# B.E. Aeronautical Engineering
## I – VIII Semesters Curriculum and Syllabus

### Semester I

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#### ELECTIVES – III

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### SEMESTER VIII
#### ELECTIVES – IV

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<td>Structural Dynamics</td>
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</table>
OBJECTIVES:
- To enable learners of Engineering and Technology develop their basic communication skills in English.
- To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading and writing leading to effective and efficient communication.

UNIT I
9+3
Listening - Introducing learners to GIE - Types of listening - Listening to audio (verbal & sounds); Speaking - Describing a simple process (filling a form, etc.) - Asking and answering questions - Telephone skills – Telephone etiquette; Reading – Critical reading - Finding key information in a given text - Sifting facts from opinions; Writing - Biographical writing (place, people) - Process descriptions (general/specific) - Definitions - Recommendations – Instructions; Grammar - Use of imperatives - Subject-verb agreement; Vocabulary - Compound words - Word Association (connotation); E-materials - Interactive exercises for Grammar and Vocabulary - Reading comprehension exercises - Listening to audio files and answering questions.

UNIT II
9+3
Listening - Listening and responding to video lectures / talks; Speaking - Role-play – Simulation - Group interaction - Speaking in formal situations (teachers, officials, foreigners); Reading - Reading and interpreting visual material; Writing - Jumbled sentences - Coherence and cohesion in writing - Channel conversion (flowchart into process) - Types of paragraph (cause and effect / compare and contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; Grammar - Tenses (Past) - Use of sequence words - Adjectives; Vocabulary - Different forms and uses of words, Cause and effect words; E-materials - Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

UNIT III
9+3
Listening - Listening to specific task - focused audio tracks; Speaking - Role-play – Simulation - Group interaction - Speaking in formal situations (teachers, officials, foreigners); Reading - Reading and interpreting visual material; Writing - Jumbled sentences - Coherence and cohesion in writing - Channel conversion (flowchart into process) - Types of paragraph (cause and effect / compare and contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; Grammar - Tenses (Past) - Use of sequence words - Adjectives; Vocabulary - Different forms and uses of words, Cause and effect words; E-materials - Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

UNIT IV
9+3
Listening - Watching videos / documentaries and responding to questions based on them; Speaking - Responding to questions - Different forms of interviews - Speaking at different types of interviews; Reading - Making inference from the reading passage - Predicting the content of a reading passage; Writing - Interpreting visual materials (line graphs, pie charts etc.) - Essay writing – Different types of essays; Grammar - Adverbs – Tenses – future time reference; Vocabulary - Single word substitutes - Use of abbreviations and acronyms; E-materials - Interactive exercises for Grammar and Vocabulary - Sample interviews - film scenes - dialogue writing.
UNIT V

Listening - Listening to different accents, Listening to Speeches/Presentations, Listening to broadcast and telecast from Radio and TV; Speaking - Giving impromptu talks, Making presentations on given topics; Reading - Email communication - Reading the attachment files having a poem/joke/proverb - Sending their responses through email; Writing - Creative writing, Poster making; Grammar - Direct and indirect speech; Vocabulary - Lexical items (fixed / semi fixed expressions); E-materials - Interactive exercises for Grammar and Vocabulary - Sending emails with attachment – Audio / video excerpts of different accents - Interpreting posters.

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

OUTCOMES:
Learners should be able to
• speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
• write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
• read different genres of texts adopting various reading strategies.
• listen/view and comprehend different spoken discourses/excerpts in different accents

TEXTBOOKS:

REFERENCES:

EXTENSIVE Reading (Not for Examination)

WEBSITES:

TEACHING METHODS:
• Lectures
• Activities conducted individually, in pairs and in groups like self introduction, peer introduction, group poster making, grammar and vocabulary games, etc.
• Discussions
• Role play activities
• Short presentations
• Listening and viewing activities with follow up activities like discussion, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc.
EVALUATION PATTERN:

**Internal assessment: 20%**
3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like

- Project
- Assignment
- Reviews
- Creative writing
- Poster making, etc.

All the four skills are to be tested with equal weightage given to each.

- Speaking assessment: Individual speaking activities, Pair work activities like role play, Interview, Group discussions
- Reading assessment: Reading passages with comprehension questions graded from simple to complex, from direct to inferential
- Writing assessment: Writing paragraphs, essays etc. Writing should include grammar and vocabulary.
- Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content.

**End Semester Examination: 80%**

<table>
<thead>
<tr>
<th>MA6151</th>
<th>MATHEMATICS – I</th>
<th>L T P C</th>
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**OBJECTIVES:**

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

**UNIT I MATRICES**
9+3

**UNIT II SEQUENCES AND SERIES**
9+3
UNIT III APPLICATIONS OF DIFFERENTIAL CALCULUS 9+3
Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes - Evolute as envelope of normals.

UNIT IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 9+3

UNIT V MULTIPLE INTEGRALS 9+3

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

OUTCOMES:
• This course equips students to have basic knowledge and understanding in one fields of materials, integral and differential calculus.

TEXT BOOKS:

REFERENCES:

PH6151 ENGINEERING PHYSICS – I L T P C 3 0 0 3

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

UNIT I CRYSTAL PHYSICS 9
Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment) - Crystal growth techniques –solution, melt (Bridgman and Czochralski) and vapour growth techniques (qualitative)
UNIT II  PROPERTIES OF MATTER AND THERMAL PHYSICS  
Elasticity- Hooke’s law - Relationship between three modulii of elasticity (qualitative) – stress -strain diagram – Poisson’s ratio –Factors affecting elasticity –Bending moment – Depression of a cantilever –Young’s modulus by uniform bending- I-shaped girders

UNIT III QUANTUM PHYSICS

UNIT IV ACOUSTICS AND ULTRASONICS
Production of ultrasounds by magnetostriction and piezoelectric methods - acoustic grating -Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Medical applications - Sonogram

UNIT V PHOTONICS AND FIBRE OPTICS
Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram) - Active and passive fibre sensors- Endoscope.

TOTAL: 45 PERIODS

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

TEXT BOOKS:
1. Arumugam M. Engineering Physics. Anuradha publishers, 2010

REFERENCES:
1. Searls and Zemansky. University Physics, 2009
5. Rajagopal K. Engineering Physics. PHI, New Delhi, 2011
OBJECTIVES:

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

UNIT I POLYMER CHEMISTRY
Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical, cationic and anionic); condensation and copolymerization. Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Preparation, properties and uses of Nylon 6,6, and Epoxy resin.

UNIT II CHEMICAL THERMODYNAMICS
Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions (problems); Criteria of spontaneity; Gibbs-Helmholtz equation (problems); Clausius-Clapeyron equation; Maxwell relations – Van’t Hoff isotherm and isochore(problems).

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY

UNIT IV PHASE RULE AND ALLOYS

UNIT V NANOCHEMISTRY
Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: nano cluster, nano rod, nanotube(CNT) and nanowire. Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrode position, chemical vapour deposition, laser ablation; Properties and applications

OUTCOMES:

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

REFERENCES:

GE6151 COMPUTER PROGRAMMING L T P C 3 0 0 3

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

UNIT I  INTRODUCTION

UNIT II  C PROGRAMMING BASICS

UNIT III  ARRAYS AND STRINGS

UNIT IV  FUNCTIONS AND POINTERS
UNIT V STRUCTURES AND UNIONS
Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
• Design C Programs for problems.
• Write and execute C programs for simple applications.

TEXTBOOKS:

REFERENCES:

GE6152 ENGINEERING GRAPHICS

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

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES
Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.
UNIT III PROJECTION OF SOLIDS 5+9
Projected solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is
inclined to one of the principal planes by rotating object method and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF
SURFACES 5+9
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of
the principal planes and perpendicular to the other – obtaining true shape of section. Development of
lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of
lateral surfaces of solids with cut-outs and holes

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+9
Principles of isometric projection – isometric scale – Isometric projections of simple solids and
truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple
vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms,
pyramids and cylinders by visual ray method.

COMPUTER AIDED DRAFTING (Demonstration Only) 3
Introduction to drafting packages and demonstration of their use.

TOTAL: 75 PERIODS

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

TEXT BOOK:
   introduction to Interactive Computer Graphics for Design and Production, Eastern Economy
   Company Limited, New Delhi, 2008.

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.

GE6161 COMPUTER PRACTICES LABORATORY

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

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

TOTAL : 45 PERIODS

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

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

Standalone desktops with C compiler 30 Nos.
(or)
Server with C compiler supporting 30 terminals or more.
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

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

Welding:
(a) Preparation of arc welding of butt joints, lap joints and tee joints.
(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, funnels, etc.
(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 vee – fitting models.
III ELECTRICAL ENGINEERING PRACTICE  
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  
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, EOR and NOT.  
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.  
5. Measurement of ripple factor of HWR and FWR.  

TOTAL: 45 PERIODS

OUTCOMES:  
- ability to fabricate carpentry components and pipe connections including plumbing works.  
- ability to use welding equipments to join the structures.  
- ability to fabricate electrical and electronics circuits.  

REFERENCES:  

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.  
3. Standard woodworking tools  
   15 Sets.  
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.
8. Power Tool: Angle Grinder 2 Nos
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

GE6163 PHYSICS AND CHEMISTRY LABORATORY – I

PHYSICS LABORATORY – I

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

LIST OF EXPERIMENTS
(Any FIVE Experiments)
1. (a) Determination of Wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
2. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
3. Determination of wavelength of mercury spectrum – spectrometer grating
5. Determination of Young’s modulus by Non uniform bending method
6. Determination of specific resistance of a given coil of wire – Carey Foster’s Bridge
OUTCOMES:
• The hands on exercises undergone by the students will help them to apply physics principles of optics and thermal physics to evaluate engineering properties of materials.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:
1. Diode laser, lycopodium powder, glass plate, optical fiber.
2. Ultrasonic interferometer
3. Spectrometer, mercury lamp, grating
4. Lee’s Disc experimental set up
5. Traveling microscope, meter scale, knife edge, weights
6. Carey foster’s bridge set up
   (vernier Caliper, Screw gauge, reading lens are required for most of the experiments)

CHEMISTRY LABORATORY- I

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

LIST OF EXPERIMENTS
(Any FIVE Experiments)
1. Determination of DO content of water sample by Winkler’s method.
2. Determination of chloride content of water sample by argentometric method.
3. Determination of strength of given hydrochloric acid using pH meter.
4. Determination of strength of acids in a mixture using conductivity meter.
5. Estimation of iron content of the water sample using spectrophotometer.
   (1,10- phenanthroline / thiocyanate method).
7. 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.

REFERENCES:

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

<table>
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<tr>
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<th>Quantity</th>
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<tbody>
<tr>
<td>Iodine flask</td>
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</tr>
<tr>
<td>pH meter</td>
<td>5 Nos</td>
</tr>
<tr>
<td>Conductivity meter</td>
<td>5 Nos</td>
</tr>
<tr>
<td>Spectrophotometer</td>
<td>5 Nos</td>
</tr>
<tr>
<td>Ostwald Viscometer</td>
<td>10 Nos</td>
</tr>
</tbody>
</table>

Common Apparatus : Pipette, Burette, conical flask, percelain tile, dropper (each 30 Nos.)
OBJECTIVES:

- To make learners acquire listening and speaking skills in both formal and informal contexts.
- To help them develop their reading skills by familiarizing them with different types of reading strategies.
- To equip them with writing skills needed for academic as well as workplace contexts.
- To make them acquire language skills at their own pace by using e-materials and language lab components.

UNIT I
9+3
Listening - Listening to informal conversations and participating; Speaking - Opening a conversation (greetings, comments on topics like weather) - Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); Reading - Developing analytical skills, Deductive and inductive reasoning - Extensive reading; Writing - Effective use of SMS for sending short notes and messages - Using ‘emoticons’ as symbols in email messages; Grammar - Regular and irregular verbs - Active and passive voice; Vocabulary - Homonyms (e.g. ‘can’) - Homophones (e.g. ‘some’, ‘sum’); E-materials - Interactive exercise on Grammar and vocabulary – blogging; Language Lab - Listening to different types of conversation and answering questions.

UNIT II
9+3
Listening - Listening to situation based dialogues; Speaking - Conversation practice in real life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); Reading - Reading a short story or an article from newspaper, Critical reading, Comprehension skills; Writing - Writing a review / summary of a story / article, Personal letter (Inviting your friend to a function, congratulating someone for his / her success, thanking one’s friends / relatives); Grammar - modal verbs, Purpose expressions; Vocabulary - Phrasal verbs and their meanings, Using phrasal verbs in sentences; E-materials - Interactive exercises on Grammar and vocabulary, Extensive reading activity (reading stories / novels), Posting reviews in blogs - Language Lab - Dialogues (Fill up exercises), Recording students’ dialogues.

UNIT III
9+3
Listening - Listening to the conversation - Understanding the structure of conversations; Speaking - Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information – expressing feelings (affection, anger, regret, etc.); Reading - Speed reading – reading passages with time limit - Skimming; Writing - Minutes of meeting – format and practice in the preparation of minutes - Writing summary after reading articles from journals - Format for journal articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices, references) - Writing strategies; Grammar - Conditional clauses - Cause and effect expressions; Vocabulary - Words used as nouns and verbs without any change in the spelling (e.g. ‘rock’, ‘train’, ‘ring’); E-materials - Interactive exercise on Grammar and vocabulary - Speed Reading practice exercises; Language Lab - Intonation practice using EFLU and RIE materials – Attending a meeting and writing minutes.

UNIT IV
9+3
Listening - Listening to a telephone conversation, Viewing model interviews (face-to-face, telephonic and video conferencing); Speaking - Role play practice in telephone skills - listening and responding, -asking questions, -note taking – passing on messages, Role play and mock interview for grasping interview skills; Reading - Reading the job advertisements and the profile of the company concerned – scanning; Writing - Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate; Grammar - Numerical expressions - Connectives (discourse markers); Vocabulary - Idioms and their meanings – using idioms in sentences; E-materials - Interactive exercises on
Grammar and Vocabulary - Different forms of résumés- Filling up a résumé / cover letter; Language Lab - Telephonic interview – recording the responses - e-résumé writing.

UNIT V

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

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

OUTCOMES:
Learners should be able to

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

TEXTBOOKS:

REFERENCES:

EXTENSIVE Reading (Not for Examination)

Websites
2. http://owl.english.purdue.edu
TEACHING METHODS:
- Lectures
- Activities conducted individually, in pairs and in groups like individual writing and presentations, group discussions, interviews, reporting, etc
- Long presentations using visual aids
- Listening and viewing activities with follow up activities like discussions, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc
- Projects like group reports, mock interviews etc using a combination of two or more of the language skills

EVALUATION PATTERN:

Internal assessment: 20%
3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like
- Project
- Assignment
- Report
- Creative writing, etc.

All the four skills are to be tested with equal weightage given to each.
- Speaking assessment: Individual presentations, Group discussions
- Reading assessment: Reading passages with comprehension questions graded following Bloom’s taxonomy
- Writing assessment: Writing essays, CVs, reports etc. Writing should include grammar and vocabulary.
- Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content graded following Bloom’s taxonomy.

End Semester Examination: 80%

MA6251 MATHEMATICS – II

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

UNIT I VECTOR CALCULUS
Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green’s theorem in a plane, Gauss divergence theorem and Stokes’ theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.
UNIT II  ORDINARY DIFFERENTIAL EQUATIONS  9+3
Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy’s and Legendre’s linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT III  LAPLACE TRANSFORM  9+3

UNIT IV  ANALYTIC FUNCTIONS  9+3
Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: \( w = z+k, kz, 1/z, z^2, e^z \) and bilinear transformation.

UNIT V  COMPLEX INTEGRATION  9+3
Complex integration – Statement and applications of Cauchy’s integral theorem and Cauchy’s integral formula – Taylor’s and Laurent’s series expansions – Singular points – Residues – Cauchy’s residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

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

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

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
- To enrich the understanding of various types of materials and their applications in engineering and technology.

UNIT I  CONDUCTING MATERIALS  

UNIT II  SEMICONDUCTING MATERIALS  

UNIT III  MAGNETIC AND SUPERCONDUCTING MATERIALS  
Superconductivity: properties – Type I and Type II superconductors – BCS theory of superconductivity (Qualitative) – High T_c superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT IV  DIELECTRIC MATERIALS  

UNIT V  ADVANCED ENGINEERING MATERIALS  

TOTAL: 45 PERIODS

OUTCOMES:
- The students will have the knowledge on physics of materials and that knowledge will be used by them in different engineering and technology applications.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- Principles of electrochemical reactions, redox reactions in corrosion of materials and methods for corrosion prevention and protection of materials.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.

UNIT I WATER TECHNOLOGY

Introduction to boiler feed water-requirements-formation of deposits in steam boilers and heat exchangers- disadvantages (wastage of fuels, decrease in efficiency, boiler explosion) prevention of scale formation -softening of hard water -external treatment zeolite and demineralization - internal treatment- boiler compounds (phosphate, calgon, carbonate, colloidal) - caustic embrittlement -boiler corrosion-priming and foaming- desalination of brackish water –reverse osmosis.

UNIT II ELECTROCHEMISTRY AND CORROSION


UNIT III ENERGY SOURCES

Introduction- nuclear energy- nuclear fission- controlled nuclear fission- nuclear fusion- differences between nuclear fission and fusion- nuclear chain reactions- nuclear reactor power generator- classification of nuclear reactor- light water reactor- breeder reactor- solar energy conversion- solar cells- wind energy. Batteries and fuel cells:Types of batteries- alkaline battery- lead storage battery- nickel-cadmium battery- lithium battery- fuel cell H₂ -O₂ fuel cell- applications.

UNIT IV ENGINEERING MATERIALS

Abrasives: definition, classification or types, grinding wheel, abrasive paper and cloth. Refractories: definition, characteristics, classification, properties – refractoriness and RUL, dimensional stability, thermal spalling, thermal expansion, porosity; Manufacture of alumina, magnesite and silicon carbide, Portland cement- manufacture and properties - setting and hardening of cement, special cement- waterproof and white cement–properties and uses. Glass - manufacture, types, properties and uses.

UNIT V FUELS AND COMBUSTION


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:

GE6252 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING L T P C
4 0 0 4

OBJECTIVES:
• To explain the basic theorems used in Electrical circuits and the different components and function of electrical machines.
• To explain the fundamentals of semiconductor and applications.
• To explain the principles of digital electronics
• To impart knowledge of communication.

UNIT I ELECTRICAL CIRCUITS & MEASUREMENTS 12
Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

UNIT II ELECTRICAL MECHANICS 12

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 12

UNIT IV DIGITAL ELECTRONICS 12
Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion (single concepts)
UNIT V  FUNDAMENTALS OF COMMUNICATION ENGINEERING  12
Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

TOTAL: 60 PERIODS

OUTCOMES:
• ability to identify the electrical components explain the characteristics of electrical machines.
• ability to identify electronics components and use of them to design circuits.

TEXT BOOKS:

REFERENCES:

GE6253  ENGINEERING MECHANICS  L T P C  3 1 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  BASICS AND STATICs OF PARTICLES  12

UNIT II  EQUILIBRIUM OF RIGID BODIES  12
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  12
UNIT IV  DYNAMICS OF PARTICLES  12
Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - 

bodies.

UNIT V  FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS  12
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 : 60 PERIODS

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

TEXT BOOKS:

REFERENCES:
Pearson Education 2010.
company, New Delhi 2008.

GE6261 COMPUTER AIDED DRAFTING AND MODELING LABORATORY

L T P C  0 1 2 2

OBJECTIVES:
• To develop skill to use software to create 2D and 3D models.

LIST OF EXERCISES USING SOFTWARE CAPABLE OF DRAFTING AND MODELING
1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, 
relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using Bspline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and 
dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V- 
block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc.
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

Note: Plotting of drawings must be made for each exercise and attached to the records written by students.

TOTAL: 45 PERIODS

OUTCOMES:
• ability to use the software packers for drafting and modeling
• ability to create 2D and 3D models of Engineering Components

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Description of Equipment</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Pentium IV computer or better hardware, with suitable graphics facility</td>
<td>30 No.</td>
</tr>
<tr>
<td>2.</td>
<td>Licensed software for Drafting and Modeling.</td>
<td>30 Licenses</td>
</tr>
<tr>
<td>3.</td>
<td>Laser Printer or Plotter to print / plot drawings</td>
<td>2 No.</td>
</tr>
</tbody>
</table>

GE6262 PHYSICS AND CHEMISTRY LABORATORY – II

LIST OF EXPERIMENTS (Any FIVE Experiments)
1. Determination of Young’s modulus by uniform bending method
2. Determination of band gap of a semiconductor
3. Determination of Coefficient of viscosity of a liquid – Poiseuille’s method
4. Determination of Dispersive power of a prism – Spectrometer
5. Determination of thickness of a thin wire – Air wedge method
6. Determination of Rigidity modulus – Torsion pendulum

OUTCOMES:
• The students will have the ability to test materials by using their knowledge of applied physics principles in optics and properties of matter.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:
1. Traveling microscope, meter scale, Knife edge, weights
2. Band gap experimental set up
3. Burette, Capillary tube, rubber tube, stop clock, beaker and weighing balance
4. spectrometer, prism, sodium vapour lamp.
5. Air-wedge experimental set up.
6. Torsion pendulum set up.
   (vernier Caliper, Screw gauge, reading lens are required for most of the experiments)
CHEMISTRY LABORATORY - II

OBJECTIVES:
• To make the student acquire practical skills in the wet chemical and instrumental methods for quantitative estimation of hardness, alkalinity, metal ion content, corrosion in metals and cement analysis.

LIST OF EXPERIMENTS
(Any FIVE Experiments)
1. Determination of alkalinity in water sample
2. Determination of total, temporary & permanent hardness of water by EDTA method
3. Estimation of copper content of the given solution by EDTA method
4. Estimation of iron content of the given solution using potentiometer
5. Estimation of sodium present in water using flame photometer
6. Corrosion experiment – weight loss method
7. Conductometric precipitation titration using BaCl\textsubscript{2} and Na\textsubscript{2}SO\textsubscript{4}

OUTCOMES:
• The students will be conversant with hands-on knowledge in the quantitative chemical analysis of water quality related parameters, corrosion measurement and cement analysis.

REFERENCES:
5. Laboratory classes on alternate weeks for Physics and Chemistry.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:
1. Potentiometer - 5 Nos
2. Flame photo meter - 5 Nos
3. Weighing Balance - 5 Nos
4. Conductivity meter - 5 Nos

Common Apparatus : Pipette, Burette, conical flask, percelain tile, dropper (30 Nos each)
MA6351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C 3 1 0 4

OBJECTIVES
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- 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 9 + 3
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 9 + 3

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9 + 3
Classification of PDE – Method of separation of variables - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

UNIT IV FOURIER TRANSFORMS 9 + 3

UNIT V Z-TRANSFORMS AND DIFFERENCE EQUATIONS 9 + 3

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

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

TEXT BOOKS

REFERENCES
OBJECTIVES

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

TEXT BOOKS

REFERENCES

AE6301     AERO ENGINEERING THERMODYNAMICS     L   T   P  C
                        3 0 0 3

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

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

UNIT II     SECOND LAW AND ENTROPY

UNIT III     THERMODYNAMIC AVAILABILITY AND AIR STANDARD CYCLES
UNIT IV PROPERTIES OF PURE SUBSTANCE AND POWER CYCLE

UNIT V BASICS OF PROPULSION AND HEAT TRANSFER
Classification of jet engines - simple jet propulsion system – thrust equation – specific impulse –ideal and non-ideal cycle analysis - conduction in parallel, radial and composite wall – basics of convective and radiation heat transfer.

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

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

TEXT BOOKS:

REFERENCES:

CE6451 FLUID MECHANICS AND MACHINERY L T P C 3 0 0 3

OBJECTIVES:
• The applications of the conservation laws to flow through pipes and hydraulic machines are studied
• To understand the importance of dimensional analysis.
• To understand the importance of various types of flow in pumps and turbines.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS
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
UNIT III  DIMENSIONAL ANALYSIS
Need for dimensional analysis – methods of dimensional analysis – Similitude – types of similitude - Dimensionless parameters - application of dimensionless parameters – Model analysis.

UNIT IV  PUMPS

UNIT V  TURBINES

TOTAL: 45 PERIODS

OUTCOMES:
• Upon completion of this course, the students can able to apply mathematical knowledge to predict the properties and characteristics of a fluid.
• Can critically analyse the performance of pumps and turbines.

TEXT BOOK:

REFERENCES:

CE6452  SOLID MECHANICS  L  T  P  C
3  0  0  3

OBJECTIVES:
• To introduce various behavior of structural components under various loading conditions.

UNIT I  INTRODUCTION

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

UNIT III  DEFLECTION OF BEAMS
UNIT IV  TORSION – SPRINGS – COLUMNS  10
Torsion of solid and hollow circular shafts – shear stress variation – open and closed-coiled helical
springs – stresses in helical springs – classification of columns – euler buckling – columns with
different end conditions.

UNIT V  BIAXIAL STRESSES  7
Stresses in thin-walled pressure vessels – combined loading of circular shaft with bending, torsion
and axial loadings – Mohr’s circle and its construction – determination of principal stresses.
TOTAL: 45 PERIODS

OUTCOMES
• Solve the problems related to the structural components under various loading conditions.

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

REFERENCES:
   Edition.

AE6302  ELEMENTS OF AERONAUTICS

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

UNIT I  HISTORY OF FLIGHT  8
Balloon flight – ornithopters - early airplanes by wright brothers, biplanes and monoplanes,
developments in aerodynamics, materials, structures and propulsion over the years.

UNIT II  BASICS OF FLIGHT MECHANICS  9
Physical properties and structure of the atmosphere, temperature, pressure and altitude relationships,
newton’s law of motions applied to aeronautics - evolution of lift, drag and moment. aerofoils, mach
number, maneuvers.

UNIT III  AIRCRAFT CONFIGURATIONS  10
Different types of flight vehicles, classifications. components of an airplane and their functions.
conventional control, powered control, basic instruments for flying - typical systems for control
actuation.

UNIT IV  AIRPLANE STRUCTURES AND MATERIALS  9
General types of construction, monocoque, semi-monocoque and geodesic constructions, typical wing
and fuselage structure. metallic and non-metallic materials, use of aluminium alloy, titanium, stainless
steel and composite materials. stresses and strains – hooke’s law – stress - strain diagrams - elastic
constants.
UNIT V  POWER PLANTS
Basic ideas about piston, turboprop and jet engines - use of propeller and jets for thrust production - comparative merits, principles of operation of rocket, types of rockets and typical applications, exploration into space.

TOTAL: 45 Periods

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

TEXT BOOKS:

REFERENCES:

CE6315  STRENGTH OF MATERIALS LABORATORY

L T P C  0 0 3 2

OBJECTIVES
To supplement the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the strength of materials under externally applied loads. This would enable the student to have a clear understanding of the design for strength and stiffness

LIST OF EXPERIMENTS
1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium 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.

TOTAL: 45 Periods

OUTCOMES:
- Ability to perform different destructive testing
- Ability to characteristic materials
LIST OF EQUIPMENT FOR 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>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>

CE6461 FLUID MECHANICS AND MACHINERY LABORATORY

L T P C
0 0 3 2

OBJECTIVES:
Upon Completion of this subject, the students can able to have hands on experience in flow measurements using different devices and also perform calculation related to losses in pipes and also perform characteristic study of pumps, turbines etc.,

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.

OUTCOMES:
- Ability to use the measurement equipments for flow measurement
- Ability to do performance trust on different fluid machinery

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR 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>
</tbody>
</table>
OBJECTIVES

- To enhance the basic knowledge in applied thermodynamics

LIST OF EXPERIMENTS

1. Performance test on a 4-stroke engine
2. Valves 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: 45 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>
OBJECTIVES

- To teach and train the students in the lab about the design and drafting of aero components

LIST OF EXPERIMENTS

1. Design and modeling of rectangular plate with hole.
2. Design and modeling of spar components.
3. Design and modeling of aerofoil sections.
4. Design and modeling of cut section for wings.
5. Design and modeling of machine component.
6. Design and modeling of bulk head.
7. Design and analysis of a truss.
8. Design and analysis of beam distributed load.
9. Facing and Turning (Taper, Step) operations in CNC.
10. Drilling operations in CNC.

TOTAL: 45 PERIODS

OUTCOMES

Ability to design and model difficult aero component and perform structural analysis using available software packages

<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>Computer nodes</td>
<td>30</td>
<td>1 to 8</td>
</tr>
<tr>
<td>2</td>
<td>Modeling Packages</td>
<td>30 licenses</td>
<td>1 to 6</td>
</tr>
<tr>
<td>3</td>
<td>FEA&amp;CAM SOFTWARE</td>
<td>30 licenses</td>
<td>7 &amp; 8</td>
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<tr>
<td>4</td>
<td>UPS</td>
<td>1</td>
<td>1 to 8</td>
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<tr>
<td>5</td>
<td>CNC Machine</td>
<td>1</td>
<td>9,10</td>
</tr>
<tr>
<td>6</td>
<td>Printer</td>
<td>2</td>
<td>All</td>
</tr>
</tbody>
</table>

MA6459

NUMERICAL METHODS

OBJECTIVES

- This course aims at providing the necessary basic concepts of a few numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS


UNIT II INTERPOLATION AND APPROXIMATION

Interpolation with unequal intervals - Lagrange’s interpolation – Newton’s divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton’s forward and backward difference formulae.
UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3
Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson’s 1/3 rule – Romberg’s method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson’s 1/3 rules.

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

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

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

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

TEXT BOOKS

REFERENCES

AE6401 AERODYNAMICS - I

OBJECTIVES:
- To introduce the concepts of mass, momentum and energy conservation relating to aerodynamics.
- To make the student understand the concept of vorticity, irrotationality, theory of airfoils and wing sections.
- 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 air foil perform
- A knowledge of incompressible flow
- An explosive to Boundary layer theory

TEXT BOOKS:

REFERENCES:

AE6402 AIRCRAFT SYSTEMS AND INSTRUMENTS

OBJECTIVES:
- 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 12
Conventional Systems – power assisted and fully powered flight controls – power actuated systems –
engine control systems – push pull rod system – operating principles – modern control systems –
digital fly by wire systems – auto pilot system, active control technology

UNIT III ENGINE SYSTEMS 8
Fuel systems – piston and jet engines – components - multi-engine fuel systems, lubricating systems -
piston and jet engines – starting and ignition systems – piston and jet engines

UNIT IV AIRCONDITIONING AND PRESSURIZING SYSTEM 8
Basic air cycle systems – vapoour cycle systems, boot-strap air cycle system – evaporative vapour
 cycle systems – evaporation air cycle systems – oxygen systems – fire protection systems, deicing
 and anti icing system.

UNIT V AIRCRAFT INSTRUMENTS 9
Flight instruments and navigation instruments – accelerometers, air speed indicators – mach meters –
altimeters - gyroscopic instruments– principles and operation – study of various types of engine
instruments – tachometers – temperature gauges – pressure gauge – operation and principles.

TOTAL: 45 PERIODS

OUTCOMES

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

TEXT BOOKS:

REFERENCES:
   Administration, The English Book Store, New Delhi, 1995

AT6302 MECHANICS OF MACHINES L T P C
3 1 0 4

OBJECTIVES:

- To understand the principles in the formation of mechanisms and their kinematics.
- To understand the effect of friction in different machine elements.
- To analyse the forces and toques acting on simple mechanical systems
- To understand the importance of balancing and vibration.

UNIT I KINEMATIC OF MECHANICS 10
Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain –
kineamatics analysis in simple mechanisms – velocity and acceleration polygons – Analytical methods
– computer approach – cams – classifications – displacement diagrams - layout of plate cam profiles
– derivatives of followers motion – circular arc and tangent cams.
UNIT II GEARS and GEAR TRAINS

UNIT III FRICTION  

UNIT IV FORCE ANALYSIS

UNIT V BALANCING AND VIBRATION

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

OUTCOMES
• Upon completion of this course, the students can able to apply mathematical knowledge to predict the properties and characteristics of a fluid.
• Can critically analyse the performance of pumps and turbines.

TEXT BOOKS

REFERENCES

AE6403 AIRCRAFT STRUCTURES - I

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
### UNIT II ENERGY METHODS

### UNIT III COLUMNS
Euler’s column curve – inelastic buckling – effect of initial curvature – the 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

### UNIT V INDUCED STRESSES
Thermal stresses – impact loading – Fatigue – Creep - Stress Relaxation

<table>
<thead>
<tr>
<th>TOTAL (L:45+T:15): 60 PERIODS</th>
</tr>
</thead>
</table>

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

### TEXT BOOKS:
3. Peery and Azar, "Aircraft Structures"

### REFERENCES:

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### AE6404 PROPULSION - I

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

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

### UNIT I FUNDAMENTALS OF AIR BREATHING ENGINES
UNIT II
INLETS, NOZZLES AND COMBUSTION CHAMBERS FOR JET ENGINES

UNIT III
COMPRESSORS FOR JET ENGINES
Principle of operation of centrifugal compressor and axial flow compressor – Work done and pressure rise – velocity diagrams – degree of reaction – free vortex and constant reaction designs of axial flow compressor – performance characteristics of centrifugal and axial flow compressors– stage efficiency calculations - cascade testing

UNIT IV
TURBINES FOR JET ENGINES

UNIT V
RAMJET PROPULSION

TOTAL: 45 PERIODS

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

TEXT BOOKS:
2. James Award, "Aerospace Propulsion System"

REFERENCES:
OBJECTIVES
- To study the properties of materials used in Aircraft structure.
- To study the failure of different component under different loading condition

LIST OF EXPERIMENTS
1. Determination of young's modulus for metallic materials
2. Determination of flexural strength of metallic materials.
3. Deflection of a simply-supported beam
4. Deflection of a cantilever beam.
5. Verification of superposition theorem
6. Verification of maxwell's reciprocal theorem
7. Influence line study on beams
8. Buckling load estimation of slender eccentric columns
9. Construction of south well plot
10. Study of non-destructive testing procedures
11. Determination of flexural rigidity of composite beams
12. Shear failure of bolted and riveted joints
13. Calibration of proving ring and spring
14. Truss and frame analysis.
(Only 10 experiments will be conducted)

TOTAL: 45 PERIODS

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

<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>1,2,11,12</td>
</tr>
<tr>
<td>2</td>
<td>Beams with weight hangers and dial gauges</td>
<td>6</td>
<td>3,4,5,6,7</td>
</tr>
<tr>
<td>3</td>
<td>Truss model and frame model</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>Column set up with dial gauges</td>
<td>2</td>
<td>8,9</td>
</tr>
</tbody>
</table>

AE6412 AERODYNAMICS LABORATORY

OBJECTIVES
- To predict different aerodynamic propulsion used in aero application

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

TOTAL: 45 PERIODS

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

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>Venturimeter</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Orificemeter</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Pipe friction apparatus</td>
<td>1</td>
<td>2,3</td>
</tr>
<tr>
<td>4</td>
<td>Subsonic Wind tunnel</td>
<td>1</td>
<td>4,5,6,7,8,9,10</td>
</tr>
<tr>
<td>5</td>
<td>Models(aerofoil, rough and smooth cylinder, flat plate)</td>
<td>2</td>
<td>5,6,7,8,9</td>
</tr>
</tbody>
</table>

AE6413 CAD AND AIRCRAFT COMPONENT DRAWING

LIST OF EXERCISES
1. Design and drafting of riveted joints
2. Design and drafting of welded joints.
3. Design and drafting control components cam
4. Design and drafting control components bell crank
5. Design and drafting control components gear
6. Design and drafting control components push-pull rod
7. Three view diagram of a typical aircraft
8. Layout of typical wing structure.
9. Layout of typical fuselage structure.
10. Layout of control system

TOTAL: 60 PERIODS

OUTCOMES
- Ability to design and draw different joints and components using manual drafting method.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Equipments</th>
<th>Quantity</th>
<th>Experiments No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Drawing Boards, Drafting machines</td>
<td>30</td>
<td>1, 5</td>
</tr>
</tbody>
</table>
OBJECTIVES

- 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  9
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 attitudes 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  10
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) - 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  10
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  8
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  8
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 (L:45+T:15): 60 PERIODS

OUTCOMES

- Ability to analyse the performance of aircraft under various Flight conditions such as take off, cruise, landing, climbing, gliding, turning and other maneuvers.

TEXT BOOK

REFERENCES
OBJECTIVES:
- To provide the students various methods for analysis of aircraft wings and fuselage.
- To provide the the behavior of major aircraft structural components.

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

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

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

UNIT IV  BUCKLING OF PLATES

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

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

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

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  FUNDAMENTAL ASPECTS OF COMPRESSIBLE FLOW  9
Compressibility, continuity, momentum and energy equations for steady one dimensional flow, compressible bernoulli’s equation, area – mach number – velocity relation, mach cone, mach angle, one dimensional isentropic flow through variable area duct, critical conditions, characteristic mach number, area-mach number relation, maximum discharge velocity – operating characteristics of nozzles- introduction to hypersonic flows

UNIT II  SHOCK AND EXPANSION WAVES  10

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

UNIT IV  HIGH SPEED FLOW OVER AIRFOILS, WINGS AND AIRPLANE CONFIGURATION  9
Critical Mach number, Drag divergence Mach number, Shock Stall, Supercritical Airfoil Sections, Transonic area rule, Swept wing, Airfoils for supersonic flows, Lift, drag, Pitching moment and Centre of pressure for supersonic profiles, Shock-expansion theory, wave drag, supersonic wings, Design considerations for supersonic aircraft- aerodynamic heating.

UNIT V  EXPERIMENTAL TECHNIQUES FOR HIGH SPEED FLOWS  8
Wind tunnels for transonic, Supersonic and hypersonic flows, shock tube, Gun tunnels-peculiar problems in the operation of hypersonic tunnels - Supersonic flow visualization methods

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

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

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
- To impart knowledge 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 HYPERSONIC AIRBREATHING PROPULSION 8

UNIT II FUNDAMENTALS OF CHEMICAL ROCKET PROPULSION 9

UNIT III SOLID ROCKET PROPULSION 10

UNIT IV LIQUID AND HYBRID ROCKET PROPULSION 10

UNIT V ADVANCED PROPULSION TECHNIQUES 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.

TOTAL: 45 PERIODS

OUTCOMES
- Understanding various propulsion systems
- Knowledge in rocket propulsion systems
- Knowing the applications and principles of liquid and solid-liquid propulsion systems
- Application of nuclear propulsion in rocketery

TEXT BOOKS:
REFERENCES:
1. James Award, "Aerospace Propulsion System"
2. Hieter and Pratt, "Hypersonic Air Breathing Propulsion"

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

TEXT BOOKS:
OBJECTIVES
To the study of nature and the 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 12
Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – 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 10
Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry-Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;: Mitigation procedures- Control of particulate and gaseous emission, Control of SO₂, NOₓ, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies – 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 overutilization of surface and ground 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. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landsides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources
Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT
Public awareness.

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:
AE6511  AIRCRAFT STRUCTURES LABORATORY - II  L T P C  0 0 3 2

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

TOTAL: 45 PERIODS

OUTCOMES
- Ability to perform Bending, Torsion, Shear, Vibration test on metabolic, composite specimen

<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>Photo elasticity set up</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>100 kN Universal Testing Machine</td>
<td>1</td>
<td>8,9</td>
</tr>
<tr>
<td>3</td>
<td>Vibration set up with accessories</td>
<td>1</td>
<td>5,6</td>
</tr>
<tr>
<td>4</td>
<td>Wagner beam</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Unsymmetrical bending set up</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Set up for combined bending and torsion</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

AE6512  PROPULSION LABORATORY  L T P C  0 0 3 2

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

LIST OF EXPERIMENTS
1. Study of aircraft piston and gas turbine engines
2. Velocity profiles of free jets.
3. Velocity profiles of wall jets.
4. Wall pressure measurements of a subsonic ramjet duct.
5. Flame stabilization studies using conical flame holders.
6. Cascade testing of compressor blades
7. Velocity and pressure measurements in co-axial jets
8. Flow visualization of secondary injection in a supersonic cross flow
9. Wall pressure distribution in subsonic diffusers.
10. Wall Pressure measurements in supersonic nozzles

TOTAL: 45 PERIODS

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

<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>Goblin engine</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Inline engine</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Radial/ V- type engine</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Jet facility with compressor and storage tank</td>
<td>1</td>
<td>2,3,7,8,10</td>
</tr>
<tr>
<td>5</td>
<td>Multitube manometer</td>
<td>2</td>
<td>2,3,4,7,9</td>
</tr>
<tr>
<td>6</td>
<td>Wind tunnel</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>0-5 bar pressure transducer with pressure indicator</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>(or) DSA pressure scanner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Schlieren/ Shadowgraph set up</td>
<td>1</td>
<td>7,10</td>
</tr>
<tr>
<td>9</td>
<td>Ramjet facility</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>Conical flame holder</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>11</td>
<td>Compressor blade set</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>

GE6674 COMMUNICATION AND SOFT SKILLS- LABORATORY BASED

OBJECTIVES:
To enable learners to,
- Develop their communicative competence in English with specific reference to speaking and listening
- Enhance their ability to communicate effectively in interviews.
- Strengthen their prospects of success in competitive examinations.

UNIT I LISTENING AND SPEAKING SKILLS

CONVERSATIONAL SKILLS (FORMAL AND INFORMAL) - GROUP DISCUSSION - MAKING EFFECTIVE PRESENTATIONS USING COMPUTERS, LISTENING/WATCHING INTERVIEWS CONVERSATIONS, DOCUMENTARIES. LISTENING TO LECTURES, DISCUSSIONS FROM TV/ RADIO/ PODCAST.

UNIT II READING AND WRITING SKILLS

READING DIFFERENT GENRES OF TESTS RANGING FROM NEWSPAPERS TO CREATIVE WRITING. WRITING JOB APPLICATIONS - COVER LETTER - RESUME - EMAILS - LETTERS - MEMOS - REPORTS. WRITING ABSTRACTS - SUMMARIES - INTERPRETING VISUAL TEXTS.
UNIT III ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS
12
International English Language Testing System (IELTS) - Test of English as a Foreign Language (TOEFL) - Civil Service (Language related) - Verbal Ability.

UNIT IV INTERVIEW SKILLS
12
Different types of Interview format- answering questions- offering information- mock interviews-body language(paralinguistic features)- articulation of sounds- intonation.

UNIT V SOFT SKILLS
12
Motivation- emotional intelligence-Multiple intelligences- emotional intelligence- managing changes-time management-stress management-leadership straits-team work- career planning - intercultural communication- creative and critical thinking

TOTAL: 60 PERIODS

Teaching Methods:
1. To be totally learner-centric with minimum teacher intervention as the course revolves around practice.
2. Suitable audio/video samples from Podcast/YouTube to be used for illustrative purposes.
3. Portfolio approach for writing to be followed. Learners are to be encouraged to blog, tweet, text and email employing appropriate language.
4. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
5. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for graining proficiency and better participation in the class.

Lab Infrastructure:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description of Equipment (minimum configuration)</th>
<th>Qty Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Server</strong></td>
<td>1 No.</td>
</tr>
<tr>
<td></td>
<td>• PIV System</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 1 GB RAM / 40 GB HDD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• OS: Win 2000 server</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Audio card with headphones</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• JRE 1.3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><strong>Client Systems</strong></td>
<td>60 Nos.</td>
</tr>
<tr>
<td></td>
<td>• PIII or above</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 256 or 512 MB RAM / 40 GB HDD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• OS: Win 2000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Audio card with headphones</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• JRE 1.3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Handicam</td>
<td>1 No.</td>
</tr>
<tr>
<td>4</td>
<td>Television 46&quot;</td>
<td>1 No.</td>
</tr>
<tr>
<td>5</td>
<td>Collar mike</td>
<td>1 No.</td>
</tr>
<tr>
<td>6</td>
<td>Cordless mike</td>
<td>1 No.</td>
</tr>
<tr>
<td>7</td>
<td>Audio Mixer</td>
<td>1 No.</td>
</tr>
<tr>
<td>8</td>
<td>DVD recorder/player</td>
<td>1 No.</td>
</tr>
<tr>
<td>9</td>
<td>LCD Projector with MP3/CD/DVD provision for Audio/video facility</td>
<td>1 No.</td>
</tr>
</tbody>
</table>
Evaluation:
Internal: 20 marks
Record maintenance: Students should write a report on a regular basis on the activities conducted, focusing on the details such as the description of the activity, ideas emerged, learning outcomes and so on. At the end of the semester records can be evaluated out of 20 marks.

External: 80 marks
Online Test - 35 marks
Interview - 15 marks
Presentation - 15 marks
Group Discussion - 15 marks

Note on Internal and External Evaluation:
1. Interview – mock interview can be conducted on one-on-one basis.
2. Speaking – example for role play:
   a. Marketing engineer convincing a customer to buy his product.
   b. Telephonic conversation- fixing an official appointment / placing an order / enquiring and so on.
3. Presentation – should be extempore on simple topics.
4. Discussion – topics of different kinds; general topics, and case studies.

OUTCOMES:
At the end of the course, learners should be able to
- Take international examination such as IELTS and TOEFL
- Make presentations and Participate in Group Discussions.
- Successfully answer questions in interviews.

REFERENCES:
2. Graded Examinations in Spoken English and Spoken English for Work downloadable materials from Trinity College, London.
4. Interactive Multimedia Programs on Managing Time and Stress.

Web Sources:
http://www.slideshare.net/rohitjsh/presentation-on-group-discussion
http://www.washington.edu/doit/TeamN/present_tips.html
http://www.oxforddictionaries.com/words/writing-job-applications
http://www.kent.ac.uk/careers/cv/coveringletters.htm
http://www.mindtools.com/pages/article/newCDV_34.htm
OBJECTIVES:
- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization.

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

TEXTBOOKS:

REFERENCES:
OBJECTIVES:
• 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 8
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 10
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 8
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 9
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 10
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+T:15): 60 PERIODS

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

TEXT BOOKS:

REFERENCES:
OBJECTIVES:

- 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 DEGREES OF FREEDOM SYSTEMS 10
Two degrees of freedom systems - static and dynamic couplings - vibration absorber - principal co-ordinates - principal modes and orthogonal conditions - eigen value problems - hamilton’s principle - lagrangean equations and application.

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

UNIT IV APPROXIMATE METHODS 9

UNIT V ELEMENTS OF AEROELASTICITY 8
Vibration due to coupling of bending and torsion - aeroelastic problems - 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

TEXT BOOKS:

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

UNIT I MICROMECHANICS

UNIT II MACROMECHANICS

UNIT III LAMINATED PLATE THEORY
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
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
Basic design concepts of sandwich construction - materials used for sandwich construction - failure modes of sandwich panels - bending stress and shear flow in composite beams.

OUTCOMES
- Understanding the mechanics of composite materials
- Ability to analyse the laminated composites for various loading eases
- Knowledge gained in manufacture of composites

TEXT BOOKS:

REFERENCES:
OBJECTIVES

- 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

TEXT BOOK

REFERENCES
AE6611 AERO ENGINE AND AIRFRAME LABORATORY

OBJECTIVES
- 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.

OUTCOMES
- Ability to maintain and repair the aero engines.

TOTAL: 45 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>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 set</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>

AE6612 AIRCRAFT DESIGN PROJECT - I

OBJECTIVES:
- To make the student work in groups and understand the Concepts involved in Aerodynamic design, Performance analysis and stability aspects of different types of airplanes

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

TOTAL : 45 PERIODS

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

AE6613 COMPUTER AIDED SIMULATION LABORATORY

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OBJECTIVES:
- 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. Simulation of flow through a Converging-diverging nozzle.
2. Simulation of flow through an axial flow compressor blade passage.
3. Simulation of supersonic flow over a wing of biconvex cross section
4. Hot flow simulation through an axial flow turbine blade passage.
5. Simulation of flow through subsonic and supersonic diffusers.
6. Structural analysis of a tapered wing
7. Structural analysis of a fuselage structure
8. Analysis of a composite laminate structure
9. Structural analysis of a landing gear
10. Thermo structural analysis of a composite laminate structure

TOTAL : 45 PERIODS

OUTCOMES
- Use of different simulation and analysis software to simulate flow behavior and perform structural analysis

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>Modelling packages</td>
<td>30 licenses</td>
</tr>
<tr>
<td></td>
<td>(i) CATIA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) ANSYS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(iii) Pro E</td>
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</tr>
<tr>
<td></td>
<td>(iv) NASTRAN</td>
<td></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>
OBJECTIVES:

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

UNIT I INTRODUCTION

UNIT II TQM PRINCIPLES
Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles 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
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

UNIT V QUALITY SYSTEMS

TOTAL: 45 PERIODS

OUTCOMES:

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

TEXTBOOK:

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

UNIT I INTRODUCTION TO AVIONICS
Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies – Introduction to digital computer and memories.

UNIT II DIGITAL AVIONICS ARCHITECTURE

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

UNIT IV INTRODUCTION TO NAVIGATION SYSTEMS

UNIT V AIR DATA SYSTEMS AND AUTO PILOT
Air data quantities – Altitude, Air speed, Vertical speed, Mach Number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to built Digital avionics architecture
- Ability to Design Navigation system
- Ability to design and perform analysis on air system

TEXT BOOKS:

REFERENCES:
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  8

UNIT II  FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION  9

UNIT III  FINITE VOLUME METHOD FOR CONVECTION DIFFUSION  10
Steady one-dimensional convection and diffusion – Central, upwind differing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

UNIT IV  FLOW FIELD ANALYSIS  9

UNIT V  TURBULENCE MODELS AND MESH GENERATION  9

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the students can able
- To create numerical modeling and its role in the field of fluid flow and heat transfer
- To use the various discretization methods, solution procedures and turbulence modeling to solve flow and heat transfer problems.

TEXT BOOKS:
REFERENCES:

AE6702 EXPERIMENTAL STRESS ANALYSIS

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

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

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

UNIT III PHOTOELASTICITY
Two dimensional photo elasticity, Photo elastic materials, Concept of light - photoelastic effects, stress optic law, Transmission photoelasticity, Jones calculus, plane and circular 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
Relation between stresses in coating and specimen, use of failure theories in brittle coating, Moire method of strain analysis.

UNIT V NON–DESTRUCTIVE TESTING
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 .
- Knowledge in NDT in stress analysis.
TEXT BOOKS:

REFERENCES:

AE6711         AIRCRAFT DESIGN PROJECT - II         L T P C
0 0 3 2

OBJECTIVES:
Each group of students is assigned to continue the structural design part of the airplane. The following are the assignments are 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: 45 PERIODS

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

AE6712         AIRCRAFT SYSTEMS LABORATORY         L T P C
0 0 3 2

OBJECTIVES
- 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.

TOTAL: 45 PERIODS

OUTCOMES
- 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>

AE6713 FLIGHT INTEGRATION SYSTEMS AND CONTROL LABORATORY

L T P C
0 0 3 2

OBJECTIVES:
- 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.

Note:
** If MATLAB software is not available, the mathematical & graphical analysis of the experiment has to be done.
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>
</tr>
</thead>
<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>
</tr>
<tr>
<td>3.</td>
<td>Encoder Kit</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>4.</td>
<td>Decoder Kit</td>
<td>10</td>
<td>7</td>
</tr>
<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>
</tr>
<tr>
<td>8.</td>
<td>* Regulated power supply</td>
<td>10</td>
<td>5,6,7</td>
</tr>
<tr>
<td>9.</td>
<td>MATLAB software</td>
<td>-</td>
<td>8,9,10</td>
</tr>
</tbody>
</table>

*Is not needed when regulated power supply is in built.

AE6801 WIND TUNNEL TECHNIQUES

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

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

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

UNIT III CALIBRATION OF WIND TUNNELS

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

- Ability to use various techniques of Aerodynamic data generation.

TEXT BOOKS:

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

REFERENCES:

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

AE6811 PROJECT WORK

OBJECTIVES:

- 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.

OUTCOMES:

- 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.

AE6001 THEOREY OF ELASTICITY

OBJECTIVES:

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

UNIT I BASIC EQUATIONS OF ELASTICITY

Definition of Stress and Strain: Stress - Strain relationships - Equations of Equilibrium, Compatibility equations, Boundary Conditions, Saint Venant’s principle - Principal Stresses, Stress Ellipsoid - Stress invariants.
UNIT II

PLANE STRESS AND PLANE STRAIN PROBLEMS

Airy’s stress function, Bi-harmonic equations, Polynomial solutions, Simple two dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams.

UNIT III

POLAR COORDINATES

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

UNIT IV

TORSION

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

UNIT V

INTRODUCTION TO THEORY OF PLATES AND SHELLS

Classical plate theory – Assumptions – Governing equations – Boundary conditions – Navier’s method of solution for simply supported rectangular plates – Levy’s method of solution for rectangular plates under different boundary conditions.

TOTAL: 45 PERIODS

OUTCOMES

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

TEXT BOOKS:


REFERENCES:


AE6002 AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE

PRACTICES

L T P C

3 0 0 3

OBJECTIVES

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

UNIT I

AIRCRAFT GROUND HANDLING AND SUPPORT EQUIPMENT


UNIT II

GROUND SERVICING OF VARIOUS SUB SYSTEMS

Air conditioning and pressurization – Oxygen and oil systems – Ground units and their maintenance.
UNIT III  MAINTENANCE OF SAFETY
Shop safety – Environmental cleanliness – Precautions

UNIT IV  INSPECTION

UNIT V  AIRCRAFT HARDWARE, MATERIALS, SYSTEM PROCESSES
Hand tools – Precision instruments – Special tools and equipments in an airplane maintenance shop – Identification terminology – Specification and correct use of various aircraft hardware (i.e. nuts, bolts, rivets, screws etc) – American and British systems of specifications – Threads, gears, bearings, etc – 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.

TEXT BOOK

REFERENCES
UNIT III  SATELLITE INJECTION AND SATELLITE PERTURBATIONS

UNIT IV  INTERPLANETARY TRAJECTORIES

UNIT V  BALLISTIC MISSILE TRAJECTORIES

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

AE6004  HEAT TRANSFER
L T P C
3 0 0 3

OBJECTIVES:
- 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
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

UNIT III  RADIATION
UNIT IV  NUMERICAL METHODS IN HEAT TRANSFER  12

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

GE6084  HUMAN RIGHTS  L T P C
3 0 0 3

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

UNIT I

UNIT II

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

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


TOTAL : 45 PERIODS

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

REFERENCES:

AE6005 HELICOPTER THEORY

L T P C
3 0 0 3

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

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

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

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

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

UNIT V ROTOR VIBRATIONS

TOTAL: 45 PERIODS
OUTCOMES:
- To perform the Aerodynamics calculation of Rotor blade
- To perform stability and control characteristics of Helicopter
- To perform and control Rotor vibration

TEXT BOOKS:

REFERENCES:
2. R W Prouty, "Helicopter Aerodynamics"

REFERENCES

AE6007 FATIGUE AND FRACTURE    L    T    P    C
                                      3    0    0    3

OBJECTIVES:
• 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
S.N. curves - Endurance limits - Effect of mean stress, Goodman, Gerber and Soderberg relations
and diagrams - Notches and stress concentrations - Neuber’s stress concentration factors - Plastic
stress concentration factors - Notched S.N. curves – Fatigue of composite materials.

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

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

UNIT IV    FRACTURE MECHANICS     10
Strength of cracked bodies - Potential energy and surface energy - Griffith’s theory - Irwin - Orwin
extension of Griffith’s theory to ductile materials - stress analysis of “cracked bodies - Effect of
thickness on fracture toughness” - stress intensity factors for typical geometries.

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

TOTAL: 45 PERIODS

OUTCOMES
• Ability to apply mathematical knowledge to define fatigue behaviors
• Ability to perform fatigue design
• Ability to analyse the fracture due to fatigue

TEXT BOOKS:

REFERENCES:
   Netherlands, 1989.

AE6008 UAV SYSTEMS L T P C 3 0 0 3

OBJECTIVES:
• 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

REFERENCES:

GE6083 DISASTER MANAGEMENT L T P C 3 0 0 3

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

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

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

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

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

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

TOTAL: 45 PERIODS

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

TEXTBOOK:
13: 978-9380386423

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

DISASTER MANAGEMENT

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 stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

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

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

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

TOTAL: 45 PERIODS

TEXTBOOK:

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

AE6009 INDUSTRIAL AERODYNAMICS L T P C
3 0 0 3

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

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

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

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

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

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:
OBJECTIVES:

- 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

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

Review of types of plastics used in airplanes - Maintenance and repair of plastic components - Repair of cracks, holes etc., 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


UNIT IV REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM

Trouble shooting and maintenance practices - Service and inspection - Inspection and maintenance of landing gear systems. - Inspection and maintenance of air-conditioning and pressurization system, water and waste system. Installation and maintenance of Instruments - handling - Testing - Inspection. Inspection and maintenance of auxiliary systems - Rain removal system - Position and warning system - Auxiliary Power Units (APUs).

UNIT V SAFETY PRACTICES


TOTAL: 45 PERIODS

OUTCOMES

- Ability to identify the airframe components
- Ability to perform defect investigation skill to maintain the airframe

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

UNIT II  PROPELLERS
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
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

UNIT V  OVERHAULING
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

REFERENCES:
OBJECTIVES

- 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.

TEXT BOOK
OBJECTIVES

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

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

UNIT II  SIMPLE SOLUTION METHODS FOR HYPERSONIC INVISCID FLOWS  9

UNIT III  VISCOUS HYPERSONIC FLOW THEORY  9
Boundary layer equations for hypersonic flow – hypersonic boundary layers – self similar and non self similar boundary layers – solution methods for non self similar boundary layers – aerodynamic heating and its adverse effects on airframe.

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

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

TOTAL: 45 PERIODS

OUTCOMES

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

TEXT BOOKS:

REFERENCES:

OBJECTIVES:
- To provide details, operating principles and limitations of forces, pressure, velocity and temperature measurements. To describe flow visualization techniques and to highlight in depth discussion of analog methods.

UNIT I  BASIC MEASUREMENTS IN FLUID MECHANICS 7

UNIT II  CHARACTERISTICS OF MEASUREMENTS 10

UNIT III  FLOW VISUALIZATION AND ANALOGUE METHODS 9

UNIT IV  PRESSURE, VELOCITY AND TEMPERATURE MEASUREMENTS 9

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, temperature etc

TEXT BOOKS:
REFERENCES:
2. NAL-UNI Lecture Series 12: Experimental Aerodynamics, NAL SP 98 01 April 1998
3. Lecture course on "Advanced Flow diagnostic techniques" 17-19 September 2008 NAL, Bangalore

AE6015 ROCKETS AND MISSILES L T P C 3 0 0 3

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

UNIT I CLASSIFICATION OF ROCKETS AND MISSILES 9
Various methods of classification of missiles and rockets – Basic aerodynamic characteristics of surface to surface, surface to air, air to surface and air to air missiles – Examples of various Indian space launch vehicles and missiles – Current status of Indian rocket programme with respect to international scenario

UNIT II AERODYNAMICS OF ROCKETS AND MISSILES 10

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

UNIT IV STAGING OF ROCKETS AND MISSILES 8
Design philosophy behind multistaging of launch vehicles and ballistic missiles – optimization of multistage vehicles – stage separation techniques in atmosphere and in space – stage separation dynamics and lateral separation characteristics –

UNIT V CONTROL OF ROCKETS AND MISSILES 8
Introduction to aerodynamic and jet control methods – various types of aerodynamic control methods for tactical and short range missiles- aerodynamic characteristics - various types of thrust vector control methods including secondary injection thrust vector control for launch vehicles and ballistic missiles –.

TOTAL: 45 PERIODS

OUTCOMES
• Knowledge in types of rockets and missiles with respect to Indian & international scenario
• Gaining informations on aerodynamics of rocket and missiles
• Knowledge on stages and remote control of rockets missiles
TEXT BOOKS:

REFERENCES:

AE6016 STRUCTURAL DYNAMICS L T P C
3 0 0 3

OBJECTIVES:
- 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 FORCE DEFLECTION PROPERTIES OF STRUCTURES 9

UNIT II PRINCIPLES OF DYNAMICS 9
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 9

UNIT IV ENERGY METHODS 9

UNIT V APPROXIMATE METHODS 9
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 approxite methods of evaluating natural modes of vibration.

TEXT BOOKS:
REFERENCES: