# FACULTY OF ENGINEERING, TECHNOLOGY AND MANAGEMENT SCIENCES

## VINAYAKA MISSION'S RESEARCH FOUNDATION (Deemed to be University) SALEM (TAMILNADU)

# REGULATION - 2012

## B.E AERONAUTICAL ENGINEERING (REGULAR) - CBCS

## VINAYAKA MISSIONS KIRUPANANDA VARIYAR ENGINEERING COLLEGE, SALEM

# VINAYAKA MISSSION'S KIRUPANANDA VARIYAR ENGINEERNG COLLEGE SALEM

## SCHOOL OF MECHANICAL SCIENCES

BOARD : **MECHANICAL SCIENCES**
REGULATION : **2012 (CHOICE BASED CREDIT SYSTEM)**
PROGRAM : **B.E – AERONAUTICAL ENGINEERING - FULL TIME**

## CREDIT DETAILS SEMESTER WISE

| SEMESTER | THEORY SUBJECTS | PRACTICALS | CREDIT |
|---|---|---|---|
| I | 6 | 3 | 25 |
| II | 6 | 3 | 26 |
| III | 6 | 3 | 26 |
| IV | 6 | 3 | 28 |
| V | 6 | 3 | 26 |
| VI | 6 | 3 | 25 |
| VII | 6 | 3 | 25 |
| VIII | 3 | 1 | 15 |
| **TOTAL** | **45** | **22** | **196** |

## SEMESTER I

| SL. No | COURSE CODE | COURSE TITLE | DEPARTMENT | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | |
| 1 | | English for Effective Communication | ENG | 3 | 0 | 0 | 3 |
| 2 | | Engineering Mathematics-I | MATHS | 3 | 1 | 0 | 4 |
| 3 | | Engineering Physics | PHY | 3 | 0 | 0 | 3 |
| 4 | | Engineering Mechanics – Statics | MECH | 3 | 0 | 0 | 3 |
| 5 | | Environmental Science and Engineering | CHEM | 3 | 0 | 0 | 3 |
| 6 | | Computer Foundation Program | CSE | 3 | 0 | 0 | 3 |
| PRACTICAL | | | | | | | |
| 7 | | Workshop | MECH | 0 | 0 | 3 | 2 |
| 8 | | Engineering Physics Laboratory | PHY | 0 | 0 | 3 | 2 |
| 9 | | Computer Foundation Program Laboratory | CSE | 0 | 0 | 3 | 2 |
| | | | **TOTAL** | **18** | **1** | **9** | **25** |

## SEMESTER II

| SL. No | COURSE CODE | COURSE TITLE | DEPARTMENT | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | |
| 1 | | Business English | ENG | 3 | 0 | 0 | 3 |
| 2 | | Engineering Mathematics-II | MATHS | 3 | 1 | 0 | 4 |
| 3 | | Engineering Chemistry | CHEM | 3 | 0 | 0 | 3 |
| 4 | | Engineering Mechanics-Dynamics | MECH | 3 | 1 | 0 | 4 |
| 5 | | Programming in C | EEE | 3 | 0 | 0 | 3 |
| 6 | | Material Science | PHY | 3 | 0 | 0 | 3 |
| PRACTICAL | | | | | | | |
| 7 | | Programming in C Laboratory | EEE | 0 | 0 | 3 | 2 |
| 8 | | Engineering Graphics Laboratory | MECH | 0 | 0 | 3 | 2 |
| 9 | | Engineering Chemistry Laboratory | CHEM | 0 | 0 | 3 | 2 |
| | | | **TOTAL** | **18** | **2** | **9** | **26** |

## SEMESTER III

| SL. No | COURSE CODE | COURSE TITLE | DEPARTMENT | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | |
| 1 | | Advanced Engineering Mathematics | MATHS | 3 | 1 | 0 | 4 |
| 2 | | Electrical and Electronics Engineering | EEE | 3 | 0 | 0 | 3 |
| 3 | | Elements of Aeronautics | AERO | 3 | 0 | 0 | 3 |
| 4 | | Engineering Thermodynamics | MECH | 3 | 1 | 0 | 4 |
| 5 | | Fluid Mechanics and Machinery | CIVIL | 3 | 1 | 0 | 4 |
| 6 | | Mechanics of Machines | MECH | 3 | 1 | 0 | 4 |
| PRACTICAL | | | | | | | |
| 1 | | Electrical And Electronics Engineering Laboratory | EEE | 0 | 0 | 3 | 2 |
| 2 | | Fluid Mechanics and Machinery Laboratory | CIVIL | 0 | 0 | 3 | 2 |
| 3 | | Thermodynamics Laboratory | MECH | 0 | 0 | 3 | 2 |
| | | | **TOTAL** | **18** | **4** | **9** | **28** |

## SEMESTER IV

| SL. No | COURSE CODE | COURSE TITLE | DEPARTMENT | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | |
| 1 | | Numerical Methods | MATHS | 3 | 1 | 0 | 4 |
| 2 | | Aerodynamics – I | AERO | 3 | 1 | 0 | 4 |
| 3 | | Propulsion – I | AERO | 3 | 0 | 0 | 3 |
| 4 | | Aircraft Structures – I | AERO | 3 | 1 | 0 | 4 |
| 5 | | Aircraft Systems and Instruments | AERO | 3 | 0 | 0 | 3 |
| 6 | | Strength of Materials | CIVIL | 3 | 1 | 0 | 4 |
| PRACTICAL | | | | | | | |
| 1 | | Aircraft Structures - I Laboratory | AERO | 0 | 0 | 3 | 2 |
| 2 | | Aircraft Systems Laboratory | AERO | 0 | 0 | 3 | 2 |
| 3 | | Aerodynamics Laboratory | AERO | 0 | 0 | 3 | 2 |
| | | | **TOTAL** | **18** | **4** | **11** | **28** |

## SEMESTER V

| SL. No | COURSE CODE | COURSE TITLE | DEPARTMENT | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | |
| 1 | | Aerodynamics – II | AERO | 3 | 1 | 0 | 4 |
| 2 | | Propulsion – II | AERO | 3 | 0 | 0 | 3 |
| 3 | | Aircraft Structures – II | AERO | 3 | 1 | 0 | 4 |
| 4 | | Aircraft Performance | AERO | 3 | 0 | 0 | 3 |
| 5 | | Heat Transfer | MECH | 3 | 1 | 0 | 4 |
| 6 | | Elective – I | | 3 | 0 | 0 | 3 |
| PRACTICAL | | | | | | | |
| 1 | | Aircraft Structures - II Laboratory | AERO | 0 | 0 | 3 | 2 |
| 2 | | Propulsion Laboratory | AERO | 0 | 0 | 3 | 1 |
| 3 | | Professional Communication and Personality Development Laboratory | MGMT | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **18** | **3** | **9** | **26** |

## SEMESTER VI

| SL. No | COURSE CODE | COURSE TITLE | DEPARTMENT | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | |
| 1 | | Aircraft Stability and Control | AERO | 3 | 1 | 0 | 4 |
| 2 | | Helicopter Aerodynamics | AERO | 3 | 0 | 0 | 3 |
| 3 | | High Temperature Materials | MECH | 3 | 0 | 0 | 3 |
| 4 | | Rockets and Missiles | AERO | 3 | 1 | 0 | 4 |
| 5 | | Aero Engine Maintenance and Repair | AERO | 3 | 0 | 0 | 3 |
| 6 | | Elective – II | | 3 | 0 | 0 | 3 |
| PRACTICAL | | | | | | | |
| 7 | | Aero Engine Maintenance and Repair Laboratory | AERO | 0 | 0 | 3 | 2 |
| 8 | | Aircraft Structure Repair Laboratory | AERO | 0 | 0 | 3 | 1 |
| 9 | | Aircraft Design Project | AERO | 0 | 0 | 3 | 2 |
| | | | **TOTAL** | **18** | **2** | **9** | **25** |

## SEMESTER VII

| SL. No | COURSE CODE | COURSE TITLE | DEPARTMENT | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | |
| 1 | | Composite Materials | AERO | 3 | 0 | 0 | 3 |
| 2 | | Computational Fluid Dynamics | MECH | 3 | 1 | 0 | 4 |
| 3 | | Finite Element Analysis | MECH | 3 | 1 | 0 | 4 |
| 4 | | Avionics | AERO | 3 | 0 | 0 | 3 |
| 5 | | Elective – III | | 3 | 0 | 0 | 3 |
| 6 | | Elective – IV | | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | | |
| 7 | | Finite Element Analysis Laboratory | MECH | 0 | 0 | 3 | 2 |
| 8 | | Computer Aided Design and Drafting Laboratory | MECH | 0 | 0 | 3 | 2 |
| 9 | | Comprehension | AERO | 0 | 0 | 2 | 1 |
| | | | **TOTAL** | **18** | **2** | **8** | **25** |

## SEMESTER VIII

| SL. No | COURSE CODE | COURSE TITLE | DEPARTMENT | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | |
| 1 | | Elective – V | | 3 | 0 | 0 | 3 |
| 2 | | Elective –VI | | 3 | 0 | 0 | 3 |
| 3 | | Elective – VII | | 3 | 0 | 0 | 3 |
| PRACTICAL | | | | | | | |
| 4 | | Project Work & Viva Voce | AERO | 0 | 0 | 12 | 6 |
| | | | **TOTAL** | **9** | **0** | **12** | **15** |

**Total Credit: 198**

## LIST OF ELECTIVE COURSES

| SL. No | COURSE CODE | COURSE TITLE | DEPARTMENT | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | |
| 1 | | Manufacturing Technology | MECH | 3 | 0 | 0 | 3 |
| 2 | | Theory of Elasticity | MECH | 3 | 0 | 0 | 3 |
| 3 | | Space Mechanics | AERO | 3 | 0 | 0 | 3 |
| 4 | | Aircraft General Engineering and Maintenance Practices | AERO | 3 | 0 | 0 | 3 |
| 5 | | Vibration and Aero Elasticity | MECH | 3 | 0 | 0 | 3 |
| 6 | | Airframe Maintenance and Repair | AERO | 3 | 0 | 0 | 3 |
| 7 | | Theory of Plates and Shells | MECH | 3 | 0 | 0 | 3 |
| 8 | | Computer Integrated Manufacturing | MECH | 3 | 0 | 0 | 3 |
| 9 | | Fatigue and Fracture Mechanics | MECH | 3 | 0 | 0 | 3 |
| 10 | | Air Transportation and Aircraft Maintenance Management | AERO | 3 | 0 | 0 | 3 |
| 11 | | Helicopter Maintenance | AERO | 3 | 0 | 0 | 3 |
| 12 | | Air Traffic Control and Aerodrome Design | AERO | 3 | 0 | 0 | 3 |
| 13 | | Entrepreneurial Skills Development for Engineers | MECH | 3 | 0 | 0 | 3 |
| 14 | | Professional Ethics and Human Values | Management | 3 | 0 | 0 | 3 |
| 15 | | Total Quality Management | MECH | 3 | 0 | 0 | 3 |
| 16 | | Resource Management Techniques | Management | 3 | 0 | 0 | 3 |
| 17 | | Wind Tunnel Techniques | AERO | 3 | 0 | 0 | 3 |
| 18 | | Aircraft Design | AERO | 3 | 0 | 0 | 3 |
| 19 | | Computer Aided Design and Analysis | MECH | 3 | 0 | 0 | 3 |
| 20 | | Unmanned Aircraft Systems | AERO | 3 | 0 | 0 | 3 |
| 21 | | Robotics Engineering | MECH | 3 | 0 | 0 | 3 |
| 22 | | Cryogenics | MECH | 3 | 0 | 0 | 3 |
| 23 | | Launch Vehicles and Spacecraft Propulsion | AERO | 3 | 0 | 0 | 3 |
| 24 | | Organizational Behaviour and Management | Management | 3 | 0 | 0 | 3 |
| 25 | | Fundamentals of Nano Science | PHY | 3 | 0 | 0 | 3 |
| 26 | | Control Engineering | EEE | 3 | 0 | 0 | 3 |

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| I | **ENGLISH FOR EFFECTIVE COMMUNICATION (Common for all branches)** | 3 | 0 | 0 | 3 |

**AIM:** To Strengthen the basic LSRW (Listening, Speaking, Reading and Writing) skills.

**OBJECTIVES:**

1. To make the students of Engineering courses learn English for Effective communication
2. To make them competent enough in the use of English in today's global scenario.
3. To make our Engineering graduates fit for any MNC today.

**OUTCOME:**

1. It is hoped that the students who are taught the revised English for Effective communication syllabus will be able to communicate in English.
2. This syllabus will enable our U.G Engineering graduates to face any challenges with confidence and they will prove with their counter part any where in the globe.

**UNIT – I**

Word formation with prefixes and suffixes, Antonyms & Synonyms-Tense Forms , Active and Passive voices- Different kinds of Nouns and Pronouns - Use of Verbs and Adverbs – Adjectives, Degrees of Comparison - Conditional Sentences -– Common Errors in English- Reported Speech- Articles.

**UNIT – II**

Phonetics (Vowels, Consonants and Diphthongs) - Pronunciation Guidelines - Vocabulary (Homophones).

**UNIT – III**

Principles of Communication - Defining and Describing Objects -.Role Play- Debate- Telephonic Etiquettes.

**UNIT – IV**

How to write reports, report writing – Recommendations - Discussing data and coming to conclusions –Technical Reports –Project proposals- Brochures- News Letters- Memorandum (or) Memo

**UNIT – V**

Flowcharts - Pie-charts – Bar charts- Interpreting tables- Formal and Informal letters - Resume Writing.

**TEXT BOOK**

1. **English for Effective Communication,**
   Departments of English, VMKV & AVIT.
   Erode: SCM Publishers, 2009.

**REFERENCE BOOKS**


1. M.Ashraf Rizvi, **Effective Technical Communication.**
   New Delhi:Tata McGraw Hill Publications, 2007.
2. Pickett and Laster.**Technical English: Writing, Reading and Speaking.**
   New York: Harper and Row Publications, 2002.
3. Cutts, Martin.**ThePlain English Guide – How to Write Clearly and Communicate Better.**
   New Delhi: OxfordUniversity Press, 1995.
4. Narayanaswami.V.R.**Strengthen Your Writing.** Chennai: Orient Longman Ltd., 1996.
5. Prof.K.R.Lakshmi Narayanan & Dr.T.Murugavel, **Communication Skills for Engineers,**
   Chennai: SCI Publications, 2002.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| I | **ENGINEERING MATHEMATICS - I (COMMON TO THE BRANCHES MECH, ECE, CSE, CSSE, EEE, EIE,CIVIL,IT,MECHTRONICS, AERONAUCTICAL ,ETC, AUTOMOBILE)** | 3 | 1 | 0 | 4 |

**AIM:** To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering.

**OBJECTIVES:** The syllabus for the Engineering Mathematics I have been framed catering to the needs of the Engineering students. It is purely applications oriented. To mention a few i)To utilize the powerful features of MATLAB one has to be an expert in Matrix theory (ii) The matrix theory plays an vital role in simplifying large arrays of equation and in determining their solution.(iii)Partial differential equation frequently occured in the theory of elasticity and Hydraulics.(iv)In circuit branches the current flow can be calculated by using Laplace transform when EMF,resistance and inductions are known.

**OUTCOME:**At the end of this course the students will be in a position to apply the knowledge of Mathematics in the respective Engineering branches.

**UNIT I MATRICES 09**

Characteristic equation – Eigen values and eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors (Without proof) – Cayley-Hamilton theorem (excluding proof) – Orthogonal transformation of a symmetric matrix to diagonal form.

**UNIT II DIFFERENTIAL CALCULUS 09**

Curvature – Cartesian and Parametric Co-ordinates – Centre and radius of curvature – Circle of curvature – Evolute

**UNIT III FUNCTIONS OF SEVERAL VARIABLES 09**

Partial Derivatives – Total Differential - Maxima and Minima – constrained Maxima and Minima by Lagrangian Multiplier Method.

**UNIT IV LAPLACE TRANSFORMS 09**

Laplace transform – transform of elementary functions – basic properties – derivatives and integrals of transforms – transforms of derivatives and integrals – initial and final value theorems – Transform of periodic functions.

**UNIT V APPLICATIONS OF LAPLACE TRANSFORMS 09**

Inverse Laplace transform – Convolution theorem – Initial and Final value theorem-Solution of linear ODE of second order with constant coefficients and first order simultaneous equation with constant coefficients using Laplace transforms.

**Tutorial Hours: 15 Lecture Hours: 45 Total hours: 60**

**TEXT BOOKS**


1**. "**Engineering Mathematics**"** by Department of Mathematics, VMU

2.Veerarajan, T., "Engineering Mathematics", Tata McGraw Hill Publishing Co.,NewDelhi, 2006.

3.Dr.A .Singaravelu ,Engineering Mathematics Volume I & Volume II by Meenakshi Publications.


**REFERENCE BOOKS**


1. Grewal, B.S., "Higher Engineering Mathematics" (36th Edition), Khanna Publishers, Delhi 2001.
2. Kreyszig, E., "Advanced Engineering Mathematics" (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
3. Kandasamy .P., Thilagavathy. K., and Gunavathy. K., "Engineering Mathematics",Volumes I & II (4th edition), S.Chand & Co., New Delhi., 2001.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| I | **COMPUTER FOUNDATION PROGRAM (COMMON TO ALL BRANCHES)** | 3 | 0 | 0 | 3 |

**AIM:** To study the basics of Computer, Hardware, Software Applications, Algorithms and Problem solving methodologies

**OBJECTIVE:**The proposed course exposes the students to IT Essentials. The Core Modules of this paper includes Programming, Database and Operating system and other related topics.

**OUTCOMES:**

At the end of this course, student shall be able to:

Do Problem Solving using Programming and algorithms, Describe working of Internet based applications, Document artifacts using common quality standards, Design simple data store using DBMS concepts and implement, Develop a working website with all above learning.

**UNIT I**

**Basics of Computer and Information Technology :**Digital computer fundamentals-Block diagram of a computer-component of a computer system Hardware and software definitions-Categories of software-Booting-Installing and Uninstalling Software-Software piracy-Software terminologies-Application of Computer-Role of Information Technology-History of Internet-Internet Services. **9**

**UNIT II**

**Problem Solving Methodologies and Techniques :**Problems solving Techniques-Program development cycle-Algorithm-Design-Flow chart-Program control structures-Types and generation of programming languages-Development of algorithms for simple problems. Top down and Bottom up approaches of software development. **9**

**UNIT III**

**Basics of Computer Architecture and System Software :**Fundamentals of Computer Architecture-Introduction-Organization of a small computer Central Processing Unit-Execution cycle-Instruction categories – measure of CPU performance Memory-Input/output devices-BUS-addressing modes.
System Software-Assemblers-Loaders and linkers-Compilers and interpreters. **9**

**UNIT IV**

**Basics of Operating System and DBMS :**Introduction-Basics of memory management schemes-Scheduling-threads. Introduction to File and Database systems- SQL-DDL statements-DML statements-DCL statements.

**9**

**UNIT V**

**Software Applications :**Office Automation: Application Packages-word processing-Spread sheet Application and Basics of HTML. **9**

**TOTAL HOURS : 45**

**TEXT BOOK:**

1. Faculties, School of Computer Science, VMKVEC, "An Introduction to Computer Foundation Program".

**REFERENCES**


1. Ashok N.Kamthane, programming with ANSI and TURBO C, Pearson Education (India) 2005.
2. V.Ramesh babu, fundamental of computing, VRB publisher, 2004.
3. Carl Hamacher, Zvonko Varnesie and Safwat Zaky, 5th Edition "Computer Organization", McGraw-Hill, 2002.
4. Leland L.Beck, "System Software- An Introduction to Systems Programming", 3rd Edition, Pearson Education Asia, 2000.
5. Abraham Silberschatz, Peter Baer Galvin and Greg Gange, "Operating System Concepts", Sixth Edition, John Wiley & Sons Pvt. Ltd,2003.
6. Abraham Silberschatz, Henry F.Korth and S.Sudarshan – "Database Systems Concepts", Fourth Edition, McGraw-Hill, 2002.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| I | **ENVIRONMENTAL SCIENCE AND ENGINEERING (Common to B.E all branches)** | 3 | 0 | 0 | 3 |

**AIM:** To provide the knowledge about the environmental science.

**OBJECTIVE:** It is the branch of science which deals with the effects of human activities &modern technology on environment. It creates awareness among the engineering students about environmental pollution and the role of the engineers in conservation of environment.

**OUT COME:** The students will get the knowledge about environment and they will work their corresponding field with eco -friendly. It will protect our environment from pollution

**UNIT – I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 10**

Definition, scope and importance – need for public awareness- forest resources: use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their ground water, floods, drought, conflicts over water, dams-benefits and problems-mineral resources: use effects on forests and tribal people-water resources: use and over-utilization of surface and exploitation, environmental effects if extracting and using mineral resources, case studies-food resources: world food problems, changes caused by agriculture and overgrazing, effects of modem agriculture, fertilizer-pesticide problems, water logging, salinity, case studies-energy resources: growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies –land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification –role of an individual in conservation of natural resources-equitable use of resources for sustainable lifestyles.

Field study of local area to document environmental assets-river/forest./grassland/ hill/mountain.

**UNIT – II ECOSYSTEMS AND BIODIVERSITY 14**

Concept of and ecosystem –structure and function of an ecosystem-producers, consumers and decomposers-energy flow in the ecosystem-ecological succession-food chains, food webs and ecological pyramids-introduction, types, characteristic features, structure and function of the (a)forest ecosystem (b). grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)-introduction to biodiversity- definition: genetic, species and ecosystem diversity-biogeographical classification of India-value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values-biodiversity at global, national and local levels-India as a mega-diversity nation-hot-spots of biodiversity-threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts-endangered and endemic species of India –conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

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

**UNIT - III ENVIRONMENTAL POLLUTION 8**

Definition-causes, effects and control measures of: (a) air pollution (b) water pollution (c) soil pollution (d) marine pollution (e) noise pollution (f) thermal pollution (g) nuclear hazards – solid waste management: caused, effects and control measures of urban and industrial wastes-role of an individual in prevention of pollution-pollution case studies – disaster management: floods, earthquake, cyclone and landslides.

Field study of local polluted site-urban / rural / industrial / agriculture

**UNIT - IV SOCIAL ISSUES AND THEIR ENVIRONMENT 7**

From unsustainable to sustainable development-urban problems related to energy- water conservation, rain water harvesting, watershed management –resettlement and rehabilitation of people, its problems and concerns, case studies – environmental ethics: issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies – wasteland reclamation-consumerism and waste products-environment protection act-air (prevention and control of pollution) act-water (prevention and control of pollution) act- wildlife protection act-forest conservation act-issues involved in enforcement of environmental legislation-public awareness.

**UNIT – V HUMAN POPULATION AND THE ENVRONMENT 6**

Population growth, variation among nations – population explosion – family welfare programme- environment and human health – human rights- value education- HIV/ AIDS – women and child welfare –role of information technology in environment and human health –case studies.

**Total Hours : 45**

**TEXT BOOK:**


1. Raman Sivakumar, Environmental Science and Engineering, Vijay Nicole imprints Pvt.Ltd.


**REFERENCE BOOKS :**


1. Bharucha Erach, The Biodiversity of India, publishing Pvt. Ahmedabad, India,
2. Trivedi R.K. Hand book of Environmental laws, Rules, Guidelines, Compliances and Standards, Vol. and II, Enviro Media.
3. Cunningham, W.P.Cooper, T.H.Gorhani, Environmental Encyclopedia, jaicao., House, Mumbai, 2001.
4. Weger K.D., Environmental Management, W.B. Saunders, Co., Philadelphia, USA., 1998.
5. Gilbert M.Masters, Introduction to Environmental Engineering and science, pearson Education Pvt., Ltd., Second Edition, 2004
6. Miller `T.G. Jr., Environmental Science, Wadsworth Publishing Co.
7. Townsend C., Harper J and Michael Begon, Essentials of Ecology, Blackwell Science
8. Trivedi R.K And P.K. Goel, Introduction to air pollution, Techno-Science publications.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| I | **ENGINEERING PHYSICS**<br>**(Common to B.E all branches)** | **3** | **0** | **0** | **3** |

**AIM**: To Strengthens the fundamental knowledge in physics will improve the scientific thinking of students.

**OBJECTIVE:**

To familiarize students with the basic concepts of Physics and their application in Engineering & Technology

**OUTCOME**: Students will gain knowledge in the basic concepts of physics which can be applied in Engineering & Technology

**UNIT – ILasers**

Einstein coefficients (A&B), Nd – YAG laser, $CO_2$ laser, semiconductor laser (homojunction) – uses of lasers – Holography – construction and reconstruction of a hologram.

**UNIT – IIFibre Optics**

Principle and propagation of light in optical fibres – numerical aperture and acceptance angle – types of optical fibres (material, refractive index, mode) – Applications: Fibre optic communication system (block diagram only) – fibre optic sensors (displacement sensor and pressure sensor).

**UNIT – III Crystal Physics**

Lattice – unit cell – Bravais lattice – Lattice planes – Miller indices – 'd' spacing in cubic lattice – calculation of number of atoms per unit cell – atomic radius – coordination number – packing factor for SC, BCC, FCC, HCP structures.

**UNIT – IV Acoustics**

Classification of sound – characteristics of musical sound – loudness – Weber-Fechner law – decibel – absorption coefficient – experimental determination – reverberation – reverberation time – Sabine's formula (no derivation) – factors affecting acoustics of buildings (reverberation time, loudness, focusing, echo, echolen effect, resonance and noise) and their remedies.

**UNIT- V Non – Destructive Testing**

Liquid penetrant method – ultrasonic flaw detection – ultrasonic flaw detector (block diagram) – X-ray Radiography: displacement method – X-ray Fluoroscopy – merits and demerits of each method.

**TEXT BOOK**


1. Gaur R. K. and Gupta S. L., "Engineering Physics", Dhanpat Rai publishers, New Delhi, 2001.
2. Rajendran. V, "Engineering Physics", Tata Mc Graw Hill Publication and Co New Delhi, 2009.


**REFERENCE BOOKS**


1. Pillai S.O "Solid Sate Physics", New Age International Publication, New Delhi, (2003).
2. Palanisamy P.K. "Physics for Engineers", Scitech publications (India) Pvt. Ltd., Chennai (2005).
3. Rajendran V and Marikani "Physics for Engineers", Tata McGraw Hill Publising Company Ltd, New Delhi(2004).
4. Arumugam M, "Engineering Physics", Anuradha Agencies, Kumbakonam, Second Edition(2005).

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| I | **ENGINEERING MECHANICS – STATICS (Common to Mech, Auto, Aero & Civil)** | 3 | 0 | 0 | 3 |

**AIM:** To provide the knowledge about mechanics and statics

**OBJECTIVE:** It is the branch of Engineering Mechanics, which deals with the forces and their effects, while acting upon the bodies at rest.

**OUTCOME:** The students would have learned the fundamental of Mechanics systems of forces which are very essential for engineering students to further build up his studies in the mechanical engineering branch.

**Unit – I** **9**

**Fundamentals of Mechanics:** Introduction, Basic Dimensions and units of mechanics, Secondary Dimensional Quantities, Law of Dimensional Homogeneity, Dimensional Relation Between Force and Mass, Unit of Mass, Idealizations of Mechanics, Vector and Scalar Quantities, Equality and Equivalence of Vectors, Law of Mechanics.

**Element of Vector Algebra:** Introduction, Magnitude and Multiplication of a Vector by a Scalar, Addition and Subtraction of Vectors, Resolution of Vectors: Scalar Components, Unit Vectors, Useful Ways of Representing Vectors, Scalar or Dot Product of Two Vectors, Cross product of Two Vectors, Scalar triple Product, Note on Vector Notation.

**Unit – II** **9**

**System of Forces:** Position Vector, Moment of a Force About a Point and Axis, Couple and Couple moment, Couple Moment as a Free Vector, Addition and Subtraction of Couples, Moment of a Couple about a Line.

**Equivalent Force System:** Introduction - Translation of a Force to a Parallel position, Resultant of Special Force Systems, Distributed Force Systems.

**Unit – III** **9**

**Equations of Equilibrium:** Introduction, Free Body Diagram, Free Bodies Involving Interior Sections, General Equations of Equilibrium, Problems in Equilibrium I and II, Two Point Equivalent Loading, Problems Arising From Structures, Static Indeterminacy.

**Unit-IV** **9**

**Friction Forces:** Introduction, Laws of Coulomb Friction, Simple and Complex Contact Friction Problems, Transmission of Power Through - Belts, Screw Jack, Wedge, Belt Friction, Square Screw Thread.

**Unit-V** **9**

**Properties of Surfaces:** Introduction, First Moment of an Area and the Centroid and Other Centers, Theorem of Pappus-Guldinus, Second Moments and the Product of an Area of a Plane Area, Transfer Theorems, Computations Involving Second Moments and Products of Area, Relation Between Second Moments and Products of Area, Polar Moment of Area, Principal Axes.

**Moments and Product of Inertia:** Introduction, Definition of Inertia Quantities, Relation Between Mass-Inertia Terms and Area-inertia Terms, Translation of Coordinates Axes.

**Total: 45 Hours**

**Text Book:**


1. Engineering Mechanics: Statics and Dynamics, Shames Irving H and G.Krishna Mohana Rao., Pearson Education, 2006
2. Engineering Mechanics: Statics and Dynamics, S.Rajasekaran and G.Sankara Subramaniam, Vikas Publishing House Pvt Ltd.,


**Reference:**


3. Engineering Mechanics, Dr. R.K.Bansal, Lakshmi Publications.
4. Engineering Mechanics, R.S.Khurmi, S.Chand Company Ltd.,

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| I | **ENGINEERING PHYSICS LAB (Common to all branches of B. E.)** | **0** | **0** | **3** | **2** |

**AIM:** To provide the knowledge about basics of physics
**OBJECTIVE:**
To gain the knowledge of taking precise readings from equipments
**OUTCOME**: Students will have the knowledge of taking measurements precisely

**List of Experiments**

1. Young's modulus of a bar - Non-uniform bending
2. Rigidity modulus of a wire - Torsional Pendulum
3. Viscosity of a liquid - Poiseuille's method
4. Velocity of ultrasonic waves in liquids - Ultrasonic Interferometer
5. Particle size determination using Laser
6. Wavelength of spectral lines – grating - Spectrometer
7. Thickness of a wire - Air wedge Method
8. Thermal conductivity of a bad conductor - Lee's disc
9. Band gap determination of a thermistor - Post Office Box
10. Specific resistance of a wire – Potentiometer

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| I | **WORKSHOP PRACTICE LAB**<br>**(Common to all departments - Except Bio-Tech & Bio info)** | **0** | **0** | **3** | **2** |

**AIM:**

The aim of the lab to learn Business fitting, Carpentry and welding technics.

**OBJECTIVE:** To learn the experience of practice in basic sections of the workshop namely fitting, Carpentry and welding in order to know the various methods involved in making parts of the various machines.

**OUTCOME:** The students would have been completely exposed to the various basic methods that are going to play in the manufacture of even very heavy machines.

**FITTING**

1. Vee Joint
2. Square Joint
3. Dove Tail Joint

**CARPENTRY**

1. Planning
2. Half lab
3. Dove Tail Joint

**WELDING**

1. Arc Welding of butt Joint.
2 Arc Welding of Lap Joint

**DEMONSTRATION**

1. Sheet Metal – Fabrication of tray and cone
2. Black Smithy – Round to square rod.
3. Foundry – Mould Preparation using single piece and split pattern

**Reference:**

1. "Basic Workshop Practice ", Department of Mechanical Engineering, VMKV EngineeringCollege, 2008

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| I | **COMPUTER FOUNDATION PROGRAM LAB (COMMON TO ALL BRANCHES)** | **0** | **0** | **3** | **2** |

**AIM:** To give the knowledge about computer programs

**OBJECTIVE:** The proposed course exposes the students to IT Essentials. The Core Modules of this paper includes Programming, Database and Operating system and other related topics.

**OUTCOME:**

At the end of this course, student shall be able to:

Do Problem Solving using Programming and algorithms, Describe working of Internet based applications, Document artifacts using common quality standards, Design simple data store using DBMS concepts and implement, Develop a working website with all above learning.

**I. OFFICE AUTOMATION**

1. Create a document with all formatting effects.
2. Create a document to send mails using mail merge option.
3. Create an Excel File to analyze the student's performance. Create a chart for the abovedata to depict it diagrammatically.
4. Create Excel sheet to maintain employee information and use this data to send mailsusing mail merge.
5. Create a Power Point presentation for your personal profile with varying animationeffects with timer.

**II. SQL QUERIES**

1. Write SQL Commands for Data Definition, Table Creation with constraints.
2. Write SQL Commands for Insert, Select, Update and Delete operations.
3. Write SQL Commands for aggregate functions.

**III. HTML**

1. Write HTML code to develop a web page having the background in red and title"My First Page" in any other color.
2. Design a page having background color given text color red and using all theattributes of font tab.
3. Create a web page, when user clicks on the link it should go to the bottom of thepage.
4. Create a web page, showing an ordered& unordered list of name of your five friends.
5. Create a web page with appropriate content and insert an image towards the lefthand side of the page when user clicks on the image. It should open another webpage.
6. Create a web page which should contain a table having two rows and twocolumns.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| II | **BUSINESS ENGLISH**<br>**(For I year B.E., all branches)** | **3** | **0** | **0** | **3** |

**AIM:** To provide the basic knowledge of business English.

**OBJECTIVES:**

1. To make the students understand the principles of Basic English grammar and use it in their day today life.
2. To make the engineering graduates employable and industry ready.
3. To make our students that they are second to none in the best use of the English language.

**OUTCOME:** Outcome of the revised Business English syllabus for the second semester UG Engineering students for the academic year 2012-2013.

1. By teaching this syllabus, it is believed that the UG Engineering graduates will develop their fluency level of using English.
2. Students, who undergo this syllabus, will fulfill the expectations of the industries and find themselves employable in any field.

**UNIT – I**

Subject and Verb Agreement (Concord) - Impersonal Passive Voice – Preposition - Cause and Effect - Phrasal Verbs - Idioms and Phrases - Question Tags – Vocabulary.Sentence Pattern (SVOCA) -Auxiliary and Modal verbs- Simple, Complex and Compound Sentences.

**UNIT – II**

Stress (Word Stress and Sentence Stress) – Intonation - Differences Between British and American English – Indianism.

**UNIT – III**

Understanding Ideas and Making Inferences- Interview Questions (Direct, Open-ended and Closed Questions) - E-mail Netiquette, Sample E-mails- Group Discussion and Mock interview.

**UNIT – IV**

Instruction - Check-list - Minutes of the Meeting and Writing Agenda - Note making. Rearranging the jumbled sentences- Technical Articles- Project Proposals.

**UNIT – V**

Skimming - Scanning -Reading Comprehension - Interpreting Tables - Business Letters (Calling for Quotation, Placing Orders and Complaint Letters) - Essay Writing and Developing Hints – Expansion of an Idea.

**TEXT BOOK**

1. **English for Effective Communication,**
Departments of English, VMKV & AVIT.
Erode: SCM Publishers, 2009.

**REFERENCE BOOKS**

1. M.Ashraf Rizvi, **Effective Technical Communication.**
New Delhi:Tata McGraw Hill Publications, 2007.
2. Pickett and Laster.**Technical English: Writing, Reading and Speaking.**
New York: Harper and Row Publications, 2002.
3. Cutts, Martin.**ThePlain English Guide – How to Write Clearly and Communicate Better.**
New Delhi: OxfordUniversity Press, 1995.
4. Narayanaswami.V.R.**Strengthen Your Writing.** Chennai: Orient Longman Ltd., 1996.
5. Prof.K.R.Lakshmi Narayanan & Dr.T.Murugavel, **Communication Skills for Engineers,**
Chennai: SCI Publications, 2002.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| II | **ENGINEERING MATHEMATICS-II (COMMON TO THE BRANCHES MECH, ECE, CSE, CSSE, EEE, EIE,CIVIL,IT,MECHTRONICS, AERONAUCTICAL , ETC, AUTOMOBILE)** | **3** | **1** | **0** | **4** |

**AIM:** To provide students with mathematical knowledge and skills needed to support their concurrent and subsequent engineering and science studies

**OBJECTIVES:** The syllabus for the Engineering Mathematics II have been framed catering to the needs of the Engineering students. It is purely applications oriented. To mention a few (i) Differential equation plays a vital role in finding the solutions of problems related to oscillations of Mechanical and Electrical systems, bending of beam, conduction of heat, velocity of chemical reaction etc.,and as such play an very important role in all modern scientific and engineering studies.(ii)The complex functions are useful in the study of Fluid mechanics, Thermodynamics and electric fields.

**OUTCOME:** At the end of this course the students will be in a position to apply the knowledge of Mathematics in the respective Engineering branches.

**UNIT I ORDINARY DIFFERENTIAL EQUATIONS 09**

Solutions of third and higher order linear ordinary differential equation with constant coefficients– Method of variation of parameters– Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

**UNIT II MULTIPLE INTEGRALS 09**

Double integration –change of order of integration- Cartesian and polar coordinates –Area as a double integral – Triple integration – volume as a triple integral.

**UNIT III VECTOR CALCULUS 09**

Directional derivatives – Gradient, Divergence and Curl – Irrotational and solenoidal- vector fields – vector integration – Green's theorem, Gauss divergence theorem and Stoke's theorem (excluding proof).

**UNIT IV ANALYTIC FUNCTIONS 09**

Function of a complex variable –Analytic function – Necessary conditions - Cauchy Riemann equations – Sufficient conditions (excluding proof) – Harmonic conjugate–Constructions of analytic functions-conformal mapping($w=z+c, w=z^2, w=1/z$)-bilinear transformation

**UNIT V COMPLEX ANALYSIS 09**

Statement and application of Cauchy's integral theorem and integral formula – Taylor's and Laurent's expansions –Residues – Cauchy's residue theorem-contour integration over unit circle.

**Tutorial Hours: 15 Lecture Hours: 45 Total hours: 60**

**TEXT BOOKS**


1**. "**Engineering Mathematics**"** by Department of Mathematics, VMU

2. Veerarajan, T., "Engineering Mathematics", Tata McGraw Hill Publishing Co., NewDelhi, 2006.

3.Dr.A .Singaravelu ,Engineering Mathematics Volume I & Volume II by Meenakshi Publications.


**REFERENCE BOOKS**


1. Grewal, B.S., "Higher Engineering Mathematics" (36th Edition), Khanna Publishers,Delhi 2001.
2. Kreyszig, E., "Advanced Engineering Mathematics" (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
3. Kandasamy .P., Thilagavathy. K., and Gunavathy. K., "Engineering Mathematics",Volumes I & II (4th edition), S.Chand & Co., New Delhi., 2001

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| II | **ENGINEERING CHEMISTRY**<br>(Common to all Branches) | **3** | **0** | **0** | **3** |

**AIM**

To impart in basic knowledge in chemistry so that the student will understand the engineering concept and they can face the competitive examinations effectively

**OBJECTIVE**

With a solid foundation in basic scientific and engineering principles, while allowing specialization in Engineering chemistry and ability to assess the impact of engineering solutions in a global and societal context.

**OUTCOME**

The student will come out with the ability to assess the impact of engineering solutions.

**UNIT I : WATER TECHNOLOGY & CORROSION 9**

Sources of water – impurities – Hardness and its determination (problems to be avoided) – boiler troubles – water softening (zeolite & Demineralisation) – Domestic water treatment – Desalination (Electrodialysis & Reverse Osmosis).
Corrosion – Types – principles – corrosion control methods (Sacrificial and Impressed current method).

**UNIT II : ELECTROCHEMISTRY, BATTERIES AND FUEL CELLS 9**

Ostwald Law and Debye Huckle's law - Cells – Electrode (SHE, Calomel and Glass) - Electrode potential – Nernst equation – EMF series.
Primary cells – secondary batteries – charging and discharging.

**UNIT III : CHEMISTRY OF ADVANCED MATERIALS 9**

Portland cement –setting and hardening – RCC – Special cements.
Organic electronic material, solid oxide materials, shape memory alloys, nanomaterials, polymers, fullerenes, ceramics, fibers, lubricants, refractories & composites (definition, classification and applications)

**UNIT IV : PHASE EQUILIBRIA & NUCLEAR CHEMISTRY 9**

Phase rule: statement and explanation of terms involved – One component system –
Condensed phase rule – Two component system.
Nuclear Chemistry – Fission – Fusion – working of nuclear reactor – Radiations and harmful effects.

**UNIT V : CHROMATOGRAPHY AND SPECTROSCOPY 9**

Chromatography — classification & principles (Paper, column, thin layer, gas, HPLC).
Spectroscopy – Electromagnetic radiation – Beer Lambert's law – UV – Visible – IR (Principle and Instrumentation, block diagram) – Atomic absorption spectroscopy.

**Total: 45 hours**

**REFERENCES**:


1. Engineering Chemistry by S.S. Dara.
2. Engineering Chemistry by Jain & Jain.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| II | **PROGRAMMING IN C**<br>(Common to all Branches) | 3 | 0 | 0 | 3 |

**AIM:**

The aim is to introduce C programming to the students.

**OBJECTIVES:**

To enable the student to learn programming knowledge in C.

**OUTCOME:**

Do develop the skill of the student to develop the programming in C language.

**UNIT I Introduction**

Algorithms & flowcharts-Overview of C-Features of C-IDE of C Structure of C program-Compilation & execution of C program-Identifiers, variables, expression, keywords, data types, constants, scope and life of variables, local and global variables. Operators: arithmetic, logical, relational, conditional and bitwise operators- Special operators: size of () & comma (,) operator-Precedence and associativity of operators & Type conversion in expressions.

**Basic input/output and library functions**

Single character input/output i.e. getch(), getchar(), getche() & putchar()-Formatted input/output: printf() and scanf()-Library Functions: concepts, mathematical and character functions.

**UNIT II Control structures**

Conditional control-Loop control and Unconditional control structures.

**Functions:** The Need of a function-User defined and library function- Prototype of a function-Calling of a function-Function argument-Passing arguments to function- Return values-Nesting of function-main()-Command line arguments and recursion. Storage class specifier – auto, extern, static, & register.

**UNIT III**

**Arrays:** Single and multidimensional arrays-Array declaration and initialization of arrays-Array as function arguments.

**Strings:** Declaration-Initialization and string handling functions.

**Structure and Union:** Defining structure-Declaration of structure variable-Accessing structure members-Nested structures-Array of structures-Structure assignment-Structure as function argument-Function that returns structure- Union.

**UNIT IV**

**Pointers:** The '&' and * operators-Pointers expressions-Pointers vs arrays-Pointer to functions-Function returning pointers-Static and dynamic memory allocation in C.

**DMA functions:** malloc(), calloc(), sizeof(), free() and realloc()-Preprocessor directives.

**UNIT V**

**File management:** Defining, opening & closing a file, text file and binary file- Functions for file handling: fopen,fclose, gets, puts, fprintf, fscan, getw, putw, fputs, fgets, fread, fwrite-Random access to files: fseek, ftell, rewind-File name as Command Line Argument.

**TEXT BOOKS:**

1. Balaguruswami.E, 'Programming in C', TMH Publications,1997

**REFERENCE BOOKS:**

1. Behrouz A. Forouzan & Richard F. Gilberg, "Computer Science A Structured Programming using C", Cengage Learning, 3rd Edition, 2007
2. Gottfried , 'Programming with C', schaums outline series, TMH publications,1997
3. Mahapatra , 'Thinking in C', PHI publications, 2nd Edition, 1998.
4. Stevens , 'Graphics programming in C', BPB publication, 2006
5. Subbura.R , 'Programming in C', Vikas publishing, 1st Edition, 2000

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| II | **MATERIAL SCIENCE**<br>**(Common to Mechanical, Auto, Aero & Civil of B. E.)** | **3** | **0** | **0** | **3** |

**AIM:** To provide the knowledge about various materials used in engineering

**OBJECTIVE:**

To familiarize students with the classical and quantum aspects of materials and their application in Engineering & Technology

**OUTCOME:**

Students will be enabled in applying their knowledge of materials in Engineering & Technology

**UNIT- I Conducting Materials**

Classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function

**UNIT- II Semiconducting Materials**

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – extrinsic semiconductors – carrier concentration derivation in n-type and p-type semiconductor Hall effect –Experimental arrangement and Applications.

**UNIT – III Magnetic and Dielectric Materials**

Origin of magnetic moment – Bohr magneton – Dia and para magnetism – Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti – ferromagnetic materials – Ferrites – applications

**UNIT – IV Dielectric Materials**

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internal field – Claussius – Mosotti relation (derivation) – dielectric loss - uses of Dielectric materials

**UNIT- V Nano Materials**

Synthesis of nanostructured materials – Top-down and Bottom-up methods- Lithography - sol-gel method - carbon nanotubes - synthesis of carbon nanotubes - applications

**TEXT BOOKS:**

1. Charles Kittel ‘Introduction to Solid State Physics’, John Wiley & sons, Singapore (2007).
2. Pillai S.O ‘Solid Sate Physics’, New Age International Publication, New Delhi, (2003).
3. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.

**REFERENCES:**

1. Rajendran, V, and Marikani A, ‘Materials science’ TMH publications, New delhi(2004).
2. Jayakumar, S. ‘Materials science’, R.K. Publishers, Coimbatore, (2008).
3. Palanisamy P.K, ‘Materials science’, Scitech publications(India) Pvt. LTd., Chennai, second Edition(2007).
4. Arumugam. M, ‘Materials Science’ Anuradha publications, Kumbakonam, (2006).
5. Rajendran. V, “Engineering Physics”, Tata Mc Graw Hill Publication and Co New Delhi, (2009).

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| II | **ENGINEERING MECHANICS – DYNAMICS (Common to Mech, Auto & Aero)** | 3 | 1 | 0 | 4 |

**AIM:** To study about mechanics and dynamics in engineering.

**OBJECTIVE:** It is the branch of Engineering Mechanics, which deals with the forces and their effects, while acting upon the bodies in motion.

**OUTCOME:** The students would have learned the fundamental of Mechanics systems of forces Kinematics of particle, Impulse–Momentum Methods for Rigid bodies which are very essential for engineering students to further build up his studies in the mechanical engineering branch.

**Unit-I** **9**

**Kinematics of a Particle – Simple Relative Motion**

Introduction, General Notions, Velocity and Acceleration Calculations, Simple, Kinematical Relations and Applications

**Particle Dynamics**

Introduction, Rectangular Coordinates, Rectilinear Translation, Cylindrical Coordinates, central Force Motion, System of Particles

**Unit – II** **9**

**Energy Method for Particles**

**Analysis for a Single Particle:** Introduction, Conservative Force Field, Conservation of Mechanical Energy, Alternative form of Work-Energy Equation.

**System of particles:** Work-Energy Equations, Kinetic Energy Expression Based on Center of Mass, Work-Kinetic Energy Expression Based on Center of Mass

**Linear Momentum:** Impulse and Momentum Relations for a Particle, Linear-Momentum Considerations for a System of Particles, Impulsive Forces, Impact Forces.

Moment of Momentum: Moment of Momentum Equation for a Single and a system of particles.

**Unit – III** **9**

**Kinematics of Rigid Bodies: Relative Motion**

Introduction, Translation and Rotation of Rigid Bodies, Chasles' Theorem, Applications of the Fixed-Vector Concept, General Relationships between Time Derivatives of a Vector for Different References, General Relationships between Velocities of a Particle for Different References, Acceleration of a Particle for Different References.

**Unit – IV** **9**

**Kinetics of Plane Motion of Rigid Bodies**

Introduction, Moment-of-Momentum Equations, Pure Rotation of a body of Revolution About its Axis of Revolution, Pure Rotation of a body with Two Orthogonal Planes of Symmetry, Pure Rotation of Slab Like Bodies, Rolling Slab Like Bodies, General Plane Motion of a Slab Like Bodies, Pure Rotation of an Arbitrary Rigid Body.

**Unit – V** **9**

**Energy and Impulse–Momentum Methods for Rigid Bodies**

Introduction, Energy Method: Kinetic Energy of a Rigid Body, Work – Energy Relations, Impulse–Momentum Methods: Angular Momentum of a Rigid Body about any Point in the Body, Impulse–Momentum Equations, Impulsive Forces and torques, Eccentric-Impact.

**Total: 45 PERIODS**

**Text Book:**


1. Engineering Mechanics: Statics and Dynamics, Shames Irving H and G.Krishna Mohana Rao., Pearson Education, 2006
2. Engineering Mechanics: Statics and Dynamics, S.Rajasekaran and G.Sankara Subramaniam, Vikas Publishing House Pvt Ltd.,


**Reference:**


3. Engineering Mechanics, Dr. R.K.Bansal, Lakshmi Publications.
4. Engineering Mechanics, R.S.Khurmi, S.Chand Company Ltd.,

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| II | **PROGRAMMING IN C LAB (COMMON TO CSE, IT, CSSE, M.Sc, MECH, AUTO, AERO, CIVIL, BIO-TECH, BIO-INFO)** | **0** | **0** | **3** | **2** |

**AIM:**

To practice and develop applications using C Programming languages.

**OBJECTIVES:**

To enable the student to learn programming knowledge in C.

**OUTCOME:**

Do develop the skill of the student to develop the programming in C language.

**Experiments:**

1. Implementation of Sine and cosine series.
2. Generation of Fibonacci series.
3. To find the i) Factorial number.
   ii) Sum of n natural numbers.
4. Reversing the digits of an integer
5. Conversion of decimal number to octal number
6. Conversion of character integer to decimal number
7. Finding the square root of a given number by applying algorithm
8. (a) Find GCD of two numbers

(b) Generate Prime numbers between 1 and n.

9. Greatest of three numbers using if statement and conditional operator.
10. Read two numbers and swap those two numbers using temporary variable and without using temporary variable.
11. Quadratic equation for different sets of inputs.
12. Use of switch….Case statements.
13. Matrix operations
    a) Addition
    b) Transpose
    c) Multiplication
14. Ascending and Descending order.
15. Given a set of n numbers, find the length of the longest monotone increasing subsequence.
16. Sort by exchange,selection and partitioning method
17. Use of pointers and array of pointers
18. Linear search.
19. Binary search.
20. Files operations.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| II | **ENGINEERING GRAPHICS (Common to MECH, AUTO, AERO, CIVIL, ECE, EIE, EEE, ETC& MECT)** | **0** | **0** | **3** | **2** |

**AIM:** To study about basics of engineering graphics

**OBJECTIVES:** To develop in student's graphic skill for communication of concepts, ideas and designof engineering products and expose them to existing national standards related totechnical drawings.

**OUTCOME:** The students would have learned the engineering graphics which is the basic language for an engineer to communicate is idea in manufacturing the various items.

**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.

**Free hand sketching:**

Representation of Three Dimensional objects – General principles of orthographicprojection – Need for importance of multiple views and their placement – First angleprojection – layout views – Developing visualization skills through free handsketching of multiple views from pictorial views of objects.

**UNIT I PLANE CURVES AND FREE HAND SKETCHING 9**

**Curves used in engineering practices:**

Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method –Construction of cycloid – construction of involutes of squad and circle – Drawing oftangents and normal to the above curves.

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 9**

Projection of points and straight lines located in the first quadrant – Determination oftrue lengths and true inclinations – Projection of polygonal surface and circularlamina inclined to both reference planes.

**UNIT III PROJECTION OF SOLIDS 9**

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis isinclined to one reference plane by change of position method.

**UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 9**

Sectioning of above solids in simple vertical position by cutting planes inclined to onereference plane and perpendicular to the other – Obtaining true shape of section.Development of lateral surfaces of simple and truncated solids – Prisms, pyramids,cylinders and cones – Development of lateral surfaces of solids with cylindricalcutouts, perpendicular to the axis.

**UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 9**

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.Perspective projection of prisms, pyramids and cylinders by visual ray method.

**Total: 45 PERIODS**

**TEXT BOOKS:**

1. N.D. Bhatt, "Engineering Drawing" Charotar Publishing House, 46$^{th}$Edition,(2003).
2. K. V. Natrajan, "A text book of Engineering Graphics", DhanalakshmiPublishers, Chennai (2006).

**REFERENCES:**

1. M.S. Kumar, "Engineering Graphics", D.D. Publications, (2007).
2. K. Venugopal & V. Prabhu Raja, "Engineering Graphics", New AgeInternational (P) Limited (2008).
3. M.B. Shah and B.C. Rana, "Engineering Drawing", Pearson Education(2005).
4. K. R. Gopalakrishnana, "Engineering Drawing" (Vol.I&II), Subhas Publications(1998).
5. Dhananjay A.Jolhe, "Engineering Drawing with an introduction to AutoCAD"Tata McGraw Hill Publishing Company Limited (2008).
6. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw HillPublishing Company Limited, New Delhi, (2008).

**Note: 1.** Mini drafter is to be used for unit-I&II

2. Free hands sketch and drafting software is to be used for Unit-III, IV&V.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| **II** | **ENGINEERING CHEMISTRY LAB**<br>(Common to all Branches) | **0** | **0** | **3** | **2** |

**AIM**:

To impart in basic knowledge in chemistry so that the student will understand the engineering concept.

**OBJECTIVE:**

To learn the relevant experience using laboratory experiments

**OUTCOME:**

The student will have the experience in handling the instruments relevant to his/her theory.

1. Estimation of total hardness of water sample by EDTA method.
2. Determination of alkalinity by indicator method.
3. Estimation of ferrous ion by Potentiometry.
4. Titration of strong acid with strong base by Conductometry.
5. Acid base reaction by pH metry.
6. Estimation of copper from its ore.
7. Estimation of iron by spectrophotometer.
8. Estimation of sodium by flame photometer.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| III | **ADVANCED ENGINEERING MATHEMATICS** (Common to CIVIL, MECH, MECHAT,AUTO, AERO, ECE, EEE, CSE, EIE, IT) | 3 | 1 | 0 | 4 |

**AIM:** The aim of the subject is to provide a fundamental knowledge of Partial differential equation and Fourier series

**OBJECTIVES:**

- Partial differential equations arises in most of the Engineering discipline when the number of independent variables in the given problem under discussion is two or more.
- Fourier series is used to express even aperiodic functions in terms of periodic functions making them amenable for further processing.
- Fourier series has the wide application in the field of heat diffusion, wave propagation and in signal and systems analysis.
- Transform techniques are very useful in the field of signal and system analysis.
- Z - transform plays an important role in analysis of Discrete signals. This is a prelude to learn higher semester courses.

**OUTCOME:** The student will understand the usage of Fourier series application in the field of heat diffusion, wave propagation and in signal and systems analysis

**UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9**

Formation - Solutions of standard types f(p,q)=0, clairauts form, f(z,p,q)=0,f(p,x)=g(q,y) of first order equations - Lagrange's Linear equation - Linear partial differential equations of second and higher order with constant coefficients.

**UNIT II FOURIER SERIES 9**

Dirichlet's conditions - General Fourier series - Half-range Sine and Cosine series - Parseval's identity – Harmonic Analysis.

**UNIT III BOUNDARY VALUE PROBLEMS 9**

Classification of second order linear partial differential equations - Solutions of one - dimensional wave equation, one-dimensional heat equation - Steady state solution of two-dimensional heat equation - Fourier series solutions in Cartesian coordinates.

**UNIT IV FOURIER TRANSFORMS 9**

Statement of Fourier integral theorem - Fourier transform pairs - Fourier Sine and Cosine transforms – Properties - Transforms of simple functions - Convolution theorem - Parseval's identity.

**UNIT V Z - TRANSFORM 9**

Z-Transform – Elementary Properties – Inverse Z-Transform – Convolution Theorem – Formation of Difference Equations – Solution of Difference Equations using Z-Transform.

**Tutorial : 15 Total hours: 60**

**TEXT BOOK:**

A.Singaravelu,"Transforms and Partial Differential Equations", Meenakshi Agencies,Chennai

**REFERENCES:**


1. T. Veerarajan, "Engineering Mathematics" (for semester III), Third Edition Tata McGraw- Hill Publishing Company limited.
2. Grewal, B.S., "Higher Engineering Mathematics" (35th Edition), Khanna Publishers,Delhi 2000.
3. Kreyszig, E., "Advanced Engineering Mathematics" (8th Edition), John Wiley and Sons,(Asia) Pte Ltd.,Singapore, 2000.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| III | ELECTRICAL AND ELECTRONICS ENGINEERING | 3 | 0 | 0 | 3 |

**AIM:** To facilitate the understanding of the principles of electrical and electronics engineering.
**OBJECTIVE**:

- To understand the basics of electrical circuits i.e. series and parallel.
- To understand the effect of magnetic lines of force on electricity.
- To understand the Principle and operation of electrical machines.
- To understand the basics of electronics and operation of electronic devices.
- To understand the operation of communication system.

**OUUTCOME:** The students would be able to understand about electric and magnetic circuits along with electrical, electronics and communication engineering

**Unit I Electric Circuits 9**

Definition of Voltage, Current, Power & Energy, Ohm‟s law, Kirchoff‟s Law & its applications – simple problems, division of current in series & parallel circuits, generation of alternating EMF, definition of RMS value, average value, peak factor, form factor. Power in single phase AC – three phase system.

**Unit II Magnetic Circuits 9**

Definition of MMF, Flux, Reluctance, Properties of Flux lines, Self & Mutual Inductance, Ampere Turns, Series & parallel magnetic circuits, Comparison between Electric & magnetic circuits, Law of Electromagnetic induction, Fleming‟s Right & Left hand rule.

**Unit III Electrical Machines 9**

Construction, Type, Principle of Operation & Working Principle of DC Generator, DC Motor, Transformer, Induction Motor, Induction type single phase energy meter, Domestic wiring practice, Tube light circuit, Earthing&earthing methods.

**Unit IV Electronics Engineering 9**

PN Junction diode &Zener diode – Characteristics – Half wave and full wave rectifier – Bipolar junction transistors – CB,CE, CC Configurations and characteristics – basic concepts of amplifiers and oscillators – Logic gates – Inverting, Non inverting amplifiers and Operational amplifiers- Basic Computer organization – Block diagram of Microprocessors (8085)

**Unit V Communication Engineering 9**

Introduction to communication systems – Need for modulation – Types- Block Diagram representation only– Block diagram of TV system – Introduction to cellular & mobile telephony- Block diagram of Optical and Satellite communication systems.

**TOTAL : 45** Periods

**Textbooks:**

1. Nagsarkar T K &Sukhija M S, “Basic of Electrical Engineering”, Oxford Press 2005.
2. Muthusubramaninan R, Salivahanan S and Muraleedharan K A, “Basic Electrical, Electronics and Computer Engineering”, Tata McGraw Hill, Second Edition 2004.

**References:**

1. Edminister J A, “Electric Circuits”, Schaum‟s Series. McGraw Hill, 2005
2. Van Valkenbergm, “Electric Circuits and Network Analysis”, Prentice Hall (India) Pvt, Ltd, 2005.
3. SmarjithGhosh, “Fundamentals of Electrical and Electronics Engineering”, Prentice Hall (India) Pvt, Ltd, 2005.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| III | ELEMENTS OF AERONAUTICS | 3 | 0 | 0 | 3 |

**AIM**: To introduce the basic concepts of aerospace engineering and the current developments in the field**.**

**OBJECTIVE**:

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

**OUTCOME:** The students would be able to understand about history, principle, configurations, structure and power plants of airplanes**.**

**UNIT I HISTORICAL EVALUATION 8**

Early airplanes, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

**UNIT II AIRCRAFT CONFIGURATIONS 5**

Components of an airplane and their functions. Different types of flight vehicles, classifications. Types of control systems, Basic instruments for flying, Typical systems for control actuation.

**UNIT III INTRODUCTION TO PRINCIPLES OF FLIGHT 10**

Physical properties and structure of the atmosphere, Temperature, pressure and altitude relationships, Evolution of lift, drag and moment.Types of Aerofoils, Mach number, Maneuvers.

**UNIT IV INTRODUCTION TO AIRPLANE STRUCTURES AND MATERIALS 12**

General types of construction, Monocoque, semi-monocoque and geodesic construction, Typical wing and fuselage structure. Metallic and non-metallic materials, Use of aluminium alloy, titanium, stainless steel and composite materials.

**UNIT V POWER PLANTS USED IN AIRPLANES 10**

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

**TOTAL : 45 Periods**

**TEXT BOOKS**

1. Anderson, J.D., “Introduction to Flight”, McGraw-Hill, 1995.

**REFERENCES**

1. Kermode, A.C., “Flight without Formulae”, McGraw-Hill, 1997.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| III | **ENGINEERING THERMODYNAMICS** (Common to MECH,AUTO and AERO) | 3 | 1 | 0 | 4 |

**AIM:** To introduce the basic concepts of thermodynamic laws and power cycles.

**OBJECTIVE:**

- To achieve an understanding of fundamentals of thermodynamic systems and first law of thermodynamics.
- To provide an in-depth study of availability and second law of thermodynamics.
- To understand the concept of working fluid and its properties.
- To provide in-depth study of power cycles applying the different working fluids studied in the previous chapter.
- To understand the Thermodynamic Relations and also to understand combustion equations.

**OUTCOME:** The students would be able to understand about three laws of thermodynamics and power cycles.

**UNIT –I BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS 9**

Thermodynamic systems, Concepts of continuum, Thermodynamic properties, Equilibrium, Process cycle, Work, temperature, Zeroth law of Thermodynamics.First law of thermodynamics – Applications to closed and open systems, Internal energy, Specific heats, Enthalpy, Steady and unsteady flow conditions.Problens.

**UNIT –II SECOND LAW OF THERMODYNAMICS 9**

Statements, Reversibility, Causes of irreversibility, Carnot cycle, Reversed Carnot cycle, Heat engines, refrigerators, Heat pumps.Clausius inequality, Entropy, Principles of increase in entropy, Carnot theorem, Available energy, Availability.Problems.

**UNIT –III WORKING FLUIDS 9**

Definition of working fluid ,Thermodynamic properties of pure substances, property diagram, PVT surface of water and other substances, calculation of properties. First law and second law analysis using tables and charts.Properties of ideal and Real gases, Equation of state, Gas laws, Vanderwaal's equation of state, Compressibility, Compressibility charts, Dalton's law of partial pressures, Internal energy, enthalpy, Heat and molecular weight of gas mixtures. .

**UNIT –IV POWER CYCLES 9**

Gas Power Cycles – Carnot, Otto, Diesel, Dual, Brayton, Ericsson, Stirling, Lenoir, and Atkinson cycles. Problems on Otto , Diesel , Dual and Brayton Cycles.Vapour Power Cycles – Rankine, modified rankine, Reheat, Regeneration Cycles, Binary vapour power cycles. Problems.

**UNIT –V THERMODYNAMIC RELATIONS AND COMBUSTION OF FUELS 9**

Exact differentials, T-Ds relations, Maxwell relations, clausius clapeyron equations, Joule- Thomson coefficient.Heat value of fuels, Combustion equations, Theoretical and excess air, Air fuel ratio, exhaust gas analysis, Problems.

**Tutorial : 15 Total: 60Periods**

**TEXT BOOKS**


1. Nag.P.K. - "Engineering Thermodynamics", IV Edition, Tata McGraw-Hill- New Delhi- 2008.
2. Rajput. R.K.,"A Textbook of Engineering Thermodynamics", Third Edition,Laxmi Publications, New Delhi, 2005.
3. Yunus.A.Cengel, Michael A.Boles, Thermodynamics : An Engineering Approach, McGh, 2011.


**REFERENCES**


1. Spalding & Cole., Engineering Thermodynamics, ELBS
2. Van Wylen & Sonntag., fundamentals of classical thermodynamics – Tata Mc Graw Hill
3. Rogers & Mayhew, Engineering Thermodynamics – Addision Wesley.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| III | **FLUID MECHANICS AND MACHINERY** (Common to MECH, MECT, AUTO & AERO) | **3** | **1** | **0** | **4** |

**AIM:** To introduce the basic concepts of fluid properties and various pumps and turbines

**OBJECTIVE:**

- To understand the basic fundamentals in Fluid Mechanics
- To understand the kinematics in the fluid flow.
- To understand the fluid flow concepts in application to different parameters and references.
- To understand the working principle, applications, design of various hydraulic turbines.
- To understand the working principle, applications, design of various hydraulic pumps.

**OUTCOME:** The students would be able to understand about fluid properties and types of pumps

**UNIT –I - BASIC CONCEPTS AND PROPERTIES**

Fluid – Definition - solid and fluid - Units and dimensions - Properties of fluids – Temperature - Viscosity - Compressibility - Vapour pressure - Capillary and surface tension - Fluid statics: concept of fluid static pressure - Pressure measurements by manometers and pressure gauges. Introduction to CFD, geophysical fluid dynamics.Velocity and density measurement methods.

**UNIT –II - FLUID KINEMATICS AND SIMILARITIES**

Fluid Kinematics - Flow visualization - Lines of flow - Types of flow - Velocity field and acceleration - Continuity equation (one and three dimensional differential forms)- Equation of streamline - Stream function - Velocity potential function - Circulation - Flow net – Fluid dynamics - Equations of motion - Euler's equation along a streamline - Bernoulli's equation – Applications - Venturi meter - Orifice meter - Pitot tube - Dimensional analysis - Buckingham's $\pi$ theorem- Applications - Similarity laws and models.

**UNIT –III - INCOMPRESSIBLE FLUID FLOW**

Viscous flow - Navier-Stoke's equation - Shear stress - Pressure gradient relationship - Laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseulle's) - Hydraulic and energy gradient - Flow through pipes - Darcy - Weisbagh's equation - Pipe roughness -Friction factor-Moody's diagram - Minor losses - Flow through pipes in series and in parallel - Power transmission - Boundary layer flows - Boundary layer thickness - Boundary layer separation - Drag and lift coefficients.major losses-design aspect in application of drag and lift coefficients. Piping Engineering-Introduction and Applications.

**UNIT –IV - HYDRAULIC TURBINES**

Fluid machines: definition and classification - Exchange of energy - Euler's equation for turbo machines - Construction of velocity vector diagrams - Head and specific work - Components of energy transfer - Degree of reaction.Hydro turbines: definition and classifications - Pelton turbine - Francis turbine - propeller turbine - Kaplan turbine - Working principles - Velocity triangles - Work done - Specific speed - Efficiencies - Performance curve for turbines.Energy saving design requirements for turbine.

**UNIT –V - HYDRAULIC PUMPS**

Pumps: definition and classifications - Centrifugal pump: classifications - Working principle- velocity triangles - Specific speed - Efficiency and performance curves - Reciprocating pump: classification - Working principle - Indicator diagram -Work saved by air vessels and performance curves - Cavitations in pumps - Rotary pumps- Applications.

**TEXT BOOKS**


1. Bansal- R.K.- "Fluid Mechanics and Hydraulics Machines"- ($5^{th}$ edition)- Laxmi publications (P) Ltd- New Delhi- 1995
2. Kumar- K.L.- "Engineering Fluid Mechanics"- Eurasia Publishing House (P) Ltd- New Delhi ($7^{th}$ edition)- 1995.


**REFERENCES**


1. White- F.M.- "Fluid Mechanics"- Tata McGraw-Hill- $5^{th}$ Edition- New Delhi- 2003.
2. Ramamurtham. S- "Fluid Mechanics and Hydraulics & Fluid Machines"-Dhanpat Rai & Sons, Delhi- 2003.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| III | **MECHANICS OF MACHINES** (Common to AUTO & AERO) | 3 | 1 | 0 | 4 |

**AIM:** To expose the students the different mechanisms, their method of working, Forces involved and consequent vibration during working.

**OBJECTIVE:**

- To understand the Kinematic analysis of simple mechanisms and its velocity and accelerations.
- To understand the working principle, applications, design of various hydraulic pumps.
- To know the Gear and cam profile and geometry.
- To study the Static and dynamic balancing of the various masses.
- To study the vibrations of single degree of freedom systems and Vibration isolation and absorption.

**OUTCOME:** The students would be able to understand about mechanics, friction, balancing and vibration of machines

**UNIT I MECHANISMS 9**

Machine Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom - Slider crank and crank rocker mechanisms – Inversions – Applications – Kinematic analysis of simple mechanisms – Determination of velocity and acceleration.

**UNIT II FRICTION 9**

Friction in screw and nut – Pivot and collar – Thrust bearing – Plate and disc clutches – Belt (flat and V) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive.

**UNIT III GEARING AND CAMS 9**

Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicyclic gear trains - Determination of speed and torque- Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions

**UNIT IV BALANCING 9**

Static and dynamic balancing – Single and several masses in different planes –Balancing of reciprocating masses- primary balancing and concepts of secondary balancing – Single and multi cylinder engines (Inline) – Balancing of radial V engine –direct and reverse crank method

**UNIT V VIBRATION 9**

Free, forced and damped vibrations of single degree of freedom systems – Force transmitted to supports – Vibration isolation – Vibration absorption – Torsional vibration of shaft – Single and multi rotor systems – Geared shafts – Critical speed of shaft.

**TOTAL : 45 Periods**

**TEXT BOOKS**

1. Rattan.S.S, "Theory of Machines", Tata McGraw–Hill Publishing Co., New Delhi,2004
2. Ballaney.P.L, "Theory of Machines", Khanna Publishers, New Delhi, 2002.
3. Khurmi.R.S. and Gupta ., Theory of Machines , S.Chand @ Co., 2005.

**REFERENCE BOOKS**

1.Rao,J.S and Dukkipati, R.V, "Mechanism and Machine Theory", Second Edition, Wiley Eastern Ltd., 2002.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| III | FLUID MECHANICS AND MACHINERY LABORATORY | 0 | 0 | 3 | 2 |

**AIM**: To find the performance of pump like centrifugal pump, reciprocating pump, Gear pump. To find the coefficient of discharge of orifice meter and venture meter conducting the characteristic curves of Kaplan turbine, Francis turbine and Pelton wheel.

**OBJECTIVE:**The subject should enable the student to:

- Understand the properties of the fluid and also to learn about the pressure and velocity of the flowing fluid using venture meter, orifice meter.
- Understand the discharge of fluid by using pump like centrifugal, reciprocating and gear pump and also to find the rate of flow using rota meter.
- Understand the efficiency of turbine like Kaplan and francis.
- Understand the change in pressure (friction factor) of given set of pipes.
- Understand the efficiency of Pelton wheel.

**OUTCOME:** The students would be able to understand about theexperiments in various pumps and turbine

## LIST OF EXPERIMENTS

1. Calibration of venturimeter
2. Pressure measurement with pitot static tube
3. Determination of pipe flow losses.
4. Verification of Bernoulli's theorem.
5. Flow visualization by Heleshaw apparatus.
6. Performance test on centrifugal pumps.
7. Performance test on reciprocating pumps.
8. Performance test on pelton wheel turbine.
9. Performance test on Francis turbine.
10. Determination of Viscosity of a Fluid.

***TOTAL: 60 Periods***

### *LIST OF EQUIPMENTS*

*(for a batch of 30 students)*

| Sl.No | Details of Equipments | Qty Req. | Experiment No. |
|---|---|---|---|
| 1. | Venturimeter setup | 1 | 1,3 |
| 2. | Pipe friction set up | 1 | 3 |
| 3. | Pitot tube set up | 1 | 2,4 |
| 4. | Jet pump | 1 | 6 |
| 5. | Submersible pump | 1 | 6 |
| 6. | Centrifugal pump | 1 | 6 |
| 7. | Reciprocating pump | 1 | 7 |
| 8. | Pelton wheel turbine and Francis turbine | 1 | 8,9 |
| 9. | Viscosity Meter | 1 | 10 |
| 10. | Hele-shaw apparatus | 1 | 5 |

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| III | ELECTRICAL AND ELECTRONICS ENGINEERING LAB | 0 | 0 | 3 | 2 |

**AIM:** To study about the basics of EEE lab

**OBJECTIVES:**

To enable the student to learn basics of electrical fundamentals.

**OUTCOMES:**

Do develop the skill of the student to use electrical devices in engineering products.

## LIST OF EXPERIMENTS

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

TOTAL: 60Periods

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| III | THERMODYNAMICS LABORATORY | 0 | 0 | 3 | 2 |

**AIM**: The students would be able to understand about the basics of Thermodynamics and carry out various experiments on Heat exchanger and stroke engines**.**
**OBJECTIVE:** To know about diesel engine, Gas Turbine Engine, Parallel and counter flow heat exchanger, Conductive Heat Transfer set up
**OUTCOME:** To develop skills on thermal machineries**.**

## LIST OF EXPERIMENTS

1. Performance test on a 4-stroke engine
2. Valve timing of a 4 – stroke engine and port timing of a 2 stroke engine
3. Determination of effectiveness of a parallel flow heat exchanger
4. Determination of effectiveness of a counter flow heat exchanger
5. Determination of the viscosity coefficient of a given liquid
6. COP test on a vapour compression refrigeration test rig
7. COP test on a vapour compression air-conditioning test rig
8. Study of a Gas Turbine Engine.
9. Determination of Conductive Heat Transfer Coefficient.
10. Determination of Thermal Resistance of a Composite wall.

TOTAL: 60 ***Periods***

## LIST OF EQUIPMENTS (for a batch of 30 students)

| Sl.No | Details of Equipments | Qty Req. | Experiment No. |
|---|---|---|---|
| 1. | 4 stroke twin cylinder diesel engine | 1 | 1 |
| 2. | Cut section model of 4 stroke kirloskar diesel engine and cut section model of 2 stroke petrol engine | 1 | 2 |
| 3. | Parallel and counter flow heat exchanger test rig | 1 | 3,4 |
| 4. | Red wood viscometer | 1 | 5 |
| 5. | Vapour compression refrigeration test rig | 1 | 6 |
| 6. | Vapour compression air-conditioning test rig | 1 | 7 |
| 7. | Gas Turbine Engine | 1 | 8 |
| 8. | Conductive Heat Transfer set up | 1 | 9 |
| 9. | Composite wall | 1 | 10 |

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| IV | NUMERICAL METHODS (COMMON TO MECH,AERO,AUTO,MECT, CIVIL& EEE ) | 3 | 1 | 0 | 4 |

**AIM :**To understand the concepts of eigen value, interpolation, integration& differentiation problems

**OBJECTIVES:**

- Computing the trajectory of a spacecraft requires the accurate numerical solution of a system of ordinary differential equations.
- It is used in Kinematics Simulation, Complex System Optimization
- Car companies can improve the crash safety of their vehicles by using computer simulations of car crashes. Such simulations essentially consist of solving partial differential equations numerically.
- Numerical linear algebra is important for data analysis.
- Airlines use sophisticated optimization algorithms to decide ticket prices, airplane and crew assignments and fuel needs. Historically, such algorithms were developed within the overlapping field of operations research.

**OUTCOME:** The students would be able to understand about eigen value, interpolation & approximation, differentiation & integration, ODE problems

**UNIT I SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 9**

Method of false position, Newton-Raphson method for single variable, Solutions of a linear system by Gaussian, Gauss-Jordan, Jacobian and Gauss- Seidel methods.Inverse of a matrix by Gauss-Jordan method.Eigen value of a matrix by Power Method.

**UNIT II INTERPOLATION AND APPROXIMATION 9**

Interpolation with Newton's divided differences, Lagrange's polynomial, Newton forward and backward differences, central difference Formula (Stirling's and Bessel's ).

**UNIT IIINUMERICAL DIFFERENTIATION AND INTEGRATION 9**

Numerical differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's (both $1/3^{rd}$ and $3/8^{th}$ ) rules. Rombergs rule,Two and Three point Gaussian quadrature formula. Double integrals using Trapezoidal and Simpson's rule.

**UNIT IVINITIAL VALUE PROBLEMS OF ODE 9**

Solution of equations related to simple harmonic motion, Oscillations of a spring mass system, Simple pendulum, Oscillatory electrical circuit and Deflection of beams with initial conditions - using Taylor series. Euler, Modified Euler and Runge-Kutta methods.

**UNITVBOUNDARY VALUE PROBLEMS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9**

Finite difference solution for the second order ordinary differential equations, Finite difference solution for one dimensional heat equation (both implicit and explicit). One dimensional wave equation and two dimensional Laplace and Poisson equations.

**Tutorial : 15 Hours Practical : 15 Hours Total : 75 Hours**

**TEXT BOOK**


1. A. Singaravelu ,"Numerical Methods" , Meenakshi Agency, Chennai
2. B.S.Grewal,"Higher Engineering Mathematics"Khanna Publishers,New Delhi.


**REFERENCES**


1. Sastry, S.S., " Introductory Methods of Numerical Analysis (Third Edition) ", Printice Hall of India, New Delhi, 1998.
2. T.Veerarajan, T.Ramachandran, " Numerical Methods with Programs in C and C++", Tata McGraw-Hill (2004).
3. Grewal, B.S. and Grewal, J.S., Numerical Methods in Engineering and Science Khanna Publishers, New Delhi, 1999.
4. N.Subramanian,Numerical Methods,SCM Publishers,Erode.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| IV | AERODYNAMICS – I | 3 | 1 | 0 | 4 |

**AIM:** To study aerodynamic concepts and understanding motion of air around an object enables the calculation of forces and moments acting on the object.

**OBJECTIVE:**

- To understand the fluid mechanics concepts for advanced applications.
- To study two dimensional flows in aerodynamics.
- To integrate the mathematics with aerodynamics.
- To study ideal flows over wings.
- To study real time viscous flows.

**OUTCOME:** The students would be able to understand about fluids, 2-D incompressible flow, aerofoil, wing theory and laminar & turbulent flow.

**UNIT I REVIEW OF BASIC FLUID MECHANICS 10**

System and Control volume approach, substantial, local and convective derivative, Continuity, momentum and energy equations, Inviscid 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, Equipontential Lines, Elementary Flows and their combinations.

**UNIT II TWO DIMENSIONAL INVISCID INCOMPRESSIBLE FLOW 8**

Ideal Flow over a circular cylinder, D'Alembert's Paradox, Magnus effect, KuttaJoukowski's Theorem, Starting Vortex, Kutta condition, Real flow over smooth and rough cylinder.

**UNIT III AIRFOIL THEORY 9**

Cauchy-Riemann relations, Complex Potential, Methodology of Conformal Transformation, Kutta-Joukowski transformation and its applications, Karman Trefftz Profiles, Thin Airfoil theory and its applications.

**UNIT IV SUBSONIC WING THEORY 8**

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

**UNIT V INTRODUCTION TO LAMINAR AND TURBULENT FLOW 10**

Boundary layer and boundary layer thickness, displacement thickness, momentum thickness, Energy thickness, Shape parameter, Boundary layer equations for a steady, two dimensional incompressible flow, Boundary Layer growth over a Flat plate, Critical Reynolds Number, Clausius solution, Basics of Turbulent flow, Prandtl's mixing length hypothesis, Free shear layers.

**Tutorial : 15 Total: 60 Periods**

**TEXT BOOK**


1. Houghton, E.L., and Caruthers, N.B., Aerodynamics for Engineering students, Edward Arnold Publishers Ltd., London, 1989.
2. Anderson, J.D., Fundamentals of Aerodynamics, MaGraw Hill Book Co., 1999


**REFERENCES**


1. Milne Thomson, L.H., Theoretical Aerodynamics, Macmillan, 1985
2. John J Bertin., Aerodynamics for Engineers, Pearson Education Inc, 2002 3. Clancey, L J., Aerodynamics, Pitman, 1986

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| IV | PROPULSION – I | 3 | 0 | 0 | 3 |

**AIM:** To study in detail about fundamentals of aircraft propulsion, advanced propulsion systems in gas turbine engine. To understand the principles of operation and design of aircraft power plants.

**OBJECTIVE:**

- To know the fundamentals of gas turbines and its components.
- To know the design and performance of subsonic and supersonic inlets.
- To study the types of compressors and their working principles.
- To know the different types of combustion chambers and factors affecting the combustors.
- To study the types of nozzles and flow properties in nozzles.

**OUTCOME:** The students would be able to understand about gas turbine engine, subsonic & supersonic inlets, compressors, combustion chamber and nozzles.

**Unit I Fundamentals of Gas Turbine Engines 9**

Classification of gas turbines – Open cycle and Closed cycle turbines, efficiencies -Illustration of working of gas turbine engine – The thrust equation – Factors affectingthrust – Effect of pressure, velocity and temperature changes of air enteringcompressor – Methods of thrust augmentation – Characteristics of turboprop, turbofanand turbojet – Performance characteristics.

**Unit II Subsonic and Supersonic Inlets for Jet Engines 9**

Internal flow and Stall in subsonic inlets – Boundary layer separation – Major featuresof external flow near a subsonic inlet – Relation between minimum area ratio andeternal deceleration ratio – Diffuser performance – Supersonic inlets – Startingproblem on supersonic inlets – Shock swallowing by area variation – Externaldeclaration – Models of inlet operation.

**Unit III Compressors 9**

Principle of operation of centrifugal compressor – Work done and pressure rise –Velocity diagrams – Diffuser vane design considerations – Concept of prewhirl –Rotation stall – Elementary theory of axial flow compressor – Velocity triangles –degree of reaction – Three dimensional – Air angle distributions for free vortex andconstant reaction designs – Compressor blade design – Centrifugal and Axialcompressor performance characteristics

**Unit IV Combustion Chambers 9**

Classification of combustion chambers – Important factors affecting combustionchamber design – Combustion process – Combustion chamber performance – Effectof operating variables on performance – Flame tube cooling – Flame stabilization –Use of flame holders – Numerical problems.Fuels: Types of fuels – Fuel Chemistry – limits of flammability.

**Unit V Nozzles 9**

Theory of flow in isentropic nozzles – Convergent nozzles and nozzle choking –Nozzle throat conditions – Nozzle efficiency – Losses in nozzles – Over expandedand under – expanded nozzles – Ejector and variable area nozzles – Interaction ofnozzle flow with adjacent surfaces – Thrust reversal.

**Total: 45Periods**

**Text books:**

1. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" Addison – Wesley Longman INC, 1999.
2. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. "Gas Turbine Theory",Longman, 1989.

**References:**

1. Oates, G.C., "Aero thermodynamics of Aircraft Engine Components", AIAAEducation Series, New York, 1985.
2. "Rolls Royce Jet Engine" – Third Edition – 1983.
3. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion",Standard Publishers & Distributors, Delhi, 1999.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| IV | AIRCRAFT STRUCTURES – I | 3 | 1 | 0 | 4 |

**AIM**: Analysis and design of simple aircraft structural components.

**OBJECTIVE:**

- To Understand various structural elements.
- To Understand statically determinate and indeterminate structural analysis.
- To Understand various energy method.
- To understand columns with various end condition.
- To understand various failure theories**.**

**OUTCOME:** The students would be able to understand about the knowledge about structures, columns and failure theory of aircraft.

**Unit I Statically Determinate Structures 9**

Analysis of plane truss – Method of joints – 3 D Truss - Plane frames

**Unit II Statically Indeterminate Structures 9**

Composite beam - Clapeyron's Three Moment Equation - Moment Distribution Method.

**Unit III Energy Methods 9**

Strain Energy due to axial, bending and Torsional loads - Castigliano's theorem -Maxwell's Reciprocal theorem, Unit load method - application to beams, trusses, frames,rings, etc.

**Unit IV Columns 9**

Columns with various end conditions – Euler‟s Column curve – Rankine‟s formula -Column with initial curvature - Eccentric loading – South well plot – Beam column.

**Unit V Failure Theory 9**

Maximum Stress theory – Maximum Strain Theory – Maximum Shear Stress Theory –Distortion Theory – Maximum Strain energy theory – Application to aircraft Structuralproblems.

**Tutorial : 15 Total: 60 Periods**

**Textbooks:**

Donaldson, B.K., “Analysis of Aircraft Structures – An Introduction”, McGraw-Hill,1993.

**Reference:**

Timoshenko, S., “Strength of Materials”, Vol.I and II, Princeton D. Von NostrandCo, 1990.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| IV | AIRCRAFT SYSTEMS AND INSTRUMENTS | 3 | 0 | 0 | 3 |

**AIM:** To make the students to understand the principle and working of aircraft systems and Instruments.

**OBJECTIVE:**

- To know the various types of Airplanes control systems, its components & its applications.
- Study of piston and gas turbine engine system and the various components of engines, its material requirements.
- To understand the purpose of hydraulic system & its component requirement in a modern aircraft.
- To study the various instruments used in a modern aircraft and its purpose.
- To know the various auxiliary system used in the modern Jet aircraft & its purpose.

**OUTCOME:** The students would be able to understand about airframe, engine, electrical, radio & radar systems.

**UNIT I AIRFRAME SYSTEMS 9**

Hydraulic systems - Study of typical workable system - components - Hydraulic system controllers - Modes of operation - Pneumatic systems - Advantages - Working principles - Typical Air pressure system – Brake system - Typical Pneumatic power system - Components, Landing Gear systems - Classification – Shock absorbers-Retractivemechanism.

**UNIT II ENGINE SYSTEMS 9**

Fuel systems for Piston and jet engines, - Components of multi engines. lubricating systems for piston and jet engines - Starting and Ignition systems - Typical examples for piston and jetengines.

**UNIT III AIRCRAFTELECTRICAL CONTROL SYSTEMS 9**

Power actuated systems ,Conventional Systems - Power assisted and fully powered flight controls - Engine control systems - Push pull rod system, flexible push full rod system - Components - Modern control systems - Digital fly by wire systems - Auto pilot system active control Technology, and Navigation systems Instrument landing systems, VOR – CCVcasestudies.

**UNIT IV AIRCRAFT INSTRUMENTS SYSTEM 9**

Flight Instruments,– Gyroscope – Auto pilot system – Data recorder- Black box- accelerometers, Air speed Indicators – TAS, EAS- Mach Meters - Altimeters - Principles and operation - Study of various types of engine instruments - Tachometers - Temperature gauges - Pressure gauges - Operation and Principles.

**UNIT V RADIO AND RADAR SYSTEM 9**

Communication and Navigation Instruments ,Data buses-MIL STD 1553, ARINC 429 and ARINC 629, Distance measuring equipment-Introduction Nature of Radar, Maximum Unambiguous Range, Radar Waveforms, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications.

**Total: 45 Periods**

**TEXT BOOKS**

1. McKinley, J.L., and Bent, R.D., "Aircraft Maintenance & Repair", McGraw-Hill,1993.
2. "General Hand Books of Airframe and Power plant Mechanics", U.S. Dept. of Transportation, Federal Aviation Administration, The English Book Store, New Delhi1995.

**REFERENCES**

1.Mekinley, J.L. and Bent, R.D., "Aircraft Power Plants", McGraw-Hill, 1993.
2. Pallet, E.H.J., "Aircraft Instruments & Principles", Pitman & Co., 1993.
3. Introduction to Radar Systems – Merrill I. Skolnik, Second edition, McGrawHill,1981.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| IV | **STRENGTH OF MATERIALS** (Common To MECH, AERO& AUTO) | **3** | **1** | **0** | **4** |

**AIM:** To make the students to understand the material properties like stress, strain, deflection and torsion

**OBJECTIVE:**

- To understand basic mechanical forces acting on rigid and deformable bodies
- To draw shear force and bending moment diagram for various types of beams
- To analyze the torsional effects on circular bars ,shafts , helical springs
- To form deflection equations of beams and columns for different end conditions
- To analyze the two dimensional stresses and deformation of cylinders and spherical shells

**OUTCOME:** The students would be able to understand about stress, strain, torsion and deflection

**UNIT –I -STRESS- STRAIN AND DEFORMATION OF SOLIDS 9**

Properties of material, Concept of Stress and Strain, Hook'sLaw, Stress Strain Diagram for structural steel and Non-ferrous materials.Poisson's Ratio & principles ofsuperposition, Total elongation of tapering bars of circular and rectangular cross-sections. Elongation dueto self-weight, Volumetric strain. Expression for Volumetric strain, Elastic constants, relationshipamong elastic constants, compound bars Rigid and Deformable bodies – Strength- Stiffness and Stability – Stresses; Tensile- Compressive and Shear – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads.

**UNIT –II BEAMS - LOADS AND STRESSES 9**

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever- Simply supported and Overhanging beams – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Shear stresses in beams.

**UNIT –III -TORSION 9**

Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts – Application to close-coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads – Design of helical coil springs.

**UNIT –IV -DEFLECTION OF BEAMS 9**

Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope : Double integration method- Macaulay Method- and Moment-area Method –Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns – Introduction to curved beams.

**UNIT –V -ANALYSIS OF STRESSES IN TWO DIMENSIONS 9**

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr's circle for biaxial stresses – Maximum shear stress - Strain energy in bending and torsion.

**Tutorial : 15 Total: 60 Periods**

**TEXT BOOKS**

1. Ramamutham.S- Strength of Materials- S.Chand &B Co.- New Delhi-2007.
2. Beer F. P. and Johnston R- "Mechanics of Materials"- McGraw-Hill Book Co- Third Edition- 2008.

**REFERENCES**

1. Nash W.A- "Theory and problems in Strength of Materials"- Schaum Outline Series- McGraw-Hill Book Co- New York- 2005
2. Ryder G.H- "Strength of Materials"- Macmillan India Ltd.- Third Edition- 2007
3. Ray Hulse- Keith Sherwin & Jack Cain- "Solid Mechanics"- Palgrave ANE Books- 2006.
4. Singh D.K "Mechanics of Solids" Pearson Education 2009.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| IV | AIRCRAFT STRUCTURES I – LABORATORY | 0 | 0 | 3 | 2 |

**AIM:** To make the students understand the basics and conduct experiments on aircraft structures and loads acting on it.

**OBJECTIVE:** The objective of conducting the Aircraft structure laboratory is to make the students understand and appreciate various principle and theorems involved in the theory of aircraft structures, vibrations and experimental stress analyzing the results. This will immensely help the students to enrich their knowledge in the design of various aircraft structural components, namely, wings, fuselage, landing gear, control surfaces, etc.

**OUTCOME:** The students would be able to understand about various loads acting on an aircraft.

## LIST OF EXPERIMENTS

1. Determination of Young's modulus of steel using mechanical extensometers.
2. Determination of Young's modulus of aluminum using electrical extensometers
3. Determination of fracture strength and fracture pattern of ductile materials
4. Determination of fracture strength and fracture pattern of brittle materials
5. Stress Strain curve for various engineering materials.
6. Deflection of beams with various end conditions.
7. Verification of Maxwell's Reciprocal theorem & principle of superposition
8. Column – Testing
9. South – well's plot.
10. Riveted Joints.

**TOTAL: 60Periods**

**LIST OF EQUIPMENTS (***for a batch of 30 students)*

| Sl. No. | Equipments | Qty | Experiments No. |
|---|---|---|---|
| 1. | Universal Testing Machine | 1 | 1,2,3,4,5,10 |
| 2. | Mechanical Extensometer | 1 | 1 |
| 3. | Electrical stain gauge | 10 | 2 |
| 4. | Stain indicator | 1 | 2 |
| 5. | Dial Gauges | 12 | 3,4 |
| 6. | Beam Test set up with various end conditions | 2 | 3,4 |
| 7. | Weight 1 Kg | 10 | 3,4 |
| 8. | Weight 2 Kg | 10 | 3,4 |
| 9. | Weight Pans | 6 | 3,4 |
| 10. | Column Test Apparatus | 1 | 5,6 |
| 11. | Rivet | 30 | 10 |

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| IV | AIRCRAFT SYSTEMS LABORATORY | 0 | 0 | 3 | 2 |

**AIM:** To make the students understand about various aircraft systems

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

**OUTCOME:** The students would be able to understand about jacking, levelling, rigging, symmetry checks on aircraft.

## 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 : 60 Periods*

## LIST OF EQUIPMENTS

*(for a batch of 30 students)*

| S.No. | Items | Quantity | Experiment No. |
|---|---|---|---|
| 1. | Serviceable aircraft with all above systems | 1 | 1,2,3,4,5,6,7,8,9,10 |
| 2. | Hydraulic Jacks (Screw Jack) | 5 | 1,2,4,8 |
| 3. | Trestle adjustable | 5 | 1,2,4,8 |
| 4. | Spirit Level | 2 | 8 |
| 5. | Levelling Boards | 2 | 8 |
| 6. | Cable Tensiometer | 1 | 8 |
| 7. | Adjustable Spirit Level | 1 | 8 |
| 8. | Plumb Bob | 1 | 8 |

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| IV | AERODYNAMICS LABORATORY | 0 | 0 | 3 | 2 |

**AIM:** To make the students understand about wind tunnel and flow over various airfoils

**OBJECTIVE**: To study experimentally the aerodynamic forces on different bodies at low speeds.

**OUTCOME:** The students would be able to understand about flow and pressure distribution over various airfoils.

## LIST OF EXPERIMENTS

**1.** Calibration of subsonic wind tunnel.
**2.** Pressure distribution over smooth and rough cylinder.
**3.** Pressure distribution over symmetric airfoils.
**4.** Pressure distribution over cambered airfoils & thin airfoils
**5.** Force measurement using wind tunnel balance.
**6.** Flow over a flat plate at different angles of incidence
**7.** Flow visualization studies in low speed flows over cylinders
**8.** Flow visualization studies in low speed flows over airfoil with different angle of incidence
**9.** Calibration of supersonic wind tunnel.
**10.** Supersonic flow visualization with Schlieren system.

**TOTAL: 60 Periods**

**LIST OF EQUIPMENT** (for a batch of 30 students)

| Sl. No. | Items | Quantity | Experiment No. |
|---|---|---|---|
| 1. | Wind Tunnel test section size around 300 x 300 mm with test section flow speed of 60 m/s. | 1 No. | 1, 2,3,4,5 |
| 2. | Wings of various airfoil sections (Symmetrical & cambered airfoils) | 2 Nos. each | 3, 4 |
| 3. | Angle of incidence changing mechanism | 1 No. | 3, 4 |
| 4. | Multiple Manometer stands with 20 – 30 manometer tubes | 4 Nos. | 2,3,4 |
| 5. | U-Tube Manometer | 1 No. | 1,2,3,4 |
| 6. | Static Pressure Probes | 4 Nos. | 1,2,3,4 |
| 7. | Total Pressure Probest | 4 Nos. | 1,2,3,4 |
| 8. | Pitot-Static Tubes | 4 Nos. | 1,2,3,4 |
| 9. | Wooden Models of Three Dimensional bodies (eg. Cylinder etc.,) | 2 Nos. each | 2 |
| 10. | Wind Tunnel balances (3 or 5 or 6 components) | 1 No. | 5 |
| 11. | Pressure Transducers with digital display | 1 No. | 1,2,3,4 |
| 12. | Hele-Shaw apparatus, Smoke Tunnel, Water flow channel | 1 each | 6,7,8 |
| 13. | Supersonic Wind tunnel of test section size 100 x 100 mm with storage tank capacity of 500$ft^2$ at 20 bar | 1 No. | 9,10 |
| 14. | Wooden models of cone, wedge and blunt body configurations of suitable size for flow visualization in a supersonic wind tunnel test section | 1 No. | 9,10 |
| 15. | Schlieren System | 1 No. | 9,10 |

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| V | AERODYNAMICS – II | 3 | 1 | 0 | 4 |

**AIM:** To understand the behaviour of airflow both internal and external in compressible flow regime with particular emphasis on supersonic flows.

**OBJECTIVE:**

- Understand the Fundamentals of compressible flow.
- Study the shock and expansion waves.
- Study the two dimensional compressible flow.
- Study the high speed flows over airfoils, wings and airplane configurations.
- Study the boundary layer interaction**.**

**OUTCOME:** The students would be able to understand about 2-D compressible flow, shock & expansion waves, high speed flow over wings & airfoils

**UNIT I FUNDAMENTAL ASPECTS OF COMPRESSIBLE FLOW 8**

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

**UNIT II SHOCK AND EXPANSION WAVES 12**

Normal shock relations, Prandtl's relation, Hugoniot equation, Raleigh Supersonic Pitot tube equation, Moving normal shock waves, Oblique shocks, $\theta - \beta - M$ relation, Shock Polar, Reflection of oblique shocks, left running and right running waves, Interaction of oblique shock waves, slip line, Rayleigh flow, Fanno flow, Expansion waves, Prandtl-Meyer expansion, Maximum turning angle, Simple and non-simple regions, operating characteristics of Nozzles, under expansion, over expansion.

**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 8**

Critical Mach number, Drag divergence Mach number, Shock Stall, Supercritical Airfoil Sections, Transonic area rule, Swept wing, Airfoils for supersonic flows, Lift, drag, Pitching moment and Centre of pressure for supersonic profiles, Shock expansion theory, wave drag, supersonic wings, Design considerations for supersonic aircrafts.

**UNIT V SPECIAL TOPICS 8**

Shock-Boundary layer interaction, Wind tunnels for transonic, Supersonic and hypersonic flows, shock tube, Gun tunnels, Supersonic flow visualization, Introduction to Hypersonic Flows, Numerical Analysis of one Dimensional flow.

**Tutorial : 15 Total: 60 Periods**

**TEXT BOOKS**

1. Anderson, J. D, Modern Compressible Flow, McGraw-Hill & Co., 2002.
2. Rathakrishnan., E, Gas Dynamics, Prentice Hall of India, 2004.

**REFERENCES**

1. Shapiro, A. H., Dynamics and Thermodynamics of Compressible Fluid Flow, Ronald Press, 1982.
2. Zucrow, M. J. and Anderson, J. D., Elements of Gas Dynamics, McGraw- Hill & Co., 1989.
3. Oosthuizen,P.H., &Carscallen,W.E., Compressible Fluid Flow, McGraw- Hill & Co., 1997.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| V | PROPULSION – II | 3 | 0 | 0 | 3 |

**AIM:** To have introduction of Advanced propulsion system.

**OBJECTIVE:**

- To study about the turbines and its performance for various conditions.
- To study the basics of ramjet and scramjet with their performance characteristics.
- To study the types of rockets and their working principles.
- To study about chemical rockets and propellants used in chemical rockets.
- To study the advances in rocket propulsion and space propulsion.

**OUTCOME:** The students would be able to understand about gas turbines, ramjet, Hypersonic engines and chemical propulsion.

**UNIT I AIRCRAFT GAS TURBINES 8**

Impulse and reaction blading of gas turbines – Velocity triangles and power output –Elementary theory – Vortex theory – Choice of blade profile, pitch and chord –Estimation of stage performance – Limiting factors in gas turbine design- Overallturbine performance – Methods of blade cooling – Matching of turbine andcompressor – Numerical problems.

**UNIT II RAMJET PROPULSION 8**

Operating principle of ramjet engine – various components of ramjet engines and their efficiencies – Combustion in ramjet engine – critical, subcritical and supercritical modes of operation -ramjet engine and its performance characteristics – sample ramjet design calculations – flame stability problems in ramjet combustors –integral
ram rockets.

**UNIT III HYPERSONIC AIRBREATHING PROPULSION 9**

Introduction to hypersonic airbreathing propulsion, hypersonic vehicles and supersonic combustion-need for supersonic combustion for hypersonic propulsion – salient features of scramjet engine and its applications for hypersonic vehicles – problems associated with supersonic combustion – engine/airframe integration aspects of hypersonic vehicles – various types scramjet combustors – fuel injection schemes in scramjet combustors – one dimensional models for supersonic combustion using method of influence coefficients.

**UNIT IV CHEMICAL ROCKET PROPULSION 12**

Operating principle – specific impulse of a rocket – internal ballistics – rocket performance considerations – solid propellant rockets – selection criteria of solid propellants – propellant grain design considerations – erosive burning in solid rockets – liquid propellant rockets – selection of liquid propellants – various feed systems forliquid rockets -thrust control in liquid rockets – cooling in liquid rockets and the associated heat transfer problems – advantages of liquid rockets over solid rockets - introduction to hybrid propulsion – advantages and limitations of hybrid propulsion - static testing of rockets and safety considerations.

**UNIT V ADVANCED PROPULSION TECHNIQUES 8**

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

**Total: 45Periods**

**TEXT BOOKS:**

1. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 5th Edition, 1993.
2. Mathur, M.L., and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers and Distributors, Delhi, 1988.

**REFERENCES:**

1**.** David H. Heiser and David T. Pratt., “Hypersonic Airbreathing Propulsion”, AIAA Education Series, 1999.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| V | AIRCRAFT STRUCTURES – II | 3 | 1 | 0 | 4 |

**AIM:** Analysis and design of aircraft structural components.

**OBJECTIVE:**

- To understand the unsymmetrical bending.
- To Study the shear flow in open sections.
- To Study the shear flow in closed sections.
- To Study the buckling of plates.
- To analyze the stress on wing and fuselage.

**OUTCOME**: The students would be able to understand aboutunsymmetrical bending, shear flow in open & closed sections, and stress analysis in wings & fuselage

**UNIT I UNSYMMETRICAL BENDING 8**

Bending stresses in beams of unsymmetrical sections – Bending of symmetricsections with skew loads.

**UNIT II SHEAR FLOW IN OPEN SECTIONS 9**

Thin walled beams, Concept of shear flow, shear centre, Elastic axis. With one axis ofsymmetry, with wall effective and ineffective in bending, unsymmetrical beamsections.

**UNIT III SHEAR FLOW IN CLOSED SECTIONS 10**

Bredt – Batho formula, Single and multi – cell structures.Approximate methods.Shear flow in single & multicell structures under torsion. Shear flow in single andmulticell under bending with walls effective and ineffective.

**UNIT IV BUCKLING OF PLATES 9**

Rectangular sheets under compression, Local buckling stress of thin walled sections,Crippling stresses by Needham‟s and Gerard‟s methods, Thin walled column strength.Sheet stiffener panels. Effective width, inter rivet and sheet wrinkling failures.

**UNIT V STRESS ANALYSIS IN WING AND FUSELAGE 9**

Procedure – Shear and bending moment distribution for semi cantilever and othertypes of wings and fuselage, thin webbed beam. With parallel and non parallelflanges, Shear resistant web beams, Tension field web beams (Wagner‟s).

**Tutorial : 15 Total: 60 Periods**

**TEXT BOOK**

Peery, D.J., and Azar, J.J., “Aircraft Structures”, 2nd edition, McGraw–Hill, N.Y.,1993.

**REFERENCES**

1. Megson, T.M.G., “Aircraft Structures for Engineering Students”, Edward Arnold,1995.

2. Bruhn. E.H. “Analysis and Design of Flight vehicles Structures”, Tri – state off setcompany, USA, 1985.

3. Rivello, R.M., “Theory and Analysis of Flight Structures”, McGraw-Hill, 1993.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| V | AIRCRAFT PERFORMANCE | 3 | 0 | 0 | 3 |

**AIM :** To introduce the concepts of Dynamics of Airplanes. Pre-requisite: Basics of Aerodynamics.

**OBJECTIVE:**

- To understand the atmosphere and performance of propellers.
- To understand the drag and its relation with mach number.
- To calculate Range and Endurance of Propeller and Jet airplanes.
- To calculate rates during climb and cruise conditions.
- To understand the Pull up and pull down maneuvers**.**

**OUTCOME:** The students would be able to understand about drag of bodies, steady level gliding and accelerated flight**.**

**UNIT I GENERAL CONCEPTS 9**

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

**UNIT II DRAG OF BODIES 8**

Streamlined and bluff body, Types of drag, Effect of Reynold's number on skin friction and pressure drag, Drag reduction of airplanes, Dragpolar, Effect of Mach number on drag polar

**UNIT III STEADY LEVEL FLIGHT 10**

Steady level flight, Thrust required and Power required, Thrust available and Power available for propeller driven and jet powered aircraft, Effect of altitude, maximum level flight speed, conditions for minimum drag and minimum power required, Effect of drag divergence on maximum velocity, Range and Endurance of Propeller and Jet airplanes.

**UNIT IV GLIDING AND CLIMBING FLIGHT 9**

Shallow and steep angles of climb, Rate of climb, Climb hodograph, Maximum Climb angle and Maximum Rate of climb- Effect of design parameters for propeller and jet aircrafts, Absolute and service ceiling, Cruise climb, Gliding flight, Glide hodograph

**UNIT V ACCELERATD FLIGHT 9**

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

**TOTAL: 45 Periods**

**TEXT BOOKS:**

1. Houghton,E.L. and Carruthers, N.B. Aerodynamics for engineering students, Edward Amold Publishers, 1988.
2. Anderson, Jr., J.D. Aircraft Performance and Design, McGraw-Hill International Edition, 1999

**REFERENCES:**

1. Kuethe, A.M. and Chow, C.Y., Foundations of Aerodynamics, John Wiley & Sons, 1982.
2. J.J.Bertin, Aerodynamics for Engineers, Prentice-Hall, 1988.
3. L.J. Clancey, Aerodynamics, Pitman, 1986
4. Anderson, Jr., J.D. Introduction to Flight, McGraw-Hill International Edition, 1999

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| V | HEAT TRANSFER | 3 | 1 | 0 | 4 |

**AIM:** To introduce the concepts of heat and mass transfer**.**

**OBJECTIVE:**

- To understand the physical behaviour of various modes of heat transfer, like, conduction, convection and radiation.
- To understand the application of various experimental heat transfer correlations in engineering calculations.
- To understand the basic concept of radiative heat transfer, its types & its correlations.
- To understand the thermal Analysis and sizing of heat exchangers.
- To study the Heat Transfer problems in aircraft and rocket engine combustion chamber.

**OUTCOME:** The students would be able to understand about heat conduction convective & radiation, heat exchangers & heat transfer problems

**UNIT I HEAT CONDUCTION 11**

Basic Modes of Heat Transfer – One dimensional steady state heat conduction: Composite Medium – Critical thickness – Effect of variation of thermal Conductivity –Extended Surfaces – Unsteady state. Heat Conduction: Lumped System Analysis – Heat Transfer in Semi- infinite and infinite solids – Use of Transient – Temperature charts – Application of numerical techniques.

**UNIT II CONVECTIVE HEAT TRANSFER 10**

Introduction – Free convection in atmosphere free convection on a vertical flat plate –Empirical relation in free convection – Forced convection – Laminar and turbulent convective heat transfer analysis in flows between parallel plates, over a flat plate and in a circular pipe. Empirical relations, application of numerical techniques in problem solving.

**UNIT III RADIATIVE HEAT TRANSFER 8**

Introduction to Physical mechanism – Radiation properties – Radiation shape factors –Heat exchange between non – black bodies – Radiation shields.

**UNIT IV HEAT EXCHANGERS 8**

Classification – Temperature Distribution – Overall heat transfer coefficient, Heat Exchange Analysis – LMTD Method and E-NTU Method.

**UNIT V HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING 8**

High-Speed flow Heat Transfer, Heat Transfer problems in gas turbine combustion chambers – Rocket thrust chambers – Aerodynamic heating – Ablative heat transfer.

**TUTORIAL : 15 TOTAL: 60 Periods**

**TEXT BOOKS**

1. Yunus A. Cengel., "Heat Transfer – A practical approach", Second Edition, TataMcGraw-Hill, 2002.
**2.** Incropera. F.P.andDewitt.D.P. " Introduction to Heat Transfer", John Wiley andSons – 2002.
3. Nag. P.K., "Heat and Mass Transfer", Tata McGraw-Hills Co., Ltd.,

**REFERENCES**

1. Lienhard, J.H., "A Heat Transfer Text Book", Prentice Hall Inc., 1981.
2. Holman, J.P. "Heat Transfer", McGraw-Hill Book Co., Inc., New York, 6th Edn.,1991.
3. Sachdeva, S.C., "Fundamentals of Engineering Heat & Mass Transfer", WileyEastern Ltd., New Delhi, 1981.
4. Mathur, M. and Sharma, R.P. "Gas Turbine and Jet and Rocket Propulsion",Standard Publishers, New Delhi

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| V | AIRCRAFT STRUCTURES – IILABORATORY | 0 | 0 | 3 | 2 |

**AIM:** To make the students understand the basics and conduct experiments on aircraft structures and loads acting on it.

**OBJECTIVE:** To experimentally study the unsymmetrical bending of beams, find the location of shear centre , obtain the stresses in circular discs and beams using photo elastic techniques, calibration of photo – elastic materials and study on vibration of beams.

**OUTCOME:** The students would be able to understand about various loads acting on an aircraft.

## LIST OF EXPERIMENTS

1. Unsymmetrical bending of beams
2. Shear centre location for open sections
3. Shear centre location for closed sections
4. Constant strength beam
5. Flexibility matrix for cantilever beam
6. Beam with combined loading
7. Calibration of Photo- elastic materials
8. Stresses in circular discs and beams using photoelastic techniques
9. Vibrations of beams
10. Wagner beam – Tension field beam

TOTAL: 60 **Periods**

LIST OF EQUIPMENT

*(for a batch of 30 students)*

| Sl.No. | Name of the Equipment | Qty | Experiments Number |
|---|---|---|---|
| 1 | Beam Test set –up | 2 | 1, 2, 3,4 |
| 2 | Unsymmetrical sections like ‘Z’ sections | 2 | 1, 2, 3 |
| 3 | Channel section and angle section | 2 | 1, 2, 3 |
| 4 | Dial gauges | 12 | 1, 2, 3 |
| 5 | Weights 1Kg | 10 | 1, 2, 3 |
| 6 | Weights 2 Kg | 10 | 1, 2, 3 |
| 7 | Beam Test Set – up | 2 | 3, 4 |
| 8 | Strain indicator and strain gauges | One set | 4,5,6 |
| 9 | Photo – elastic apparatus | 1 | 7,8 |
| 10 | Amplifier | 2 | 9 |
| 11 | Exciter | 2 | 9 |
| 12 | Pick – up | 2 | 9 |
| 13 | Oscilloscope | 2 | 9 |
| 14 | Wagner beam | 1 | 10 |
| 15. | Hydraulic Jack | 1 | 10 |

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| V | PROPULSION LABORATORY | 0 | 0 | 3 | 1 |

**AIM:** To make the students understand in detail about various engine and its working process.
**OBJECTIVE**: To understand the basic concepts and carryout experiments in Aerospace Propulsion.
**OUTCOME**: The students would be able to understand aboutpiston & jet engines and its related experiments

## *LIST OF EXPERIMENTS*

1. Study of an aircraft piston engine. (Includes study of assembly of sub systems, various components, their functions and operating principles)
2. Study of an aircraft jet engine (Includes study of assembly of sub systems, various components, their functions and operating principles)
3. Study of forced convective heat transfer over a flat plate.
4. Study of free convective heat transfer over a flat plate
5. Cascade testing of a model of axial compressor blade row.
6. Study of performance of a propeller.
7. Determination of heat of combustion of aviation fuel.
8. Combustion performance studies in a jet engine combustion chamber.
9. Study of free jet.
10. Study of wall jet.

**TOTAL: 60 Periods**

## LIST OF EQUIPMENTS

*(for a batch of 30 students)*

| Sl.No | Equipments | Qty | Experiments No. |
|---|---|---|---|
| 1 | Piston engines | 2 | 1 |
| 2 | Jet Engine /Engine model | 1 | 2 |
| 3 | Forced Convective apparatus | 1 | 3 |
| 4 | Free Convective apparatus | 1 | 4 |
| 5 | Axial compressor blade row model with pressure tapping | 1 | 5 |
| 6 | Watertube manometers (20 tubes) | 2 | 5,8,9 |
| 7 | Subsonic wind tunnel | 1 | 4 |
| 8 | Propeller model static and total pressure probes | 4 | 8,9 |
| 9 | 2-D travers in mechanism | 2 | 8 |
| 10. | Freejet test setup | 1 | 9 |
| 11. | Aluminium plates with deflection mechanisms | 1 | 10 |

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| V | PROFESSIONAL COMMUNICATION AND PERSONALITY DEVELOPMENT LABORATORY | 0 | 0 | 4 | 2 |

**AIM:** To develop graduates with good Presentation and Writingskills (Professional & Technical)

**OBJECTIVE:** To improve Aptitude Skills, train to improve self-learning/researching abilities, Presentation Skills & Technical Writing (Re-ports, Brochures, Manuscripts/Articles)

**OUTCOME**: The students would be able to understand about communication, Grammer, reading writing listening& speaking skills.

**UNIT I - COMMUNICATION AND SELF DEVELOPMENT:**

Basic Concepts of Communication; Process of Communication; Types of Formal communication; The Media of Communication; Channels of Communication; Barriers in Communication; How to Overcome Barriers to Communication.

**UNIT II - GRAMMAR & SYNTAX:**

Synonyms; Antonyms;Words used as different parts of speech; Spotting errors; Con-cord; Principle of proximity between subject and verb. SentenceStructure; Combination and Transformation of sentences; VerbPatterns in English.

**UNIT III - READING AND WRITING SKILLS:**

Purpose andProcess of Reading; Reading Tactics; Reading Strategies; Read-ing Comprehension; Paraphrase; Preparing outlines of paragraph/text. Elements of Effective Writing; Job Application, Bio-data, Personal Resume and Curriculum Vitae; Preparing Agendaand Minutes of a Meeting; Back office job for organizing a conference/seminar; Writing Styles; Scientific and Technical Writ-ing; Summary Writing; Writing paragraphs; Writing Essays.

**UNIT IV - LISTENING AND SPEAKING SKILLS:**

Processof listening; Hard and Soft Skills; Feedback Skills; Essentials ofGood Communications; Types of Listening; Barriers to Listening;Note taking and Note making. Skills of Effective Speaking;Component of an Effective Talk; Tone of Voice; Accent, Body Language;Timing and Duration of Speech; Audio-Visual Aids in Speech.

**UNIT V - TECHNICAL REPORT, RESEARCH CASE STUDY& REPORTING:**

Main considerations in writing a good report;Types and Structure of Reports; Collecting Data; Technical Pro-posals; Visual Aids; General Tips for Writing Reports. Re-search Case Study and Reporting

**TEXT BOOK**1. The Functional Aspects of Communication Skills, PrajapatiPrasad and Rajendra K. Sharma, S. K Kataria & Sons, NewDeihl, Rep"nt 2007.

**REFERENCE BOOKS**1.Business Communication, Sinha K. K, S. Chand, New Delhi.2.Business Communication, Asha Kaul, Prentice Hall of India.3.Business Correspondence and Report Writing' A Practical Approachto Business and Technical Communication, Sharma, R.C. andKrishna Mohan, Tata McGraw-HilI.4.A New Approach to English Grammar for High Schools, MadanSabina, Spectrum Books, New Delh.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| VI | AIRCRAFT STABILITY AND CONTROL | 3 | 1 | 0 | 4 |

**AIM:** To introduce the concepts of stability and control of airplanes.

**OBJECTIVE:**

- To provide an in-depth study of longitudinal static stability and its control.
- To provide an in-depth study of directional static stability and its control.
- To provide an in-depth study of lateralstatic stability and its control.
- To provide an in-depth study of disturbance theory and stability derivatives.
- To understand the Stability derivatives for lateral and directional dynamics.

**OUTCOME:** The students would be able to understand about static & dynamic stability of an aircraft.

**UNIT I STATIC LONGITUDINAL STABILITY AND CONTROL 12**

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

**UNIT II STATIC DIRECTIONAL STABILITY AND CONTROL 10**

Directional stability-yaw and sideslip, Criterion of directional stability, contribution to static directional stability by wing, fuselage, tail, Power effects on directional stability propeller and jet aircrafts, Rudder fixed and rudder free aspects, Rudder lock and Dorsal fin, Directional control, rudder control effectiveness, rudder requirements,
adverse yaw, asymmetric power condition, spin recovery

**UNIT III STATIC LATERAL STABILTY AND CONTROL 8**

Lateral stability-Dihedral effect, criterion for lateral stability, evaluation of lateral stability-contribution of fuselage, wing, wing fuselage, tail, total static lateral stability, lateral control, aileron control power, aileron effectiveness, strip theory estimation of aileron effectiveness, roll control by spoilers, aileron reversal, aileron reversal speed

**UNIT IV DYNAMIC LONGITUDINAL STABILITY 9**

Aircraft Equations of motion, small disturbance theory, Estimation of longitudinal stability derivatives stability derivatives, Routh's discriminant, solving the stability quartic, Phugoid motion, Factors affecting the period and damping.

**UNIT V DYNAMIC LATERAL AND DIRECTIONAL STABILITY 6**

Dutch roll and spiral instability, Auto rotation and spin, Stability derivatives for lateral and directional dynamics.

**Tutorial : 15 TOTAL: 60 Periods**

**TEXT BOOKS**

1. Perkins C.D. &Hage R.E. Airplane performance, stability and control, John Wiley & Sons 1976.
2. Nelson, R.C. Flight Stability & Automatic Control, McGraw Hill, 1998.

**REFERENCES**

1. McCormick, B.W. Aerodynamics, Aeronautics & Flight Mechanics John Wiley, 1995.
2. Babister, A.W. Aircraft Stability and response, Pergamon Press, 1980
3. Etkin, B., Dynamics of Flight Stability and Control, John Wiley, New York, 1982.
4. Pamadi, B.N. Performnce, Stability, Dynamics, and Control of Airplanes, AIAA Education Series, 2004

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| VI | HELICOPTER AERODYNAMICS | 3 | 0 | 0 | 3 |

**AIM:** To introduce fundamentals of helicopter and its role.

**OBJECTIVE:**

- To understand the basics of a helicopter.
- To Study the Blade Element Theories.
- To Study the Power requirements for Helicopter Stability.
- To Study the concept of Tilt Wing and Vectored Thrust.
- To Study the Applications of Hovercraft.

**OUTCOME:** The students would be able to understand about elements, power, lift& drag of helicopter

**UNIT I ELEMENTS OF HELICOPTER AERODYNAMICS 9**

Configuration based on Torque Reaction – Jet Rotors and Compound Helicopters – Method of Control – Collective and Cyclic Pitch Changes – Lead – Lag and Flapping Hinges.

**UNIT II IDEAL ROTOR THEORY 9**

Hovering performance – Momentum and Simple Blade Element Theories – Figure of Merit – Profile and Induced Power Estimation - Constant Chord and Ideal Twist Rotors.

**UNIT III POWER ESTIMATES 9**

Induced, Profile and Parasite Power requirements in Forward Flight – Performance Curves with Effects of Altitude – Preliminary Ideas on Helicopter Stability.

**UNIT IV LIFT, PROPULSION AND CONTROL OF V/STOL AIRCRAFT 9**

Various Configuration – Propeller, Rotor, Ducted Fan and Jet Lift – Tilt Wing and Vectored Thrust – Performance of VTOL and STOL Aircraft in Hover, Transition and Forward Motion.

**UNIT V GROUND EFFECT MACHINES 9**

Types – Hover Height, Lift Augmentation and Power Calculation for Plenum Chamber and Peripheral Jet Machine – Drag of Hovercraft on Land and Water. Applications of Hovercraft.

**TOTAL: 45 Periods**

**REFERENCE BOOKS:**

1. Gessow,A., Aerodynamics of Helicopter, MacMillan & CO ., N.Y., 1987
2. McCormick. B.W., Aerodynamics of V/STOL Flight, Academic Press, 1987
3. Johnson. W., Helicopter Theory, Princeton University Press, 1980
4. Seddon. J. ., Sion Newton, Basic Helicopter Aerodynamics, Blackwell Science, 2002
5. Gordon. J. Leishman, Principles of Helicopter Dynamics, Cambridge University press, 2006
6. Raymon W. Prouty, Helicopter Aerodynamics, PJS Publications, 1985
7. Gupta, L., “Helicopter Engineering”, Himalayan Books, 1996.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| VI | HIGH TEMPERATURE MATERIALS | 3 | 0 | 0 | 3 |

**AIM:** To learn damage mechanism and failure of components at elevated temperatures.

**OBJECTIVE:**

- To understand the various stages of creep.
- To know the importance and significance of hardening and strain hardening.
- To introduce the concept of fracture at elevated temperature.
- To understand the effect of alloying elements on corrosion.
- To Familiarize with special high temperature materials**.**

**OUTCOME:** The students would be able to understand about creep, fracture, corrosion, alloys and other materials

**UNIT I CREEP 9**

Factors influencing functional life of components at elevated temperatures, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress, temperature and strain rate.

**UNIT II DESIGN FOR CREEP RESISTANCE 9**

Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship.

**UNIT III FRACTURE 9**

Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, ductile fracture due to micro void coalescence-diffusion controlled void growth; fracture maps for different alloys and oxides.

**UNIT IV OXIDATION AND HOT CORROSION 9**

Oxidation, Pilling, Bedworth ratio, kinetic laws of oxidation- defect structure and control of oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, interaction of hot corrosion and creep, methods of combat hot corrosion.

**UNIT V SUPERALLOYS AND OTHER MATERIALS 9**

Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidification of single crystals, Intermetallics, high temperature ceramics.

**TOTAL: 45 Periods**

**TEXT BOOKS**

1. Raj. R., "Flow and Fracture at Elevated Temperatures", American Society for Metals, USA, 1985.
2. Hertzberg R. W., "Deformation and Fracture Mechanics of Engineering materials", 4th Edition, John Wiley, USA, 1996.
3. Courtney T.H, "Mechanical Behavior of Materials", McGraw-Hill, USA, 1990.

**REFERENCES**

1. Boyle J.T, Spencer J, "Stress Analysis for Creep", Butterworths, UK, 1983.
2. Bressers. J., "Creep and Fatigue in High Temperature Alloys", Applied Science, 1981.
3. McLean D., "Directionally Solidified Materials for High Temperature Service", The Metals Society, USA, 1985.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| VI | ROCKETS AND MISSILES | 3 | 1 | 0 | 4 |

**AIM:** To introduce basic concepts of design and trajectory estimation of rocket and missiles and to study the performance of rocket and missiles under various operating conditions and the fundamentals of design concepts**.**

**OBJECTIVE:**

- To know the various system of rocket, its functions and operations.
- To understand the Aerodynamics of Rockets, Missiles and Airframe Components.
- To study the Rocket Motion in Free Space and Gravitational Field.
- Determination of range and Altitude Simple Approximations to Burnout Velocity.
- To know the Staging and Control of Rockets and Missiles**.**

**OUTCOME:** The students would be able to understand about rocket and missiles.

**UNIT I ROCKET SYSTEMS 10**

Ignition system in rockets – types of igniters and igniter design considerations – injection system and propellant feed systems of liquid rockets and their design considerations – design considerations of liquid rocket thrust chambers – combustion mechanisms of liquid and solid propellants.

**UNIT II AERODYNAMICS OF ROCKETS AND MISSILES 10**

Airframe components of rockets and missiles – forces acting on a missile while passing through atmosphere – classification of missiles – slender body aerodynamics - method of describing forces and moments – lift force and lateral moment –lateral aerodynamic damping moment – longitudinal moment – drag estimation – body upwash and body downwash in missiles – rocket dispersion.

**UNIT III ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD 10**

One dimensional and two-dimensional rocket motions in free space and homogeneous gravitational fields – description of vertical, inclined and gravity turn trajectories – determination of range and altitude – simple approximations to burn out velocity and altitude – estimation of culmination time and altitude.

**UNIT IV STAGING AND CONTROL OF ROCKETS AND MISSILES 9**

Design philosophy behind multi staging of launch vehicles and ballistic missiles – multistage vehicle optimization – stage separation techniques in atmosphere and in space – stage separation dynamics and lateral separation characteristics – various types of thrust vector control methods including secondary injection thrust vector control – numerical problems on stage separation and multi staging.

**UNIT V MATERIALS FOR ROCKETS AND MISSILES 6**

Selection criteria of materials for rockets and missiles – materials for various airframe components and engine parts – materials for thrust control devices – various adverse conditions faced by aerospace vehicles and the requirement of materials to perform under these conditions.

**Tutorial : 15 TOTAL: 60 Periods**

**TEXT BOOKS:**

1. Cornelisse, J.W., “Rocket Propulsion and Space Dynamics”, J.W. Freeman &Co.,Ltd, London, 1982
2. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 5th Edition, 1993.

**REFERENCES:**

1. Parker, E.R., “Materials for Missiles and Spacecraft”, Mc.Graw Hill Book Co. Inc., 1982.
2. Mathur, M.L., and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers and Distributors, Delhi, 1988.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| VI | AERO ENGINE MAINTENANCE AND REPAIR | 3 | 0 | 0 | 3 |

**AIM:** To introduce the basic concepts of maintenance and repair of both piston and gas turbine engines and the procedures followed for overhaul of aero engines.

**OBJECTIVE:**

- To Understand the types of piston engines, principle of operation.
- To Know the inspection, maintenance and troubleshooting procedure of aircraft piston engines.
- To Understand the piston engine overhaul procedure and engine testing procedure.
- To Familiarize with types of jet engines and its principle of operations.
- To Understand the overhaul procedure of aircrafts gas turbine engines.

**OUTCOME:** The students would be able to understand about inspection, classification and maintenance of engines.

**UNIT I CLASSIFICATION OF PISTON ENGINE COMPONENTS 5**

Types of piston engines – Principles of operation – Function of components – Materialsused – Details of starting the engines – Details of carburetion and injection systems forsmall and large engines – Ignition system components – Spark plug details – Engineoperating conditions at various altitudes – Maintenance and inspection check to becarried out.

**UNIT II INSPECTIONS OF PISTON ENGINES 8**

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 – Enginemount and super charger – Checks and inspection procedures.

**UNIT III INSPECTIONS OF PISTON ENGINES 10**

Symptoms of failure – Fault diagnostics – Case studies of different engine systems –Tools and equipment requirements for various checks and alignment during overhauling– Tools for inspection – Tools for safety and for visual inspection – Methods andinstruments for non- destructive testing techniques – Equipment for replacement of partand their repair. Engine testing: Engine testing procedures and schedule preparation –Online maintenance.

**UNIT IV CLASSIFICATION OF JET ENGINE COMPONENTS 12**

Types of jet engines – Principles of operation – Functions of components – Materialsused – Details of starting and operating procedures – Gas turbine engine inspection &checks – Use of instruments for online maintenance – Special inspection procedures :Foreign Object Damage – Blade damage – etc.Maintenance procedures of gas turbine engines – Trouble shooting and rectificationprocedures – Component maintenance procedures – Systems maintenance procedures.Gas turbine testing procedures – test schedule preparation – Storage of Engines –Preservation and de-preservation procedures.

**UNIT V OVERHAUL PROCEDURES 10**

Engine Overhaul procedures – Inspections and cleaning of components – Repairsschedules for overhaul – Balancing of Gas turbine components.Trouble Shooting - Procedures for rectification – Condition monitoring of the engine onground and at altitude – engine health monitoring and corrective methods.

**TOTAL: 45 Periods**

**TEXT BOOK**

1. KROES & WILD, “Aircraft Power plants”, 7th Edition – McGraw Hill, New York,1994.

**REFERENCES**

1. TURBOMECA, “Gas Turbine Engines”, The English Book Store, New Delhi,1993.
2. UNITED TECHNOLOGIES PRATT & WHITNEY, “The Aircraft Gas turbineEngine and its Operation”, (latest edition) The English Book Store, New Delhi.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| VI | AERO ENGINE MAINTENANCE AND REPAIR LABORATORY | 0 | 0 | 3 | 2 |

**AIM:** To make the students understand about various check and repair works in aircraft engine.
**OBJECTIVE:** To introduce the knowledge of the maintenance and repair of both piston and jet aero engines and the procedures followed for overhaul of aero engines.
**OUTCOME:** The students would be able understand about piston and jet engine repair works.

## LIST OF EXPERIMENTS

1. Stripping of a piston engine
2. Engine (Piston Engine) – cleaning, visual inspection, NDT checks.
3. Piston Engine Components – dimensional checks.
4. Piston – Engine reassembly.
5. Propeller Pitch Setting
6. Stripping of a jet engine
7. Jet Engine – identification of components & defects.
8. Jet Engine – NDT checks and dimensional checks
9. Jet Engine – reassembly.
10. Engine starting procedures.

**TOTAL: 60 Periods**

LIST OF EQUIPMENTS
*(for a batch of 30 students)*

| Sl.No | Equipments | Qty | Experiments No. |
|---|---|---|---|
| 1 | Piston Engines | 2 | 1,2,3,4 |
| 2 | Jet Aero Engines | 2 | 6,7,8,9 |
| 3 | Propeller pitch setting stand | 1 | 5 |
| 4 | Aircraft with serviceable stand | 1 | 1 to 10 |
| 5 | Precision instruments (Vernier Caliper, Micro meter, Cylinder bore gauge, depth gauge, Bevel Protector and DTI | 2 each | 3,5,8 |
| 6 | NDT Equipments (Defectoscope, Dyepenetrant method, Hot oil Chalk Method | 1 each | 2,8 |

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| VI | AIRCRAFT STRUCTURE REPAIR LABORATORY | 0 | 0 | 3 | 1 |

**AIM:** To make the students understand about structure repair works.

**OBJECTIVE:** To give training on riveting, patchwork, welding and carpentry.

**OUTCOME:** The students would be able understand about welding, patch repair, sheet metal and control cable repair works

## LIST OF EXPERIMENTS

1. Aircraft wood gluing
2. Welded patch repair by TIG, MIG, PLASMA ARC.
3. Welded patch repair by MIG
4. Welded patch repair by plasma Arc
5. Fabric Patch repair
6. Riveted patch repairs.
7. Repair of composites
8. Repair of Sandwich panels.
9. Sheet metal forming.
10. Control cable inspection and repair.

**TOTAL: 60 Periods**

## LIST OF EQUIPMENT

***(for a batch of 30 students)***

| Sl.No. | Name of the Equipment | Quantity | Experiment No. |
|---|---|---|---|
| 1 | Shear cutter pedestal type | 1 | 4,6 |
| 2 | Drilling Machine | 1 | 4,5,6 |
| 3 | Bench Vices | 1 | 1,5,6 |
| 4 | Radius Bend bars | 1 | 2,3 |
| 5 | Pipe Flaring Tools | 1 | 9 |
| 6 | Carbide Gas Plant | 1 | 4 |
| 7 | MIG Weld Plant | 1 | 3 |
| 8 | TIG Weld Plant | 1 | 2 |

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| VI | AIRCRAFT DESIGN PROJECT | 0 | 0 | 3 | 2 |

**AIM:** To make the students understand about designing of an aircraft

**OBJECTIVE:** To introduce and develop the basic concept of aircraft design.
Each student is assigned with the design of an Airplane (or Helicopter or any other flight vehicle), for given preliminary specifications. The following are the assignments to be carried out:

**OUTCOME:** The students would be able understand about weight, drag& load estimation, aero foil & power plant selection for aircraft designing.

## LIST OF ASSIGNMENTS

1. Comparative configuration study of different types of airplanes
2. Preliminary weight estimations, selection of main parameters,
3. Power plant selection, Aero foil selection, Wing tail and control surfaces
4. Drag estimation
5. Detailed performance calculations and stability estimates
6. V-n diagram for the design study
7. Gust and maneuverability envelopes
8. Critical loading performance and final V-n graph calculation
9. Load estimation of wings& fuselage
10. Load estimation of fuselage.

.

**TOTAL: 60 Periods**

## LIST OF EQUIPMENTS

*(for a batch of 30 students)*

| S.No. | Items | Quantity | Experiment No. |
|---|---|---|---|
| 1. | Drawing Board | 30 | 4 and 5 |
| 2. | Drawing Instrument | 20 | 4 and 5 |

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| VII | COMPOSITE MATERIALS | 3 | 0 | 0 | 3 |

**AIM:** Analysis and design of composite structures using moulding methods of construction, fabrication to evaluate and understand the concept of laminated plates.

**OBJECTIVE:**

- To know the types of composites.
- To understand the need for stress strain relation.
- To understand the fabrication methods.
- To understand the laminated plates.
- To study and understand the different methods & analysis of composite materials**.**

**OUTCOME:** The students would be able understand about micro& macro mechanics, laminated & fabric process of materials

**UNIT I MICROMECHANICS 10**

Introduction - Advantages and application of composite materials – reinforcements and matrices - Micro mechanics – Mechanics of materials approach, elasticity approach to determine material properties – Fibre Volume ratio – Mass fraction – Effect of voids, hygro thermal effects on a lamina.

**UNIT II MACROMECHANICS 10**

Generalized Hooke's Law - Elastic constants for anisotropic, orthotropic and isotropic materials - Macro Mechanics – Stress-strain relations with respect to natural axis, arbitrary axis – Determination of material properties - Experimental characterization of lamina.

**UNIT III LAMINATED PLATES 10**

Governing differential equation for a unidirectional lamina and general laminate, angle ply and cross ply laminate, Failure criteria for composites.

**UNIT IV FABRICATION PROCESS 8**

Various open and closed mould processes, Manufacture of fibers, Types of resins, properties and applications, Netting analysis.

**UNIT V SANDWICH CONSTRUCTIONS 7**

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

**TOTAL: 45 Periods**

**TEXT BOOKS**

1. Jones, R.M., "Mechanics of Composite Materials," Taylor & Francis, II Edition, 2000.
2. MadhujiMukhapadhyay, Mechanics of Composite Materials and Structures, University Press, 2004

**REFERENCES**

1. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites," John Wiley and sons. Inc., New York, 1995.
2. Lubin, G., Handbook on Advanced Plastics and Fibre Glass, Von Nostrand Reinhold Co., New York, 1989.
3. Autar K Kaw, 'Mechanics of Composite Materials', CRC Press, 1997.
4. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Nostrand Reinhold Company, New York 1998
5. Allen Baker, Composite Materials for Aircraft Structures, AIAA Series, II Edition, 1999.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| VII | COMPUTATIONAL FLUID DYNAMICS | 3 | 1 | 0 | 4 |

**AIM:** To make the students understand the basic concepts of fluid dynamics and to create a clear picture of the condition of a flow in real motion.

**OBJECTIVE:**

- To understand the basic flow equations, characteristics of mathematical models for a given flow.
- To know the importance and significance of panel methods.
- To understand the concept of discretization, upwind differencing and implicit explicit solutions.
- To Familiarize with Finite element techniques in Computational Fluid.
- To Familiarize with Finite Volume techniques in Computational fluid analysis**.**

**OUTCOME:** The students would be able understand about flow concepts by knowing about panel, discretization and finite element & volume techniques

**UNIT I FUNDAMENTAL CONCEPTS 10**

Introduction - Basic Equations of Fluid Dynamics - Incompressible In viscid Flows:Source, vortex and doublet panel, methods - lifting flows over arbitrary bodies.Mathematical properties of Fluid Dynamics Equations -_ Elliptic, Parabolic andHyperbolic equations - Well posed problems - discretization of partial DifferentialEquations -Transformations and grids - Explicit finite difference methods of subsonic,supersonic and viscous flows.

**UNIT II PANEL METHODS 7**

Introduction – Source panel method – Vortex panel method – Applications.

**UNIT III DISCRETIZATION 8**

Boundary layer Equations and methods of solution -Implicit time dependent methods forinviscid and viscous compressible flows - Concept of numerical dissipation –Stabilityproperties of explicit and implicit methods - Conservative upwind discretization forHyperbolic systems - Further advantages of upwind differencing.

**UNIT IV FINITE ELEMENT TECHNIQUES 10**

Finite Element Techniques in Computational Fluid Dynamics; introduction - Strong andWeak Formulations of a Boundary Value Problem - Strong formulation – WeightedResidual Formulation - Galerkin Formulation - Weak Formulation –VariationalFormulation - Piecewise defined shape functions - Implementation of the FEM – TheSolution Procedure.

**UNIT V FINITE VOLUME TECHNIQUES 10**

Finite Volume Techniques - Cell Centered Formulation - ~ Lax – Vendoroff TimeStepping - Runge - Kutta Time Stepping - Multi - stage Time Stepping - Accuracy -. CellVertex Formulation - Multistage Time Stepping - FDM -like Finite Volume Techniques -Central and Up-wind Type Discretizations - Treatment of Derivatives.

**Tutorial : 15 TOTAL: 60 Periods**

**TEXT BOOK**

1. Fletcher, C.A.J., “Computational Techniques for Fluid Dynamics”, Vols. I and II,Springer - Verlag, Berlin, 1988.
2. “Computational Fluid Dynamics”, T.J.Chung, Cambridge University Press, 2002

**REFERENCES**

1. John F. Wendt (Editor), “Computational Fluid Dynamics - An Introduction”, Springer – Verlag, Berlin, 1992
2. Charles Hirsch, “Numerical Computation of Internal and External Flows”, Vols. I and II.John Wiley & Sons, New York, 1988.
3. Klaus A Hoffmann and Steve T. Chiang. “Computational Fluid Dynamics for Engineers”, Vols.I& II Engineering Education System, P.O. Box 20078, W. Wichita, K.S., 67208 - 1078 USA, 1993.
4. Anderson, John.D., “Computational Fluid Dynamics”, McGraw-Hill, 1995.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| VII | FINITE ELEMENT ANALYSIS (Common to Mech. and Aero) | 3 | 1 | 0 | 4 |

**AIM:** To make the students understand the basic concepts of finite element analysis of aircraft

**OBJECTIVE:**

- To understand the basics of Finite element techniques and 1D element equation formulation
- To gain knowledge about 2D problems in structural and Thermal
- To enable student to learn about Natural coordinates and Iso parametric Elements
- To inherit knowledge about Elasticity concepts and Virtual work
- To elaborate about dynamic analysis

**OUTCOME**: The students would be able understand about 1D, 2D and isometric problems

**UNITI 1DFINITEELEMENT ANALYSIS 12**

Historical Background – Weighted Residual Methods – Basic Concepts of FEM – Variational Formulation of B.V.P – Ritz Method – Finite Element Modeling – Element Equations – Linear and Quadratic Shape functions -Bar, Beam Elements – Applications to Heat Transfer.

**UNITII FEAOF2DPROBLEMS 12**

Basic Boundary Value Problems in 2 Dimensions – Triangular, quadrilateral, higher order elements – Poissons and Laplace Equations – Weak Formulation – Elements Matrices and Vectors – Application to Solid mechanics, Heat transfer, Fluid Mechanics.

**UNITIII ISOPARAMETRIC FORMULATION 12**

Natural Co-ordinate System – Lagrangian Interpolation Polynomials – Iso-parametric Elements – Formulation – Numerical Integration – 1D -2D Triangular elements – rectangular elements – Illustrative Examples.

**UNITIV SOLUTION TOPLANE ELASTICITYPROBLEMS 12**

Introduction to Theory of Elasticity – Plane Stress – Plane Strain and Axisymmetric Formulation – Principle of virtual work – Element matrices using energy approach

**UNITV SPECIAL TOPICS 12**

Dynamic Analysis – Equation of Motion – Mass Matrices – Free Vibration analysis – Natural frequencies of Longitudinal – Transverse and torsional vibration – Introduction to transient field problems. Non -linear analysis. Use of software – h & p elements – special element formulation.

**Tutorial : 15 Total contact Periods** : **60**

**TEXT BOOKS:**


1. Reddy J.N. "An Introduction to the Finite Element Method" , Mc Graw Hill, International Edition, 1993.
2. Segerlind L.J., "Applied Finite Element Analysis", John Wiley, 1984.


**REFERENCE BOOKS:**


1. Rao S.S., "Finite Element Method in Engineering" , Pergamon Press, 1989.
2. Chandrupatla & Belagundu, "Finite Elements in Engineering", Prentice Hall of India Private Ltd., 1997.
3. Cook, Robert Davis et al, "Concepts and Applications of Finite Element Analysis" , Wiley, John & Sons,1999.
4. George R Buchanan, "Schaum's Outline of Finite Element Analysis", McGraw Hill Company.
5. Larry J Segerlind, 'Applied Finite Element Analysis', Second Edition, John Wiley and Sons, Inc. 1984.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| VII | AVIONICS | 3 | 0 | 0 | 3 |

**AIM:** To make the students understand the avionics instruments which are used in aircraft

**OBJECTIVE:**

- To familiarize with Importance and role of avionics.
- To familiarize with modern data buses.
- To Familiarize with navigation and global positioning systems.
- To familiarize with flight control systems.
- To familiarize with various display systems.

**OUTCOME:** The students would be able understand about architecture & integration, navigation and flight control system.

**UNIT I An Overview of Avionics 9**

Definition - importance - role – major drivers for Military & Civil Aircraft - Avionics systems- sub systems- man machine (pitot - aircraft) interface – Aircraft state sensor systems – Navigation systems – External world sensor systems – task automation systems.

**UNIT II AVIONICS ARCHITECTURE & INTEGRATION 9**

Avionics architecture evolution. Avionics Data buses - MIL STD 1553, ARINC 429, ARINC 629 – comparison.

**UNIT III NAVIGATION SYSTEMS 9**

Types of Radio Navigation – ADF, DME, VOR, LORAN, DECCAN, OMEGA. ILS, MLS - Inertial sensors – Gyroscopes, Accelerometers, Inertial navigation systems – Block diagram, Platform and strap down INS. Satellite Navigation – GPS

**UNIT IV AIR DATA SYSTEMS AND FLIGHT CONTROL SYSTEM 9**

Air data quantities – Altitude, Airspeed, Mach no., Vertical Air speed, Total Air temperature, Stall warning, Altitude warning. Flight Control System - Comparision– Mechanical - Digital Fly By Wire Flight Control - Digital Fly By Light Flight Control .

**UNIT V AIRCRAFT DISPLAYS 9**

Display technologies – LED, LCD, CRT, Flat Panel Display. Primary Flight parameter displays - Head Up Display, Helmet Mounted Display, Night vision goggles, Head Down Display, MFD, MFK, Virtual cockpit.

**TOTAL= 45 PERIODS**

**TEXTBOOKS:**

1. Albert Helfrick. D, ‘Principles of Avionics’, Avionics communications Inc., 2004
2. Collinson, R.P.G, ‘Introduction to Avionics’, Chapman and Hall, 1996.

**REFERENCES:**

1. Middleton, D.H, ‘Avionics Systems’, Longman Scientific and Technical, Longman Group UK Ltd, England, 1989.
2. Spitzer, C.R. ‘Digital Avionics Systems’, Prentice Hall, Englewood Cliffs, N.J., USA1993.
3. Spitzer, C.R, ‘The Avionics Handbook’, CRC Press, 2000.
4. Pallet, E.H.J, ‘Aircraft Instruments and Integrated Systems’, Longman Scientific, 1992

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| VII | FINITE ELEMENT ANALYSIS LAB | 0 | 0 | 3 | 2 |

**AIM:** To make the students understand the basic concepts of finite element analysis of aircraft

**OBJECTIVE**: To introduce the knowledge about stress, buckling, conduction, modal & harmonic analysis

**OUTCOME:** The students would be able understand about the analysis of various beam & truss

**LIST OF EXPERIMENTS**

| | |
|---|---|
| 1 | STUDY OF ANALYSIS AND ITS BENEFITS |
| 2 | APPLICATION OF DISTRIBUTED LOADS |
| 3 | BUCKLING ANALYSIS |
| 4 | STRESS ANALYSIS OF CANTILEVER BEAM |
| 5 | MODELLING USING AXISYMMETRY |
| 6 | NONLINEAR ANALYSIS OF A CANTILEVER BEAM |
| 7 | PLANE STRESS BRACKET |
| 8 | SIMPLE CONDUCTION |
| 9 | TRANSIENT THERMAL CONDUCTION |
| 10 | STRESS ANALYSIS OF TWO DIMENSIONAL TRUSS |
| 11 | MODAL ANALYSIS OF A CANTILEVER BEAM |
| 12 | HARMONIC ANALYSIS OF A CANTILEVER BEAM |

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| VII | COMPUTER AIDED DESIGN AND DRAFTING LABORATORY | 0 | 0 | 3 | 2 |

**AIM**: To introduce the concept of design of basic structural components and to draft bothmanually and using modelling package.

**OBJECTIVE:** The Subject should enable the student to:

- Understand the design of riveted joints (Lap joint), learn the advantages and disadvantages.
- Understand the design of riveted joints (Butt joint); learn the advantages and disadvantages and types of riveted joints.
- Understand the design of the welded joint.
- Understand Layout of typical wing Structure.
- Understand Layout of typical fuselage structure.
- Understand the Computer aided modelling of typical aircraft wing.
- Understand the Computer aided modelling of typical fuselage structure.
- Understand the Computer aided modelling of landing gear.
- Understand the design of three view diagram of a typical aircraft.
- Understand the concepts and design of control system.

**OUTCOME**: The students would be able understand about the designing of aircraft wing, fuselage, landing gear and control systems.

## LIST OF EXERCISES

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

**TOTAL: 60 Periods**

## LIST OF EQUIPMENT (*for a batch of 30 students)*

| Sl.No | Equipments | Quantity | Experiments No. |
|---|---|---|---|
| 1 | Drawing Boards, Drafting machines | 30 | 1- 5, 9,10 |
| 2 | Computer and modeling software | Pentium IV PC's, - 30 Nos. License of Software – 30 | 6-8 |

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| VII | COMPREHENSION | 0 | 0 | 2 | 1 |

**AIM**: To make the students understand the concept of gathering knowledge about all the subjects
**OBJECTIVE**: To remember the knowledge of all the subjects during their course of study.
**OUTCOME**: The students would be able understand about the entire subjects during their course of study

Comprehension will be conducted with a written test during the semester and one viva-voce examination at the end of the semester in all the subjects during their course of study. The written test will consist of questions of multiple choices, objective type; fill in the blanks, true or false and short answer type questions. Also the students have to give a seminar on a topic relevance to the study.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| VIII | PROJECT WORK AND VIVA - VOCE | 0 | 0 | 12 | 6 |

**AIM**: To make the students to prepare a detailed project related to aerospace engineering
**OBJECTIVE**: To know about design, fabrication, theoretical studies and experimental studies of a particular topic.
**OUTCOME**: The students would be able to do their own design and fabrication of aerospace engineering related topics.

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

# LIST OF ELECTIVES

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | MANUFACTURING TECHNOLOGY | 3 | 0 | 0 | 3 |

**Unit I Metal Casting Processes 9**

**OBJECTIVE: To Understand the various types of Casting Processes.**

Sand casting – Sand moulds - Type of patterns – Pattern materials – Pattern allowances – Types of Moulding sand – Properties – Core making – Methods of Sand testing – Moulding machines – Types of moulding machines - Melting furnaces – Working principle of Special casting processes – Shell, investment casting – Ceramic mould – Lost Wax process – Pressure die casting – Centrifugal casting – CO2 process – Sand Casting defects – Inspection methods.

**Unit II Fabrication Process 9**

**OBJECTIVE: To Understand the various types of fastening methods and their defects.**

Fusion welding processes – Types of Gas welding – Equipments used – Flame characteristics – Filler and Flux materials - Arc welding equipments - Electrodes – Coating and specifications – Principles of Resistance welding – Spot/butt, seam welding – Percusion welding - Gas metal arc welding – Flux cored – Submerged arc welding – Electro slag welding – Tig welding – Principle and application of special welding processes - Plasma arc welding – Thermit welding – Electron beam welding – Friction welding – Diffusion welding – Flame cutting – Weld defects – Brazing and soldering process – Methods and process capabilities – Filler materials and fluxes – Types of Adhesive bonding.

**Unit III Bulk Deformation Processes 9**

**OBJECTIVE: To provide an in-depth study of Deformation Processes.**

Hot working and cold working of metals – Forging processes – Open and close die forging – Characteristics of the process – Types of Forging Machines – Typical forging operations – Rolling of metals – Flat strip rolling – Types of Rolling mills – Shape rolling operations – Tube piercing – Defects in rolled parts – Principles of Extrusion – Types of Extrusion – Hot and Cold extrusion – Principle of rod and wire drawing –

Equipments used.

**Unit IV Sheet Metal Forming Processes 9**

**OBJECTIVE: To provide an in-depth study of forming Processes.**

Sheet metal characteristics - Typical shearing operations, bending and drawing operations – Stretch forming operations — Formability of sheet metal – Test methods – Working principle and application of special forming processes - Hydro forming – Rubber pad forming – Metal spinning – Explosive forming – Magnetic pulse forming – Peen forming – Super plastic forming–Processcharacteristics .

**Unit V Forming and Shaping of Plastics 9**

**OBJECTIVE: To provide an in-depth study of plastics.**

Types of plastics - Characteristics of the forming and shaping processes – Moulding ofThermoplastics – Working principles and typical applications of - Injection moulding –Plunger and screw machines – Blow moulding – Rotational moulding – Film blowing –Extrusion - Typical industrial applications – Thermoforming – Processing ofThermosets – Working principles and typical applications - Compression moulding –Transfer moulding – Bonding of Thermoplastics – Fusion and solvent methods –Induction and Ultrasonic methods

**TOTAL: 45 Periods**

**Textbooks:**

1. HajraChoudhury, "Elements of Workshop Technology", Vol. I and II, MediaPromotorsPvt Ltd., Mumbai, 2001

2. SeropeKalpajian, Steven R.Schmid, "Manufacturing Engineering andTechnology", Pearson Education, Inc. 2002(Second Indian Reprint).

**References:**

1. Elements of Manufacturing Processes, B.S. MagendranParashar& R.K. Mittal,Prentice Hall of India, 2003.

2. Rao P.N., "Manufacturing Technology", Tata-McGraw-Hill Publishing Limited,II Edition, 2002.

3. Sharma P. C., "A text book of production technology", S. Chand and Company,IV Edition, 2003.

4.Begman, "Manufacturing Process" , John Wilely& Sons, VIII Edition, 1999.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | THEORY OF ELASTICITY | 3 | 0 | 0 | 3 |

**UNIT I ASSUMPTIONS IN ELASTICITY 5**

**OBJECTIVE: To introduce the basics and sign conventions of elasticity.**

Definitions- notations and sign conventions for stress and strain, Equations of equilibrium.

**UNIT II BASIC EQUATIONS OF ELASTICITY 12**

**OBJECTIVE: To provide an in-depth study of Principal stresses and principal strains.**

Strain – displacement relations, Stress – strain relations, Lame's constant – cubical dilation, Compressibility of material, bulk modulus, Shear modulus, Compatibility equations for stresses and strains, Principal stresses and principal strains, Mohr's circle, Saint Venant's principle.

**UNIT III PLANE STRESS AND PLANE STRAIN PROBLEMS 8**

**OBJECTIVE: To solve two-dimensional problems in bending of cantilever and simply supported beams.**

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

**UNIT IV POLAR COORDINATES 10**

**OBJECTIVE: To provide an in-depth study of Stress – strain relations.**

Equations of equilibrium, Strain displacement relations, Stress – strain relations, Axi – symmetric problems, Kirsch, Michell's and Boussinesque problems.

**UNIT V TORSION 10**

**OBJECTIVE: To introduce theories related to torsion.**

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

**TOTAL: 45 Periods**

***TEXT BOOK***

1. Timoshenko, S., and Goodier, T.N., "Theory of Elasticity", McGraw–Hill Ltd., Tokyo, 1990.

***REFERENCES***

1. Enrico Volterra& J.H. Caines, "Advanced Strength of Materials", Prentice Hall New Jersey, 1991.
2. Wng, C.T., "Applied Elasticity", McGraw–Hill Co., New York, 1993.
3. Sokolnikoff, I.S., "Mathematical Theory of Elasticity", McGraw–Hill New York, 1978.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | SPACE MECHANICS | 3 | 0 | 0 | 3 |

**Aim: To study the basic concepts of orbital Mechanics with particular emphasis on interplanetary trajectories.**

**UNIT I BASIC CONCEPTS 4**

**OBJECTIVE: To introduce References Frames and Coordinate Systems.**

The Solar System – References Frames and Coordinate Systems – The Celestial Sphere – The Ecliptic – Motion of Vernal Equinox – Sidereal Time – Solar Time – Standard Time – The Earth's Atmosphere.

**UNIT II THE GENERAL N-BODY PROBLEM 10**

**OBJECTIVE: To introduce orbital mechanics.**

The many body Problem – Lagrange – Jacobian Identity –The Circular Restricted Three Body Problem – Libration Points- Relative Motion in the N-body Problem –Two –Body Problem – Satellite Orbits – Relations Between Position and Time – Orbital Elements.

**UNIT III SATELLITE INJECTION AND SATELLITE ORBIT PERTURBATIONS 12**

**OBJECTIVE: To provide an in-depth study of Satellite Orbit Transfer.**

General Aspects of satellite Injections – Satellite Orbit Transfer –Various Cases – Orbit Deviations Due to Injection Errors – Special and General Perturbations – Cowell's Method – Encke's Method – Method of vibrations of Orbital Elements – General Perturbations Approach.

**UNIT IV INTERPLANETARY TRAJECTORIES 6**

**OBJECTIVE: To introduce concepts of trajectories.**

Two Dimensional Interplanetary Trajectories –Fast Interplanetary Trajectories – Three Dimensional Interplanetary Trajectories – Launch if Interplanetary Spacecraft –Trajectory about the Target Planet.

**UNIT V BALLISTIC MISSILE TRAJECTORIES AND MATERIALS 13**

**OBJECTIVE: To provide an in-depth study of ballistics.**

The Boost Phase – The Ballistic Phase –Trajectory Geometry- Optimal Flights – Time of Flight – Re – entry Phase – The Position of the Impact Point – Influence Coefficients. Space Environment – Peculiarities – Effect of Space Environment on the Selection of Spacecraft Material.

**TOTAL :45 Periods**

**TEXT BOOK**

1. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", W.H. Freeman & Co., 1984.

***REFERENCES***

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley, 1993.
2. Van de Kamp, P., "Elements of Astromechanics", Pitman, 1979.
3. Parker E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc., 1982.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE PRACTICES | 3 | 0 | 0 | 3 |

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

**UNIT I AIRCRAFT GROUND HANDLING AND SUPPORT EQUIPMENT 10**

**OBJECTIVE: To provide an in-depth study of ground handling of aircraft.**

Mooring, jacking, levelling and towing operations – Preparation – Equipment - precautions – Engine starting procedures – Piston engine, turboprops and turbojets – Engine fire extinguishing – Ground power units.

**UNIT II GROUND SERVICING OF VARIOUS SUB SYSTEMS 8**

**OBJECTIVE: To provide with the knowledge of servicing on various systems.**

Air conditioning and pressurization – Oxygen and oil systems – Ground units and their maintenance.

**UNIT III SAFETY 5**

**OBJECTIVE: To understand the importance of safety precautions..**

Shop safety – Environmental cleanliness – Precautions.

**UNIT IV INSPECTION 10**

**OBJECTIVE: To provide with the knowledge of aircraft documents recommended for inspection.**

Process – Purpose – Types – Inspection intervals – Techniques – Checklist – Special inspection – Publications, bulletins, various manuals – FAR Air worthiness directives – Type certificate Data Sheets – ATA specifications.

**UNIT V AIRCRAFT HARDWARE, MATERIALS, SYSTEMS PROCESSES 12**

**OBJECTIVE: To provide an in-depth knowledge of aircraft hardware and materials.**

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 & 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**

**TEXT BOOK**

1. KROES WATKINS DELP, “Aircraft Maintenance and Repair” – McGraw-Hill, New York 1993.

**REFERENCES**

1. A & P MECHANICS, “Aircraft hand Book” – F. A. A. Himalayan Book House, New Delhi, 1996.
2. A & P MECHANICS, “General hand Book” – F. A. A. Himalayan Book House, New Delhi, 1996.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | VIBRATION AND AEROELASTICITY | 3 | 0 | 0 | 3 |

**AIM: To study the dynamic behaviour of different aircraft components and the interaction among the aerodynamic, elastic and inertia forces.**

**UNIT I BASIC MOTIONS 8**

**OBJECTIVE: To introduce basics of Simple harmonic motion.**

Simple harmonic motion – Terminologies – Newton's Law – D' Alembert's principle – Energy Methods

**UNIT II SINGLE DEGREE OF FREEDOM SYSTEMS 12**

**OBJECTIVE: To provide an in-depth knowledge of vibrations.**

Free vibrations – Damped vibrations – Forced Vibrations, with and without damping – support excitation – Vibration measuring instruments.

**UNIT III MULTI DEGREES OF FREEDOM SYSTEMS 10**

**OBJECTIVE: To provide an in-depth knowledge of Longitudinal, Lateral and Torsional vibrations**.

Two degrees of freedom systems – Static and Dynamic couplings vibration absorber- Principal co-ordinates, Principal modes and orthogonal condition – Eigen value problems.Hamilton's principle-Lagrangean equation and application – Vibration of elastic bodies- Vibration of strings- Longitudinal, Lateral and Torsional vibrations.

**UNIT IV APPROXIMATE METHODS 5**

**OBJECTIVE: To enable the student to calculate natural frequencies.**

Rayleigh's and Holzer Methods to find natural frequencies.

**UNIT V ELEMENTS OF AEROELASTICITY 10**

**OBJECTIVE: To understand the importance of Aero elastic instabilities and their prevention.**

Concepts – Coupling – Aero elastic instabilities and their prevention – Basic ideas on wing divergence, loss and reversal of aileron control – Flutter and its prevention.

**TOTAL : 45 Periods**

**TEXT BOOKS**


1. TIMOSHENKO S., "Vibration Problems in Engineering"– John Wiley and Sons, New York, 1993.
2. FUNG Y.C., "An Introduction to the Theory of Aeroelasticity" – John Wiley & Sons, New York, 1995.


**REFERENCES**


1. BISPLINGHOFF R.L., ASHELY H and HOGMAN R.L., "Aeroelasticity" – Addision Wesley Publication, New York, 1983.
2. TSE. F.S., MORSE, I.F., HUNKLE, R.T., "Mechanical Vibrations", – Prentice Hall, New York, 1984.
3. SCANLAN R.H. & ROSENBAUM R., "Introduction to the study of Aircraft Vibration & Flutter", John Wiley and Sons. New York, 1982.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | AIRFRAME MAINTENANCE AND REPAIR | 3 | 0 | 0 | 3 |

**AIM: To study the maintenance aspect of airframe systems and rectification of snags.**

**UNIT I WELDING IN AIRCRAFT STRUCTURAL COMPONENTS 10**

**OBJECTIVE: To understand the importance of welding shop and their maintenance.**

Equipments used in welding shop and their maintenance – Ensuring quality welds – Welding jigs and fixtures – Soldering and brazing - Sheet Metal Repair And Maintenance - Inspection of damage – Classification – Repair or replacement – Sheet metal inspection – N.D.T. Testing – Riveted repair design, Damage investigation – reverse technology.

**UNIT II PLASTICS AND COMPOSITES IN AIRCRAFT 10**

**OBJECTIVE: To understand the importance of plastics used in airplanesand their maintenance.**

Review of types of plastics used in airplanes – Maintenance and repair of plastic components – Repair of cracks, holes etc., various repair schemes – Scopes.Inspection and Repair of composite components – Special precautions – Autoclaves.

**UNIT III AIRCRAFT JACKING, ASSEMBLY AND RIGGING 8**

**OBJECTIVE: To enable the student to perform ground operations during maintenance.**

Airplane jacking and weighing and C.G.Location.Balancing of control surfaces – Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor.

**UNIT IV REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM 10**

**OBJECTIVE: To understand the importance of Inspection and maintenance ofhydraulic and pneumatic systems of aircraft.**

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

**UNIT V SAFETY PRACTICES 7**

**OBJECTIVE: To observe safety precautions while handling Hazardous materials.**

Hazardous materials storage and handling, Aircraft furnishing practices – Equipments.Trouble shooting - Theory and practices.

**TOTAL : 45 Periods**

**TEXT BOOK**

1. KROES, WATKINS, DELP, “Aircraft Maintenance and Repair”, McGraw-Hill, New York, 1992.

**REFERENCES**

1. LARRY REITHMEIR, “Aircraft Repair Manual”, Palamar Books, Marquette, 1992.
2. BRIMM D.J. BOGGES H.E., “Aircraft Maintenance”, Pitman Publishing corp. New York, 1940

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | THEORY OF PLATES AND SHELLS | 3 | 0 | 0 | 3 |

**OBJECTIVE**

To study the behaviour of the plates and shells with different geometry under various types of loads.

**UNIT I CLASSICAL PLATE THEORY 3**

**OBJECTIVE: To introduce basic plate theory.**

Classical Plate Theory – Assumptions – Differential Equation – Boundary Conditions.

**UNIT II PLATES OF VARIOUS SHADES 15**

**OBJECTIVE: To provide an in-depth knowledge of various Governing Equations.**

Navier's Method of Solution for Simply Supported Rectangular Plates – Leavy's Method of Solution for Rectangular Plates under Different Boundary Conditions. Governing Equation – Solution for Axi-symmetric loading – Annular Plates – Plates of other shapes.

**UNIT III EIGEN VALUE ANALYSIS 8**

**OBJECTIVE: To introduce stability and free vibtration.**

Stability and free Vibration Analysis of Rectangular Plates.

**UNIT IV APPROXIMATE METHODS 10**

**OBJECTIVE: To enable the student to solve problems related to Free Vibration and Stability.**

Rayleigh – Ritz, Galerkin Methods– Finite Difference Method – Application to Rectangular Plates for Static, Free Vibration and Stability Analysis.

**UNIT V SHELLS 9**

**OBJECTIVE: To introduce Basic Concepts of Shells.**

Basic Concepts of Shell Type of Structures – Membrane and Bending Theories for Circular Cylindrical Shells.

**TOTAL : 45 Periods**

**TEXT BOOK**

1. Timoshenko, S.P. Winowsky. S., and Kreger, "Theory of Plates and Shells", McGraw-Hill Book Co. 1990.

**REFERENCES**

1. Flugge, W. "Stresses in Shells", Springer – Verlag, 1985.
2. Timoshenko, S.P. and Gere, J.M., "Theory of Elastic Stability", McGraw-Hill Book Co. 1986.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | COMPUTER INTEGRATED MANUFACTURING | 3 | 0 | 0 | 3 |

**AIM :** (a) To gain knowledge on how computers are integrated at various levels of planning and manufacturing.

(b) To understand the flexible manufacturing system and to handle the product data and various software used for manufacturing.

**UNIT I INTRODUCTION 8**

**OBJECTIVE: To introduce basics of Computer Integrated Manufacturing.**

The meaning and origin of CIM- the changing manufacturing and management scene - External communication - islands of automation and software-dedicated and open systems-manufacturing automation protocol - product related activities of a company- marketing engineering - production planning - plant operations - physical distribution- business and financial management.

**UNIT II GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING 10**

**OBJECTIVE: To provide an in-depth knowledge of computer aided process planning.**

History of group technology- role of G.T. in CAD/CAM integration - part families - classification and coding - DCLASS and MICLASS and OPITZ coding systems-facility design using G.T. - benefits of G.T. - cellular manufacturing.Process planning - role of process planning in CAD/CAM integration - approaches to computer aided process planning - variant approach and generative approaches - CAPP and CMPP process planning systems.

**UNIT III SHOP FLOOR CONTROL AND INTRODUCTION OF FMS 9**

**OBJECTIVE: To introduce the basics of FMS and its types.**

Shop floor control-phases -factory data collection system -automatic identification methods- Bar code technology-automated data collection system.FMS-components of FMS - types -FMS workstation - material handling and storage systems- FMS layout -computer control systems-application and benefits.

**UNIT IV CIM IMPLEMENTATION AND DATA COMMUNICATION 10**

**OBJECTIVE: To introduce the basics of Communication and network management .**

CIM and company strategy - system modeling tools -IDEF models - activity cycle diagram CIM open system architecture (CIMOSA)- manufacturing enterprise wheel-CIM architecture- Product data management-CIM implementation software.Communication fundamentals- local area networks - topology -LAN implementations - network management and installations.

**UNIT V OPEN SYSTEM AND DATABASE FOR CIM 8**

**OBJECTIVE: To enable the student to Develop Databases.**

Open systems-open system inter connection - manufacturing automations protocol and technical office protocol (MAP /TOP)Development of databases -database terminology- architecture of database systems-data modeling and data associations -relational data bases - database operators - advantages of data base and relational database.

**TOTAL : 45 Periods**

***TEXT BOOK***


1. Mikell.P.Groover "Automation, Production Systems and computer integrated manufacturing", Pearson Education 2001.


**REFERENCES**


1. Yoremkoren, "Computer Integrated Manufacturing System", McGraw-Hill, 1983.
2. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International, 1986.
3. David D.Bedworth, Mark R.Hendersan, Phillip M.Wolfe "Computer Integrated Design and Manufacturing", McGraw-Hill Inc.
4. Roger Hanman "Computer Intergrated Manufacturing", Addison – Wesley, 1997.
5. Mikell.P.Groover and Emory Zimmers Jr., "CAD/CAM", Prentice Hall of India Pvt. Ltd., New Delhi-1, 1998.
6. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.
7. Radhakrishnan P, SubramanyanS.andRaju V., "CAD/CAM/CIM", 2nd Edition New Age International (P) Ltd., New Delhi, 2000.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | FATIGUE AND FRACTURE MECHANICS | 3 | 0 | 0 | 3 |

**AIM: To study the concepts of estimation of the endurance and failure mechanism of components.**

**UNIT I FATIGUE OF STRUCTURES 7**

**OBJECTIVE: To introduce stressconcentration factors.**

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.

**UNIT II STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR 10**

**OBJECTIVE: To provide an in-depth study of Cycle counting techniques.**

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**

**OBJECTIVE: To provide an in-depth study of cracks and Dislocations.**

Phase in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations - fatigue fracture surfaces.

**UNIT IV FRACTURE MECHANICS 10**

**OBJECTIVE: To enable the student to analyse stress in cracked bodies.**

Strength of cracked bodies - Potential energy and surface energy - Griffith's theory - Irwin – Orwinextension 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 ANDTESTINIG 8**

**OBJECTIVE: To introduce Fail-safe design philosophies.**

Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in aerospace structures - Application to composite materials and structures.

**TOTAL : 45 Periods**

**TEXT BOOKS**


1. Prasanth Kumar – "Elements of fracture mechanics" – Wheeter publication, 1999.
2. Barrois W, Ripely, E.L., "Fatigue of aircraft structure", Pe/gamon press. Oxford, 1983.


**REFERENCES**


1. Sin, C.G., "Mechanics of fracture" Vol. I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989.
2. Knott, J.F., "Fundamentals of Fracture Mechanics", Buterworth& Co., Ltd., London, 1983

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | AIR TRANSPORTAION AND AIRCRAFT MAINTENANCEMANAGEMENT | 3 | 0 | 0 | 3 |

**AIM: To study the concepts of air transportation and the maintenance management of aircraft.**

**UNIT I INTRODUCTION 8**

**OBJECTIVE: To introduce air transportation.**

Development of air transportation, comparison with other modes of transport – Role of IATA, ICAO – The general aviation industry airline – Factors affecting general aviation, use of aircraft, airport: airline management and organisation – levels of management, functions of management, Principles of organisation planning the organisation – chart, staff departments & line departments.

**UNIT II AIRLINE ECONOMICS 10**

**OBJECTIVE: To enable the student to forcast Fleet size and Fleet plan**.

Forecasting – Fleet size, Fleet planning, the aircraft selection process, operating cost, passenger capacity, load factor etc. – Passenger fare and tariffs – Influence of geographical, economic & political factors on routes and route selection.Fleet Planning- The aircraft selection process – Fleet commonality, factors affecting choice of fleet, route selection and Capitol acquisition – Valuation & Depreciation – Budgeting, Cost planning – Aircrew evaluation – Route analysis – Aircraft evaluation.

**UNITIII PRINCIPLES OF AIRLINES SCHEDULING 10**

**OBJECTIVE: To introduce schedule of Flight operations.**

Equipment maintenance, Flight operations and crew scheduling, Ground operations and facility limitations, equipments and types of schedule – hub & spoke scheduling, advantages / disadvantages & preparing flight plans – Aircraft scheduling in line with aircraft maintenance practices.

**UNIT IV AIRCRAFT RELIABILITY 9**

**OBJECTIVE: To enable the student to determine Aircraft reliability.**

Aircraft reliability – The maintenance schedule & its determinations – Condition monitoring maintenance – Extended range operations (EROPS) & ETOPS – Ageing aircraft maintenance production.

**UNIT V TECHNOLOGY IN AIRCRAFT MAINTENANCE 8**

**OBJECTIVE: To introduce maintenance procedures of aircraft.**

Airlines scheduling (with reference to engineering) – Product support and spares – Maintenance sharing – Equipments and tools for aircraft maintenance – Aircraft weight control – Budgetary control.On board maintenance systems – Engine monitoring – Turbine engine oil maintenance – Turbine engine vibration monitoring in aircraft – Life usage monitoring – Current capabilities of NDT – Helicopter maintenance – Future of aircraft maintenance.

**TOTAL : 45 Periods**

**TEXT BOOKS**


1. FEDRIC J.H., “Airport Management”, 2000.
2. C.H. FRIEND, “Aircraft Maintenance Management”, 2000.


**REFERENCES**


1. GENE KROPF, “Airline Procedures”.
2. WILSON & BRYON, “Air Transportation”.
3. PHILIP LOCKLIN D, “Economics of Transportation”.
4. “Indian Aircraft manual” – DGCA Pub.
5. ALEXANDER T WELLS, “Air Transportation”, Wadsworth Publishing Company, California, 1993.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | HELICOPTER MAINTENANCE | 3 | 0 | 0 | 3 |

**OBJECTIVE**

To study the procedure adopted for the maintenance of helicopter.

**UNIT I FUNDAMENTALS OF A HELICOPTER 5**

**OBJECTIVE: To introduce basics of a helicopter.**

Basic directions – Ground handling, bearing – Gears.

**UNIT II MAIN ROTOR SYSTEM 9**

**OBJECTIVE: To provide an in-depth study of main rotor maintenance.**

Head maintenance – blade alignment – Static main rotor balance – Vibration – Tracking – Span wise dynamic balance – Blade sweeping –Electronic balancing – Dampener maintenance – Counter weight adjustment – Auto rotation adjustments – Mast & Flight Control Rotor - Mast – Stabilizer, dampeners – Swash plate flight control systems collective – Cyclic – Push pull tubes – Torque tubes – Bell cranks – Mixer box – Gradient unit control boosts – Maintenance & Inspection control rigging.

**UNIT III MAIN ROTOR TRANSMISSIONS 12**

**OBJECTIVE: To provide an in-depth study of Engine transmissionmaintenance.**

Engine transmission coupling – Drive shaft – Maintenance clutch – Free wheeling units – Spray clutch – Roller unit – Torque meter – Rotor brake – Maintenance of these components – vibrations – Mounting systems – Transmissions.

**UNIT IV POWER PLANTS & TAIL ROTORS 12**

**OBJECTIVE: To introduce maintenance procedures of power plant and tail rotors.**

Fixed wing power plant modifications – Installation – Different types of power plant maintenance.
Tail rotor system – Servicing tail rotor track – System rigging.

**UNIT V AIRFRAMES AND RELATED SYSTEMS 7**

**OBJECTIVE: To introduce maintenance procedures of Fuselage.**

Fuselage maintenance – Airframe Systems – Special purpose equipment.

**TOTAL : 45 Periods**

**TEXT BOOK**

1. JEPPESEN, “Helicopter Maintenance”, Jeppesons and Sons Inc., 2000.

**REFERENCES**

1. “Civil Aircraft Inspection Procedures”, Part I and II, CAA, English Book House, New Delhi, 1986.
2. LARRY REITHMIER, “Aircraft Repair Manual”, Palamar Books Marquette, 1992.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | AIR TRAFFIC CONTROL AND AERODROME DESIGN | 3 | 0 | 0 | 3 |

**AIM: To study the procedure of the formation of aerodrome and its design and air traffic control.**

**UNIT I BASIC CONCEPTS 9**

**OBJECTIVE: To introduce basics of Air Traffic Control.**

Objectives of ATS - Parts of ATC service – Scope and Provision of ATCs – VFR & IFR operations – Classification of ATS air spaces – Varies kinds of separation – Altimeter setting procedures – Establishment, designation and identification of units providing ATS – Division of responsibility of control.

**UNIT II AIR TRAFFIC SERVICES 9**

**OBJECTIVE: To introduce basics of Air Traffic services.**

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 ALERTING SERVICES, COORDINATION, EMERGENCY PROCEDURES AND RULES OF THE AIR 10**

**OBJECTIVE: To introduce communication equipment used for Flight information and advisory service.**

Radar service, Basic radar terminology – Identification procedures using primary / secondary radar – performance checks – use of radar in area and approach control services – assurance control and co-ordination between radar / non radar control – emergencies – Flight information and advisory service – Alerting service – Co-ordination and emergency procedures – Rules of the air.

**UNIT IV AERODROME DATA, PHYSICAL CHARACTERISTICS AND OBSTACLE RESTRICTION 9**

**OBJECTIVE: To enable the student to design a runway with all required services.**

Aerodrome data - Basic terminology – Aerodrome reference code – Aerodrome reference point – Aerodrome elevation – Aerodrome reference temperature – Instrument runway, physical Characteristics; length of primary / secondary runway – Width of runways – Minimum distance between parallel runways etc. – obstacles restriction.

**UNIT V VISUAL AIDS FOR NAVIGATION, VISUAL AIDS FOR DENOTING OBSTACLES EMERGENCY AND OTHER SERVICES 8**

**OBJECTIVE: To introduce the lighting systems of a fully equipped aerodrome.**

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.

**TOTAL : 45 Periods**

**TEXT BOOK**

1. AIP (India) Vol. I & II, "The English Book Store", 17-1, Connaught Circus, New Delhi.

**REFERENCES**

1. "Aircraft Manual (India) Volume I", latest Edition – The English Book Store, 17-1, Connaught Circus, New Delhi.
2. "PANS – RAC – ICAO DOC 4444", Latest Edition, The English Book Store, 17-1, Connaught Circus, New Delhi.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | ENTREPRENEURIAL SKILLS DEVELOPMENT FOR ENGINEERS (COMMON TO MECH AND AERO) | 3 | 0 | 0 | 3 |

**UNIT I ENTREPRENEURSHIP** 9

**Objective: To understand the importance of entrepreneurship for engineering students.**

Entrepreneur –Definition-Evolution and importance of entrepreneurship-Views and Theories of Entrepreneurship-Traits of Entrepreneurs- Types of Entrepreneurs – Risks and Rewards-Entrepreneur - Technocrat –Manager -Comparison–Role of Entrepreneurship in Economic Development- Factors affecting Entrepreneurial Growth-Engineers as Entrepreneurs-Ten commandments for the beginning entrepreneur.

**UNIT 2 MOTIVATION** 9

**Objective: To inculcate entrepreneurship skills for engineering students**.

Motivation-Definition and objectives-Types of motivation-Theories of Motivation- Achievement Motivation Training- Self Rating- Business games- Thematic Apperception Test - Stress Management. Entrepreneurship Development Programmes - Need- objectives.

**UNIT 3 BUSINESS AND ENTERPRISE MANAGEMENT 9**

**Objective: To create awareness of business and train in preparing the project report and crate awareness for engineering students.**

Business-definition- Classification –Small Enterprises- Characteristics- ownership structure-Various types of ownership-Project Formulation – Steps involved in setting up a Business - Market survey and Research- Techno economic Feasibility Report - Preliminary Project Report-Importance of Project Appraisal-Sources of information-Classification of needs and Agencies – Intellectual Property Rights.

**UNIT 4 FINANCIAL MANAGEMENT** 9

**Objective: To understand the importance of finance and its transactions**.

Need and objectives of financial management for engineers-Sources of Finance- Term Loans- Capital structure- Financial Institutions- Management of working capital- Costing - Break Even Analysis-Managerial uses of Breakeven analysis-Network analysis Techniques –Problems on PERT &CPM – Taxation

**UNIT 5 BUSINESS SICKNESS AND GROWTH STRATEGIES** 9

**Objective: To develop the skills of consequences of business sickness and take corrective measures.**

Sickness in small Business –Definition of sick unit- Symptoms of Sickness- Magnitude- Causes and Consequences-Preventive and Corrective measures - Institutional Support to Entrepreneurs-Government Policy for small Enterprises - Growth strategies in small Industry - Expansion-Diversification- Joint venture- Merger- sub-contracting.

**TOTAL Periods : 45**

**TEXT BOOKS:**


1. S.S. Khanka- Entrepreneurial Development- S.Chand & Co. Ltd- Ram Nagar - New Delhi-2005.
2. BhramarbarBadhai-"Entrepreneurship for Engineers"-DhanpatRai&co (P) ltd, Delhi-2001.


**REFERENCES:**


1. EDII - "A manual for Entrepreneurs"- Entrepreneurship Development Institute of India, Ahmedabad- Tata McGrawHill-2006...
2. MSME-'A guide book for new entrepreneurs'-2nd edition-2010.
3. Lawrence R.Jauch, Rajiv Gupta,William F.Glueck-"Business Policy & Strategic Management"- 7th edition-Frank Bros&co.( publishers) ltd,.2007
4. Robert DHisrich, Michael P Peters &Dean A Shepherd-"Entrepreneurship"-TataMcGrawHill, 2008.
5. Mary K Coulter, "Entrepreneurship in Action", Prentice Hall-2006.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | PROFESSIONAL ETHICS AND HUMAN VALUES | 3 | 0 | 0 | 3 |

**AIM: To create an awareness on Engineering Ethics and Human Values.To instill Moral and Social Values and Loyalty. To appreciate the rights of Others.**

**UNIT I HUMAN VALUES 10**

**OBJECTIVE: To introduce Morals, Values and Ethics required for a professional.**

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality.

**UNIT II ENGINEERING ETHICS 9**

**OBJECTIVE: To introduce Models of Professional Roles and theories about right action.**

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.

**UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9**

**OBJECTIVE: To introduce the codes of ethics.**

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study.

**UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9**

**OBJECTIVE: To introduce the importance of Safety and risk assessment.**

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies.Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

**UNIT V GLOBAL ISSUES 8**

**OBJECTIVE: To introduce various professional societies.**

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE), India, etc.

**TOTAL : 45 Periods**

**TEXT BOOKS**


1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, New York 1996.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.


***REFERENCES***


1. Charles D. Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint now available)
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, “Engineering Ethics – Concepts and Cases”, Wadsworth Thompson Leatning, United States, 2000 (Indian Reprint now available)
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | TOTAL QUALITY MANAGEMENT | 3 | 0 | 0 | 3 |

**AIM:** To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

**UNIT - I INTRODUCTION 9**

**OBJECTIVE: To understand the various principles, practices of TQM to achieve quality.**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM.

**UNIT - II TQM PRINCIPLES 9**

**OBJECTIVE: To learn the various statistical approaches for Quality control.**

Leadership - Strategic quality planning, Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process

improvement- PDSA cycle, 5s, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

**UNIT - III TQM TOOLS & TECHNIQUES - I 9**

**OBJECTIVE: To understand the TQM tools for continuous process improvement.**

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 & TECHNIQUES - II 9**

**OBJECTIVE: To understand the TQM tools for continuous process improvement.**

Quality circles - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Cost of Quality - Performance measures.

**UNIT - V QUALITY SYSTEMS 9**

**OBJECTIVE: To learn the importance of ISO and Quality systems.**

Need for ISO 9000- ISO 9000-2000 Quality System - Elements, Documentation, Quality auditing- QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - Case studies of TQM implementation in manufacturing and service sectors including IT.

**TOTAL: 45 Periods**

TEXT BOOK

1. Dale H.Besterfiled, et at., "Total Quality Management", Pearson Education Asia, Third Edition, Indian Reprint (2006).

REFERENCES

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM -Text with Cases", Butterworth - Heinemann Ltd., Oxford, Third Edition (2003).
3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd. (2006)
4. Janakiraman,B and Gopal, R.K, "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd. (2006)

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | RESOURCE MANAGEMENT TECHNIQUES | 3 | 0 | 0 | 3 |

**UNIT I INTRODUCTION AND LINEAR PROGRAMMING 9**

**OBJECTIVE: To understand the various principles, practices of Operations Research.**

Operations Research (OR)-Nature-Characteristics-Phases.-Role of OR in Decision making- Outline of OR Models Linear Programming – Formulation of L.P.problems –Solution by graphical method, simplex method, and big M methods – Applications of O.R. in production management

**UNIT II TRANSPORTATION AND ASSIGNMENT MODEL 9**

**OBJECTIVE: To learn the importance of transportation and assignment model.**

Transportation problem – Initial feasible solution- Northwest corner method, Least Cost method, Vogel's
approximation method – Test for optimality-MODI method Assignment problems- Hungarian assignment models- Travelling salesman problems

**UNIT III RESOURCE SCHEDULING AND NETWORK ANALYSIS 9**

**OBJECTIVE: To understand the various Problems of Sequencing.**

Problem of Sequencing – Problem with N jobs and 2 machines, 3 jobs and M machines. Project Management – Basic concepts – Case studies – Network construction and scheduling, Program evaluation and resource leveling by network techniques, time – Cost trade off.

**UNIT IV INVENTORY CONTROL AND SIMULATION 9**

**OBJECTIVE: To learn the importance of Inventory Control.**

Inventory Control – Various Types of inventory models – deterministic inventory models – Production model, Purchase model– with and without shortage- EOQ – Buffer stock – Shortage quantity, Probabilistic inventory models – Quantity Discount and Price Breaks Simulation – Use, advantages & limitations, Monte –Carlo simulation, application to queuing, inventory & other problems

**UNIT V QUEUEING THEORY, GAME THEORY AND REPLACEMENT MODELS 9**

**OBJECTIVE: To learn the importance of Queueing Theory, Game Theory And Replacement Models.**

Queuing theory – Poisson arrivals and exponential service times, Single channel models only. Game theory-Pay off matrix, competitive games with pure strategy, minimax criterion, principles of dominance &mixed strategies Replacement policy for items whose maintenance cost increases with time- Consideration of money value- Replacement policy- Individual, Group replacement of items that fail completely

**TOTAL : 45 Periods**

**TEXT BOOK:**

1. KantiSwarup, P.K.Gupta, &Manmohan., Operations Research – S. Chand & Sons.

**REFERENCE BOOKS:**

1. K.V.Mital and C.Mohan," Optimization Methods in O.R and System Analysis ", New Age International Publishers.
2. S.D.Sharma,"Operations Research", KedarnathRamnath& Co, 2002.
3. Hamdy A. Taha," Operations Research", 5th Edn., PHI, 1995
4. Hiller &Liberman,"Introduction to operation research", 5th Edn., McGraw Hill, 2001.
5. Ravindran,Phillips&Solberg, "Operations Research: principles and practice", 2nd Edn., Wiley India Lts, 2007.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | WIND TUNNEL TECHNIQUES | 3 | 0 | 0 | 3 |

**UNIT I PRINCIPLES OF MODEL TESTING 9**

**OBJECTIVE: To learn the importance of model testing.**

Buckingham Theorem – Non Dimensional Numbers – Scale Effect of Similarites.

**UNIT II WIND TUNNELS 9**

**OBJECTIVE: To understand the Problems of Testing in Subsonic, Transonic, Supersonic and Hypersonic Speed Regions.**

Classification – Special Problems of Testing in Subsonic, Transonic, Supersonic and Hypersonic Speed Regions– Layouts – Sizing and Design Parameters.

**UNIT III CALIBRATION OF WIND TUNNELS 9**

**OBJECTIVE: To learn the importance of Turbulence Measurements.**

Test Section Speed – Horizontal Buoyancy – Flow Angularities – Turbulence Measurements – Associated
Instrumentation – Calibration of Supersonic Tunnels.

**UNIT IV WIND TUNNEL MEASUREMENTS 9**

**OBJECTIVE: To learn the importance of Pressure, Velocity and Force Measurements.**

Pressure and Velocity Measurements - Force Measurements – Three Component and Six Component Balances– Internal Balances.

**UNIT V FLOW VISUALIZATION 9**

**OBJECTIVE: To learn various Visualization techniques.**

Smoke and Tuft Grid Techniques – Dye Injection Special Techniques – Optical Methods of Flow Visualization.

**TOTAL : 45 Periods**

**REFERENCE BOOKS:**

1. Pope, A., and Goin, L., “High Speed Wind Tunnel Testing”, John Wiley, 1985.
2. Rae, W.H., and Pope, A., “Low Speed Wind Tunnel Testing”, John Wiley Publication, 1984.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | AIRCRAFT DESIGN | 3 | 0 | 0 | 3 |

**UNIT I REVIEW OF DEVELOPMENTS IN AVIATION 9**

**OBJECTIVE: To learn categorization and configurations of an aircraft.**

Categories and types of aircrafts – various configurations – Layouts and their relative merits – strength, stiffness, fail safe and fatigue requirements – Manoeuvering load factors – Gust and manoeuverability envelopes – Balancing and maneuvering loads on tail planes.

**UNIT II POWER PLANT TYPES AND CHARACTERISTICS 9**

**OBJECTIVE: To learn Characteristics of different types of power plants.**

Characteristics of different types of power plants – Propeller characteristics and selection – Relative merits of location of power plant.

**UNIT III PRELIMINARY DESIGN 9**

**OBJECTIVE: To introduce conceptual andpreliminary design.**

Selection of geometric and aerodynamic parameters – Weight estimation and balance diagram – Drag estimation of complete aircraft – Level flight, climb, take – off and landing calculations – range and endurance – static and dynamic stability estimates – control requirements.

**UNIT IV SPECIAL PROBLEMS 9**

**OBJECTIVE: To learn optimization of wing loading and its performance under various end conditions.**

Layout peculiarities of subsonic and supersonic aircraft – optimisation of wing loading to achieve desired

Performance – loads on undercarriages and design requirements.

**UNIT V STRUCTURAL DESIGNS 9**

**OBJECTIVE: To Estimate loads on complete aircraft and components.**

Estimation of loads on complete aircraft and components – Structural design of fuselage, wings andundercarriages, controls, connections and joints.Materials for modern aircraft – Methods of analysis, testing andfabrication.

**TOTAL : 45 Periods**

**TEXT BOOKS**

1. D.P. Raymer, “Aircraft Conceptual design”, AIAA Series, 1988.
2. G. Corning, “Supersonic & Subsonic Airplane Design”, II Edition, Edwards Brothers Inc., Michigan, 1953.
3. E.F. Bruhn, “Analysis and Design of Flight Vehicle Structures”, Tristate Offset Co., U.S.A., 1980.

**REFERENCES**

1. E. Torenbeek, “Synthesis of Subsonic Airplane Design”, Delft University Press, London, 1976.
2. H.N.Kota, Integrated design approach to Design fly by wire” Lecture notes Interline Pub. Bangalore, 1992.
3. A.A. Lebedenski, “Notes on airplane design”, Part-I, I.I.Sc., Bangalore

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | COMPUTER AIDED DESIGN AND ANALYSIS | 3 | 0 | 0 | 3 |

**UNIT I INTRODUCTION TO CAD 9**

**OBJECTIVE: To introduce Design process – Computer Aided Design.**

Introduction to Design process - CAD. Geometric Modeling: Types - Wireframe, surface and solid modeling.Solid modeling techniques: CSG and B-rep - Operations: Boolean - Extrude - Sweep - Revolve. Entities - Line -Circle - Ellipse - Parabola - Cubic Spline, Bezier and B-spline.

**UNIT II GRAPHICS TRANSFORMATIONS AND DISPLAY FUNCTIONS 9**

**OBJECTIVE: To introduce Transformations.**

Coordinate systems - Transformations: translation, scaling, reflection, rotation - Concatenated transformation -Inverse transformation. Hidden line removal - Shading - Colouring - Rendering - Animation (Basic treatment only).

**UNIT III SOFTWARE PACKAGES AND TECHNOLOGY 9**

**OBJECTIVE: To introduce modeling packages.**

Commercial solid modeling packages: Important features - Technical comparison - Modules and tools – Formatof data exchange standards. Brief outline of feature technology: Classification of features - Design by features -Applications of features - Advantages and limitations - Brief outline of Parametric technology.

**UNIT IV FEM INTRODUCTION 9**

**OBJECTIVE: To enable the student to use finite element analysis and other solution techniques.**

Introduction - Steps involved in FEA: Nodes - Elements and their types, shape function, constraints, forces andnodal displacements - Stiffness matrix - Solution techniques. Analysis of spring element. Simple problems involvingstepped bar subject to axial loading and simple structural members with triangular element.

**UNIT V ANALYSIS FEA IN CAD ENVIRONMENT 9**

**OBJECTIVE: To introduce Stages of FEA in CAD environment.**

Stages of FEA in CAD environment - Preprocessor - Solver and postprocessor. Demonstration of the above
using any one commercial packages. Brief outline of kinematic analysis - Manufacturability analysis and simulation(Basic treatment only).

**TOTAL : 45 Periods**

**TEXT BOOKS**

1. Ibrahim Zeid, CAD/CAM - Theory and Practice, Tata McGraw-Hill, New Delhi, 2001
2. Radhakrishnan. P., CAD / CAM / CIM - New age international, 2000
3. Chairs McMahon and Jimmie Browne, CAD/CAM, AddisionWesly, New York, 2000

**REFERENCE BOOKS**

1. Chandupatla and Belagundu, Introduction to Finite Element Methods in Engineering, Prentice Hall of India Private Limited, New Delhi
1997
2. Newman and Sproull R. F., Principles of interactive computer graphics, Tata McGraw-Hill, New Delhi, 1997
3. Mikell P. Groover, CAD/CAM, Prentice Hall of India Private Limited, New Delhi, 1997.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | UNMANNED AIRCRAFT SYSTEMS | 3 | 0 | 0 | 3 |

**UNIT I INTRODUCTION TO UAS 9**

**OBJECTIVE: To introduce Unmanned aircraft systems.**

History of unmanned aerial vehicles- types- Introduction to Unmanned aircraft systems-Unmanned aerial vehicles –Micro aerial vehicles definitions, history, classification- applications-recent research and development in civil and defense applications – autonomous vehicles -future research in autonomous vehicles – design standards and regulatory aspects introduction to design and selection of systems

**UNIT II ASPECTS OF UAS SYSTEMS 9**

**OBJECTIVE: To provide an in-depth study of different aspects in thedevelopment of UAV.**

Involvement of different aspects in the development of UAV-aerodynamic configurations -Aspects of airframe design- Stealth design, payload types, communication, navigations & guidance systems, control & stability, launch, recovery and support systems, reliability design

**UNIT III MODELING AND CONTROL HELICOPTER MODEL 9**

**OBJECTIVE: To provide an in-depth study of Modeling and control of small and miniature unmanned helicopters.**

Modeling and control of small and miniature unmanned helicopters –single rotor helicopter design – coaxial rotor helicopter design - autonomous control of a mini quadrotor vehicle using LQG controllers – linearization and identification of helicopter model

**UNIT IV UAV DESIGN MODELING & CONTROL 9**

**OBJECTIVE: To provide an in-depth study of advanced flight control systems for rotorcraft UAV and MAV.**

Development of autonomous quad tilt wing – advanced flight control systems for rotorcraft UAV and MAV – mathematical modeling and non- linear control of VTOL aerial vehicles

**UNIT V DEPLOYMENT OF UAS/UAV SYSTEMS 9**

**OBJECTIVE: To introduce applications of UAS/UAV/MAV systems.**

Only application point of view of various UAS roles played in civil, defense applications -vision based navigation company trails- certification of UAS/UAV/MAV systems

**TOTAL : 45 Periods**

**REFERENCES:**

1. Reg Austin, Unmanned Aircraft Systems: UAVS Design, Development and Deployment John Wiley, UK,2010
2. KenzoNonami, FaridKendoul, Satoshi Suzuki, Wei Wang, Daisuke Nakazawa, Modeling and Control of Unmanned Small Scale Rotorcraft Uavs& Mavs, Springer, New York, 2010
3. Laurence R. Newcome, Unmanned aviation: a brief history of unmanned aerial vehicles, American Institute of Aeronautics and Astronautics, New York, 2004
4. KimonValavanis, Advances in unmanned aerial vehicles, Springer, Netherlands, 2007
5. Elizabeth Bone, Christopher Bolkcom, Unmanned aerial vehicles, Novinka Books, United Kingdom 2004
6. Rogelio Lozano, Unmanned Aerial Vehicles Embedded Control, John Wiley & Sons, 2010
7. Pedro Castillo, Rogelio Lozano, Alejandro E. Dzul, Modelling and control of mini-flying machines, Advances in industrial control (AIC), Springer-Verlag, London,2005
8. Bernard Mettler, Identification modeling and characteristics of miniature rotorcraft, Kluwer Publishers, USA, 2003

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | ROBOTICS ENGINEERING | 3 | 0 | 0 | 3 |

**UNIT I INTRODUCTION TO ROBOTICS 9**

**OBJECTIVE: To introduce Basic concepts of a robot.**

Basic concepts - Robot anatomy - Manipulators - kinematics: Forward and reverse kinematics - Precision
movement, robot specifications and Work volume, Types of Robot drives - Basic robot motions - Point to point control,continuous path control.

**UNIT II END EFFECTORS AND CONTROL SYSTEMS 9**

**OBJECTIVE: To introduce End effectors and their classification.**

End effectors - classification - mechanical, magnetic, vacuum and adhesive gripper - gripper force analysis anddesign. Robot control - unit control system concept - servo and non-servo control of robot joints, adaptive and optimalcontrol.

**UNIT III SENSORS 9**

**OBJECTIVE: To introduce Robot vision systems.**

Sensor devices, Types of sensors - contact, position and displacement sensors, Force and torque sensors -
Proximity and range sensors - acoustic sensors - Robot vision systems - Sensing and digitizing - Image processingand analysis.

**UNIT IV ROBOT PROGRAMMING 9**

**OBJECTIVE: To introduce programming methods of a robot.**

Robot language classification - programming methods - off and on line programming - Lead through method -Teach pendent method - VAL systems and language, simple program.

**UNIT V APPLICATIONS 9**

**OBJECTIVE: To introduce Recent developments in robotics in Aerospace industries.**

Application of robots - Material handling - Machine loading and unloading, Assembly, Inspection, Welding, Spraypainting, Mobile robot - Recent developments in robotics- safety considerations- Application in Aeronautical Engineering.

**TOTAL : 45 Periods**

**TEXT BOOKS:**

1. Deb, S. R., Robotics Technology And Flexible Automation, Tata McGraw Hill Co, New Delhi, 1994
2. Mikell P. Groover, Industrial Robotics Technology Programming And Applications, McGraw Hill Co., Singapore, 1995

**REFERENCE BOOKS:**

1. Klafter, R. D, Chmielewski, T. A. and Noggins, Robot Engineering : An Integrated Approach, Prentice Hall of India Pvt. Ltd., New
Delhi, 1994
2. Fu, K. S., Gonzalez, R. C., & Lee, C.S.G., Robotics Control, Sensing, Vision And Intelligence, McGraw Hill Book Co., Singapore,
1987
3. Craig, J. J., Introduction To Robotics Mechanics And Control, Addison-Wesley, London, 1999

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | CRYOGENICS | 3 | 0 | 0 | 3 |

**UNIT I INTRODUCTION 9**

**OBJECTIVE: To introduce cryogenic propellants.**

Historical Background - Introduction to cryogenic propellants - Liquid hydrogen, liquid helium, liquid nitrogen andliquid oxygen and their properties

**UNIT II PRODUCTION OF LOW TEMPERATURE 9**

**OBJECTIVE: To introduce Theory behind the production of low temperature.**

Theory behind the production of low temperature - Expansion engine heat exchangers - Cascade process JouleThompson Effect - Magnetic effect - Ortho and H2 - Helium4 and Helium 3

**UNIT III EFFICIENCY OF CRYOGENIC SYSTEMS 9**

**OBJECTIVE: To introduce Types of losses and efficiency of cycles.**

Types of losses and efficiency of cycles - specific amount of cooling - The fraction liquified – Cooling coefficientof performance - Thermodynamic efficiency – The energy balance Method

**UNIT IV CYCLES OF CRYOGENIC PLANTS 9**

**OBJECTIVE: To introduce various expansion cycles.**

Classification of cryogenic cycles - The structure of cycles - Throttle expansion cycles - Expander cycles -

Thermodynamic analysis - Numerical problems

**UNIT V CRYOGENIC IN AEROSPACE APPLICATIONS 9**

**OBJECTIVE: To introduce applications of cryogenic liquids.**

Cryogenic liquids in missile launching and space simulation Storage of cryogenic liquids - Effect of cryogenicliquids on properties of aerospace materials – Cryogenic loading problems - Zero gravity problems associated with cryogenic propellants - Phenomenon of tank collapse - Elimination of Geysering effect in missiles

**TOTAL : 45 Periods**

**TEXT BOOKS**

1. Haseldom, G., Cryogenic Fundamentals, Academic Press, 1971
2. Barron, R. F., Cryogenic Systems, Oxford University, 1985

**REFERENCE BOOK**

1. Parner, S. F., Propellant Chemistry, Reinhold Publishing Corpn., New York 1985

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | LAUNCH VEHICLES AND SPACECRAFT PROPULSION | 3 | 0 | 0 | 3 |

**UNIT I INTRODUCTION 9**

**OBJECTIVE: To introduce Basic Propulsion Devices.**

Introduction - Historical Note / Basic Propulsion Devices - Architectural description of Launch Vehicles andNSatellites - Rocket Equation / Staging / Payload - Launch weight relation - Propulsion Requirements / Thrust and timeNrequirements - Types of rockets / propellants / choices.

**UNIT II NOZZLE FLOWS AND AEROTHERMO CHEMISTRY 9**

**OBJECTIVE: To introduce aero thermo chemistry.**

Nozzle flows / Introduction - Performance parameters - Review of aero thermo chemistry - Propellant and burningN- Internal Ballistics - Grains / Ignition etc.

**UNIT III PROPELLANTS AND HEAT TRANSFER 9**

**OBJECTIVE: To introduce Propellants and Environmental problems.**

System Description / Propellants - Combustion / Heat Transfer / Cooling - Feed Systems - R-4 AuxilliaryNComponents - Monopropellants / Catalytic systems -Ignition / Restart / Environmental problems.

**UNIT IV SATELLITE INTEGRATION 9**

**OBJECTIVE: To introduce Propellant management and Propellant access in microgravity**.

Cold gas systems - Thruster satellite integration - Propellant management in spacecrafts - Propellant access inmicrogravity.

**UNIT V PROPULSION OPTIONS 9**

**OBJECTIVE: To introduce advanced propulsion techniques.**

Air breathing options in launch vehicles - Non chemical propulsion options - Nuclear Rockets. Electrostatic andElectromagnetic propulsion. Special thermal and integration problems

**TOTAL : 45 Periods**

**REFERENCES:**

1. G.P. Sutton : Rocket Propulsion Elements, Wiley, New York, 2006
2. C.D. Brown: Spacecraft Propulsion, AIAA Education Series, AIAA Inc., Washington DC, 1996 .

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | ORGANIZATIONAL BEHAVIOUR AND MANAGEMENT | 3 | 0 | 0 | 3 |

**Unit I Management and its Environment 9**

**OBJECTIVE: To introduce modern management and scientific management.**

Management – definition – functions, evolution of modern management scientific management movement, development of management thoughts, different schools of management, forms of organization – individual ownership – partnership – joint stock companies – cooperative enterprises – public sector undertakings – corporate frame work – share holders – Board of directors – committees – chief executive – line and functional managers – constraints – environmental – financial – legal – trade unions – technology.

**Unit II Management of Organisation 9**

**OBJECTIVE: To introduce management of human factors.**

Planning – nature and purpose – objectives – strategies – policies and planning premises – decision making, organizing – nature and process – premises departmentalisation – line and staff – decentralization – organizational culture, staffing – selection and training – placement – performance appraisal – career strategy – organizational development, leading – managing human factor – motivation, leadership – communication, controlling – system and process of controlling – controlling techniques , productivity and operations management – preventive control, industrial safety.

**Unit III Individual Behaviour 9**

**OBJECTIVE: To introduce contributing factors of individual behaviour.**

Organizational behaviour – definition – organization – managerial role and functions – organizational approaches, individual behaviour – causes – environmental effect – behaviour and performance, perception – organizational implications, personality – contributing factors – dimension, motivation – need theories – process theories – job satisfaction, learning and behaviour – learning curves, work design and approaches.

**Unit IV Group Dynamics 9**

**OBJECTIVE: To introduce leadership role and conflicts.**

Group behaviour – groups contributing factors – group norms, communication – process – barriers to communication – effective communication, Leadership – formal and informal characteristics – managerial grid – leadership styles – group decision making – leadership role in group decision, group conflict – types – causes – conflict resolution – inter group relations and conflict, organization centralization – formal and informal – organizational structures, organizational change and development – change process – resistance to change – O.D.programme – culture and ethics.

**Unit V Modern Management Concepts 9**

**OBJECTIVE: To introduce enterprise resource planning (ERP).**

Management by objectives (MBO) – principles and steps – advantages and disadvantages, management by exception (MBE), strategic management, planning for future direction – SWOT analysis – evolving development strategies, information technology in management – decision support systems – corporate models – business management games – electronic commerce/business, newer concepts – business process reengineering (BPR) – enterprise resource planning (ERP) – supply chain management (SCM) – activity based management (ABM).

**TOTAL : 45 Periods**

**Textbook:**

1. Herold Koontz and Heinz Weihrich, “Essentials of Management”, McGraw Hill, New Delhi, 5th edition, 1990.

**References:**

1. Ernest Dale, “Management Theory and Practice”, McGraw Hill Books, 1973.
2. Richard Pettinger, “Mastering Organizational Behaviour”, Macmillan Publishers Ltd., 2002.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | FUNDAMENTALS OF NANOSCIENCE | 3 | 0 | 0 | 3 |

**AIM: To make the students understand the importance ,relevance and potentialities of this emerging field of study.**

**UNIT I INTRODUCTION 10**

**OBJECTIVE: Study the basic nano technology and nano science.**

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

**UNIT II PREPARATION METHODS 10**

**OBJECTIVE: Understand interdisciplinary nature of this field.**

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

**UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES 5**

**OBJECTIVE: Understand the important role of physics, chemistry and biology.**

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

**UNIT IV PREPARATION ENVIRONMENTS 10**

**OBJECTIVE: Recognize that the rules of nano science are fundamentally different than those we experience.**

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

**UNIT V CHARECTERISATION TECHNIQUES 10**

**OBJECTIVE: Study the basic fabrication strategies of nano science.**

X-ray diffraction technique, Scanning Electron Microscopy – environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS Nano-indentation

**TOTAL : 45 Periods**

**TEXT BOOKS**

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.

2. N John Dinardo, "Nanoscalecharecterisation of surfaces & Interfaces", 2nd Edition, Weinheim Cambridge, Wiley-VCH, 2000

**REFERENCES**

1. Timp (Editor), "Nanotechnology", AIP press/Springer, 1999

2. AkhileshLakhtakia (Editor), "The Hand Book of Nano Technology,Nanometer Structure", Theory, Modeling and Simulations", Prentice-Hall of India (P) Ltd, New Delhi, 2007.

| SEMESTER | SUBJECT | L | T | P | C |
|---|---|---|---|---|---|
| ELECTIVE | CONTROL ENGINEERING | 3 | 0 | 0 | 3 |

AIM: To make the students understand the basic concepts of controls and stability.

**UNIT I INTRODUCTION 7**

**OBJECTIVE: Understand the basic types of control systems.**

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 8**

**OBJECTIVE: Know the importance and significance of feedback control systems.**

Feedback control systems Block diagram representation of control systems, Reduction of block diagrams, Output to input ratios.

**UNIT III CHARACTERISTIC EQUATION AND FUNCTIONS 8**

**OBJECTIVE: Understand the concept of transformation and responses to different inputs.**

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 12**

**OBJECTIVE: Familiarize with conditions for 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 10**

**OBJECTIVE: Familiarize with digital and PID controllers.**

Z-Transforms Introduction to digital control system, Digital Controllers and Digital PID controllers

**TOTAL: 45 Periods**

**TEXT BOOKS:**

1. OGATO, Modern Control Engineering, Prentice-Hall of India Pvt.Ltd., New Delhi, 1998.
2. Azzo, J.J.D. and C.H. HoupisFeed back control system analysis and synthesis, McGraw-Hill international 3rs Edition, 1998.

**REFERENCES:**

1. Kuo, B.C. Automatic control systems, Prentice-Hall of India Pvt.Lted., New Delhi, 1998.
2. Houpis, C.H. and Lamont, G.B. Digital control Systesm, McGraw Hill Book co. New York, U.S.A. 1995.
3. Naresh K Sinha, Control Systems, New Age International Publishers, New Delhi, 98.