Overhaul procedures - Compression testing of cylinders - Special inspection schedules - Engine fuel, control and exhaust systems - Engine mount and super charger - Checks and inspection procedures.

UNIT II  PROPELLERS  9
- 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  JET ENGINES  9
- 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 IV  TESTING AND INSPECTION  9

UNIT V  OVERHAULING  9
- 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.

TOTAL:45 PERIODS

OUTCOMES:
- Apply maintenance procedure to Aircraft Engines
- Identify the engine components and faults
- Apply non destructive testing procedures to identify the defects
- Apply overhauling procedure to new engines

TEXT BOOK:

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

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  THE 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
- Prepare preliminary design requirements for an unmanned aerial vehicle.
- Perform system testing for unmanned aerial vehicles.
- Integrate various systems of unmanned aerial vehicle.
- Design micro aerial vehicle systems by considering practical limitations.

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
• To study the types of mechanical behaviour of materials for aircraft applications

UNIT I ELEMENTS OF AEROSPACE MATERIALS

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

UNIT III CORROSION & HEAT TREATMENT OF METALS AND ALLOYS
Types of corrosion – effect of corrosion on mechanical properties – stress corrosion cracking – corrosion resistance materials used for space vehicles heat treatment of carbon steels – aluminium alloys, magnesium alloys and titanium alloys – effect of alloying treatment, heat resistance alloys – tool and die steels, magnetic alloys,

UNIT IV CERAMICS AND COMPOSITES

UNIT V HIGH TEMPERATURE MATERIALS CHARACTERIZATION
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:
• Role of corrosion and heat treatment processes of aircraft materials
• Knowledge in usage of composite materials in aircraft component design.
• Exposure to high temperature materials for space applications
• Provide the necessary mathematical knowledge that are needed in understanding their significance and operation.

TEXT BOOK

REFERENCES
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  10

UNIT II  MULTI DEGREE OF FREEDOM SYSTEMS  10
Two degrees of freedom systems - static and dynamic couplings - vibration absorber- Multi degree of freedom systems - principal co-ordinates - principal modes and orthogonal conditions - Eigen value problems - Hamilton’s principle - Lagrangean equations and application.

UNIT III  CONTINUOUS SYSTEMS  8
Vibration of elastic bodies - vibration of strings – longitudinal, lateral and torsional vibrations

UNIT IV  APPROXIMATE METHODS  9
Approximate methods - Rayleigh’s method - Dunkerley’s method – Rayleigh-Ritz method, matrix iteration method.

UNIT V  ELEMENTS OF AEROELASTICITY  8
Vibration due to coupling of bending and torsion - aeroelastic problems - Collars triangle - wing divergence - aileron control reversal – flutter – buffeting. – elements of servo elasticity

TOTAL: 45 PERIODS

OUTCOMES
- Gaining understanding of single and multi degree vibrating systems
- Ability to use numerical techniques for vibration problems
- Knowledge acquired in aero elasticity and fluttering.
- Differentiate types of vibrations according to dampness and particle motion.
- Solve Rayleigh and Holzer method to find natural frequency of an object.
- Understand the formation of Aileron reversal, flutter and wing divergence.

TEXT BOOKS:

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

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

UNIT II  APPROACHES TO DISASTER RISK REDUCTION (DRR)
Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional 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.

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

TOTAL: 45 PERIODS
TEXT BOOKS:

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

AE8009 AIRFRAME MAINTENANCE AND REPAIR

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 MAINTENANCE OF AIRCRAFT STRUCTURAL COMPONENTS
9
Equipments used in welding shop and their maintenance - Ensuring quality welds - Welding jigs and fixtures - Soldering and brazing – laser welding.
Sheet metal repair and maintenance: Selection of materials; Repair schemes; Fabrication of replacement patches; Tools - power/hand; Repair techniques; Peening - 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
Review of types of plastics used in airplanes - Maintenance and repair of plastic components - Repair of cracks and holes - various repairs schemes - Scopes.
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 - Rain removal system - Position and warning system - Auxiliary Power Units (APUs).

UNIT V SAFETY PRACTICES
8

TOTAL: 45 PERIODS
OUTCOMES:
Students who successfully complete this course will be able to:

- Identify and apply the principles of function and safe operation to aircraft as per FAA
- Understand general airframe structural repairs, the structural repair manual and structural control 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 BOOK:

REFERENCES:

AE8010 FATIGUE AND FRACTURE

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
• Analyze for cumulative damage due to fatigue.
• Analyze for crack initiation & crack growth.
• Analyze damage tolerant structures

TEXT BOOKS:

REFERENCES:

OBJECTIVE:
• To gain insights about the importance of lean manufacturing and six sigma practices.

UNIT I LEAN & SIX SIGMA BACKGROUND AND FUNDAMENTALS
Historical Overview – Definition of quality – What is six sigma - TQM and Six sigma - lean manufacturing and six sigma- six sigma and process tolerance – Six sigma and cultural changes – six sigma capability – six sigma need assessments - implications of quality levels, Cost of Poor Quality (COPQ), Cost of Doing Nothing – assessment questions.

UNIT II THE SCOPE OF TOOLS AND TECHNIQUES

UNIT III SIX SIGMA METHODOLOGIES

UNIT IV SIX SIGMA IMPLEMENTATION AND CHALLENGES
UNIT V EVALUATION AND CONTINUOUS IMPROVEMENT METHODS

Evaluation strategy – the economics of six sigma quality, Return on six Sigma (ROSS), ROI, poor project estimates – continuous improvement – lean manufacturing – value, customer focus, Perfection, focus on waste, overproduction – waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people – Kaizen – 5S.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course student can able to
- Understand the fundamentals of Lean and Six sigma.
- Understand the tools and techniques used in analysis.
- Understand the six sigma methodologies.
- Understand the implementation and challenges in six sigma.
- Understand the evaluation and continuous improvement methods.

REFERENCES:
1. Forrest W. Breifogle, III, James M. Cepello, Becki Meadows, Managing Six Sigma: A Practical
2. Fred Soleimannejad, Six Sigma Basic Steps and Implementation, Author House, 2004
   Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line
   Success, John Wiley & Sons, 2000

ME8097 NON DESTRUCTIVE TESTING AND EVALUATION

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OBJECTIVE:
- To study and understand the various Non Destructive Evaluation and Testing methods, theory and their industrial applications.

UNIT I OVERVIEW OF NDT
NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT., Visual inspection – Unaided and aided.

UNIT II SURFACE NDE METHODS

UNIT III THERMOGRAPHY AND EDDY CURRENT TESTING (ET)
UNIT IV ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE) 9

UNIT V RADIOGRAPHY (RT) 9
Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films - graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

TOTAL : 45 PERIODS

OUTCOMES:
Upon the completion of this course the students will be able to
CO1 Explain the fundamental concepts of NDT
CO2 Discuss the different methods of NDE
CO3 Explain the concept of Thermography and Eddy current testing
CO4 Explain the concept of Ultrasonic Testing and Acoustic Emission
CO5 Explain the concept of Radiography

TEXT BOOKS:

REFERENCES:

GE8072 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 in to 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  9
Global Trends Analysis and Product decision - Social Trends - Technical Trends-
Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to
Product Development Methodologies and Management - Overview of Products and
Services - Types of Product Development - Overview of Product Development methodologies
- Product Life Cycle – Product Development Planning and Management.

UNIT II  REQUIREMENTS AND SYSTEM DESIGN  9
Requirement Engineering - Types of Requirements - Requirement Engineering -
traceability Matrix and Analysis - Requirement Management - System Design & Modeling -
Introduction to System Modeling - System Optimization - System Specification - Sub-System
Design - Interface Design.

UNIT III  DESIGN AND TESTING  9
Conceptualization - Industrial Design and User Interface Design - Introduction to Concept
generation Techniques – Challenges in Integration of Engineering Disciplines - Concept
Screening & Evaluation - Detailed Design - Component Design and Verification –
Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design
of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component
design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and
Rapid Manufacturing - System Integration, Testing, Certification and Documentation

UNIT IV  SUSTAINENCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT  9
Introduction to Product verification processes and stages - Introduction to Product Validation
processes and stages - Product Testing Standards and Certification - Product Documentation
- Sustenance - Maintenance and Repair – Enhancements - Product EoL - Obsolescence
Management – Configuration Management - EoL Disposal

UNIT V  BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY  9
The Industry - Engineering Services Industry - Product Development in Industry versus
Academia –The IPD Essentials - Introduction to Vertical Specific Product Development
processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical,
Embedded and Software Systems – Product Development Trade-offs - Intellectual Property

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:
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford,
2004.

GE8074  HUMAN RIGHTS  

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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:

AE8011  HYPersonic Aerodynamics  

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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  
Boundary layer equations for hypersonic flow – hypersonic boundary layers – self similar and non self similar boundary layers – solution methods for non self similar boundary layers – aerodynamic heating and its adverse effects on airframe.

UNIT IV  VISCOUS INTERACTIONS IN HYPERSONIC FLOWS  
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 BOOK:

REFERENCES:

AE8012  WIND TUNNEL TECHNIQUES  

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

UNIT I  LOW SPEED WIND TUNNELS  
Classification –non-dimensional numbers-types of similarities - Layout of open circuit and closed circuit subsonic wind tunnels – design parameters-energy ratio - HP calculations - Calibration methods.
UNIT II  HIGH SPEED WIND TUNNELS 9
Blow down, in draft and induction tunnel layouts and their design features - Transonic, and supersonic tunnels- peculiar features of these tunnels and operational difficulties - sample design calculations and calibration methods.

UNIT III  SPECIAL WIND TUNNEL TECHNIQUES 8
Types of Special Wind Tunnels – Hypersonic, Gun and Shock Tunnels – Design features and calibration methods- Intake tests – store carriage and separation tests - wind tunnel model design for these tests

UNIT IV  WIND TUNNEL INSTRUMENTATION 10

UNIT V  FLOW VISUALIZATION and NON-INTRUSIVE FLOW DIAGNOSTICS 8
Smoke and Tuft grid techniques – Dye injection special techniques – Oil flow visualization and PSP techniques - Optical methods of flow visualization – PIV and Laser Doppler techniques – Image processing and data deduction

TOTAL: 45 PERIODS

OUTCOMES
Ability to use various techniques of Aerodynamic data generation.
- Understand the working principle of Blow down, In draft tunnels and their specifications
- Knowledge about horizontal buoyancy, flow angularities while carrying out calibration
- Understand the working principle of component axis balance and internal balances
- Ability to carry out the smoke and tuft flow visualisation procedures in WT testing

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

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

AE8013  ROCKETS AND MISSILES  L T P C
3 0 0 3

OBJECTIVE
- To give revelation on basic concepts of rocket motion, rocket aerodynamics, staging & control of rockets, materials and propulsion systems of rockets and missiles to students to augment their knowledge in the region of rockets and missile flight.

UNIT I  CLASSIFICATION OF ROCKETS AND MISSILES 6
History of rockets and missiles, Various methods of classification of missiles and rockets – Basic aerodynamic characteristics of surface to surface, surface to air, air to surface and air to air missiles – Examples of various Indian space launch vehicles and missiles – Current status of Indian rocket and missile programme.
UNIT II ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD

One Dimensional and Two Dimensional rocket Motions in Free Space and Homogeneous Gravitational Fields – description of Vertical, Inclined and Gravity Turn Trajectories – Determination of range and Altitude, Simple Approximations to Burnout Velocity and altitude-estimation of culmination time and altitude.

UNIT III AERODYNAMICS OF ROCKETS AND MISSILES


UNIT IV STAGING AND CONTROL OF ROCKETS AND MISSILES

Multistaging of rockets and ballistic missiles – Multistage Vehicle Optimization – Stage Separation Dynamics – Stage Separation Techniques in atmosphere and in space, Introduction to aerodynamic and jet control methods – various types of aerodynamic control methods for tactical and short range missiles- aerodynamic characteristics - various types of rocket thrust vector control methods.

UNIT V ROCKET PROPULSION SYSTEMS AND MATERIALS FOR ROCKETS AND MISSILES


TOTAL: 45 PERIODS

OUTCOMES:

- To be able to know about the current scenario of rockets and missiles.
- To gain knowledge about the trajectory motion of rockets and missiles.
- Gaining information on aerodynamic characteristics of rockets and missiles.
- To expand the ability to design the staging and control of own rockets.
- Basic knowledge about the propulsion systems and materials used in rockets and missiles.

TEXT BOOKS


REFERENCES


AE8014 STRUCTURAL DYNAMICS

L T P C 3 0 0 3

OBJECTIVE:

- To study the effect of periodic and a periodic forces on mechanical systems with matrix approach and also to get the natural characteristics of large sized problems using approximate methods.
UNIT I FORC E DEFLECTION PROPERTIES OF STRUCTURES

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.

TOTAL: 45 PERIODS

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:

AE8015 INDUSTRIAL AERODYNAMICS

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

UNIT I ATMOSPHERE
Types of winds, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows.
UNIT II  WIND ENERGY COLLECTORS  9
Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory.

UNIT III  VEHICLE AERODYNAMICS  9
Power requirements and drag coefficients of automobiles, Effects of cut back angle, Aerodynamics of trains and Hovercraft.

UNIT IV  BUILDING AERODYNAMICS  9
Pressure distribution on low rise buildings, wind forces on buildings. Environmental winds in city blocks, Special problems of tall buildings, Building codes, Building ventilation and architectural aerodynamics.

UNIT V  FLOW INDUCED VIBRATIONS  9
Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, Galloping and stall flutter.

OUTCOMES
- Use of aerodynamics for non-aerodynamics such as vehicle, building.
- Solve the problems and able to analyse vibrations during flow
- Identify the Atmospheric boundary layer and applications of wind energy collectors.
- Analyze the aerodynamics of road vehicles, buildings and problems of flow induced vibrations.

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

PR8491  COMPUTER INTEGRATED MANUFACTURING  L T P C
                                                              3 0 0 3

OBJECTIVE:
- To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

UNIT I  INTRODUCTION  9

UNIT II  PRODUCTION PLANNING AND CONTROL AND COMPUTER AIDED PROCESS PLANNING  9
UNIT III  CELLULAR MANUFACTURING  9

UNIT IV  FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)  9

UNIT V  INDUSTRIAL ROBOTICS  9

TOTAL : 45 PERIODS

OUTCOMES:
Student will be able to
- Describe about the classical production system, the components of CIM.
- Explain the concept of Computer Aided Process Planning (CAPP) and Material Requirements Planning (MRP)
- Illustrate the cellular manufacturing using Rank order, Clustering and Hollier method
- Explain Flexible Manufacturing system and applications of Automated Guided Vehicles in the implementation of CIM..
- Describe the configurations of Industrial Robots, and their part programming.
- Understand the use of computers in various Manufacturing support systems.

TEXT BOOKS:

REFERENCES:

UNIT I  MEASUREMENT SCIENCE AND DISPLAYS  9
Instrumentation brief review-Concept of measurement-Errors and error estimation- Functional elements of an instrument system – Transducers - classification - Static and dynamic characteristics- calibration - classification of aircraft instruments - Instrument displays panels and cockpit layout.

UNIT II  AIR DATA INSTRUMENTS AND SYNCHRO TRANSMISSION SYSTEMS  9
Air data instruments-airspeed, altitude, Vertical speed indicators. Static Air temperature, Angle of attack measurement, Synchronous data transmission system
UNIT III  GYROSCOPIC INSTRUMENTS  9
Gyroscope and its properties, gyro system, Gyro horizon, Direction gyro-direction indicator, Rate gyro-rate of turn and slip indicator, Turn coordinator, acceleration and turning errors.

UNIT IV  AIRCRAFT COMPASS SYSTEMS & FLIGHT MANAGEMENT SYSTEM  9
Direct reading compass, magnetic heading reference system-detector element, monitored gyroscope system, DGU, RMI, deviation compensator. FMS- Flight planning-flight path optimization-operational modes-4D flight management

UNIT V  POWER PLANT INSTRUMENTS  9
Pressure measurement, temperature measurement, fuel quantity measurement, engine power and control instruments-measurement of RPM, manifold pressure, torque, exhaust gas temperature, EPR, fuel flow, engine vibration, monitoring.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the available basic concepts of Flight instruments to the engineers.
- Understand the necessary knowledge that are needed in significance and operations of Flight instruments.
- The students will also have an exposure to various topics such as measurement concepts, air data sensors and measurements, Flight Management Systems, and other instruments pertaining to Gyroscopic measurements and Engine data measurements
- Student will be able to deploy these skills effectively in understanding and analyzing the instrumentation methods in avionics engineering.

REFERENCES:

AE8017  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  9
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  9
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  9
Equations of equilibrium, Strain - displacement relations, Stress – strain relations, Airy’s stress function, Axi – symmetric problems, Introduction to Dunder’s table, Curved beam analysis, Lame’s, Kirsch, Michell’s and Boussinesque problems – Rotating discs.
UNIT IV TORSION
Navier’s theory, St. Venant’s theory, Prandtl’s theory on torsion, semi-inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections. Membrane Analogy.

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

TOTAL: 45 PERIODS

OUTCOMES
• Ability to use mathematical knowledge to solve problem related to structural elasticity.
• Identify stress-strain relation in 3D, principal stress and principal strain.
• Analyze a structure using Elasticity concepts.
• Use analytical techniques to predict deformation, internal force and failure of simple solids and structural components.
• Solve aerospace-relevant problems in plane strain and plane stress in Cartesian and polar coordinates.

TEXT BOOKS:

REFERENCES:

AE8018 AIR TRAFFIC CONTROL AND PLANNING

OBJECTIVE:
• To study the procedure of the formation of aerodrome and its design and air traffic control.

UNIT I BASIC CONCEPTS
Objectives of air traffic control systems - Parts of ATC services – Scope and Provision of ATCs – VFR & IFR operations – Classification of ATS air spaces – Various kinds of separation – Altimeter setting procedures – Establishment, designation and identification of units providing ATS – Division of responsibility of control.

UNIT II AIR TRAFFIC SYSTEMS
Area control service, assignment of cruising levels - minimum flight altitude - ATS routes and significant points – RNAV and RNP – Vertical, lateral and longitudinal separations based on time / distance –ATC clearances – Flight plans – position report

UNIT III FLIGHT INFORMATION SYSTEMS
UNIT IV AERODROME DATA

UNIT V NAVIGATION AND OTHER SERVICES
Visual aids for navigation Wind direction indicator – Landing direction indicator – Location and characteristics of signal area – Markings, general requirements – Various markings – Lights, general requirements – Aerodrome beacon, identification beacon – Simple approach lighting system and various lighting systems – VASI & PAPI - Visual aids for denoting obstacles; object to be marked and lighter – Emergency and other services.

OUTCOMES:
- Understanding the requirement of air traffic control systems and types of air traffic control system.
- Knowledge in flight information systems and rules of air traffic systems.
- Knowledge indirection indicator systems for air navigation.

REFERENCES

TOTAL : 45 PERIODS

TEXT BOOK

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

UNIT II PLANNING

UNIT III ORGANISING
UNIT IV  DIRECTING

UNIT V  CONTROLLING
System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

TOTAL: 45 PERIODS

OUTCOME:
- Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

TEXT BOOKS:

REFERENCES:

GE8076  PROFESSIONAL ETHICS IN ENGINEERING  L T P C
3 0 0 3

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

UNIT I  HUMAN VALUES

UNIT II  ENGINEERING ETHICS

UNIT III  ENGINEERING AS SOCIAL EXPERIMENTATION
Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.
UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS

UNIT V GLOBAL ISSUES

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

Web sources:
1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org