VELS

INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)

(DEEMED TO BE UNIVERSITY Estd. u/s 3 OF THE UGC ACT, 1956)

**NAAC ACCREDITED**

PALLAVARAM - CHENNAI - INDIA

# B.E
# Mechanical Engineering

## Curriculum and Syllabus
**(Based on Choice Based Credit System)**
**Effective from the Academic year**
## 2015-2016
## (Modified Version)

**Department of Mechanical Engineering**
**School of Engineering**

# PROGRAMME OUTCOMES:

Bachelor of Mechanical Engineering curriculum is designed to impart Knowledge, Skill and Attitude on the graduates to

1. Have a successful career in Mechanical Engineering and allied industries.
2. Have expertise in the areas of Design, Thermal, Materials and Manufacturing.
3. Contribute towards technological development through academic research and industrial practices.
4. Practice their profession with good communication, leadership, ethics and social responsibility.
5. Graduates will adapt to evolving technologies through life-long learning.

# PROGRAMME SPECIFIC OUTCOMES

1. An ability to apply knowledge of mathematics and engineering sciences to develop mathematical models for industrial problems.
2. An ability to identify, formulates, and solve the complex engineering problems with high degree of competence.
3. An ability to design and conduct experiments, as well as to analyze and interpret data obtained through those experiments.
4. An ability to design mechanical systems, component, or a process to meet desired needs within the realistic constraints such as environmental, social, political and economic sustainability.
5. An ability to use modern tools, software and equipment to analyze multidisciplinary problems.
6. An ability to demonstrate on professional and ethical responsibilities.
7. An ability to communicate, write reports and express research findings in a scientific community.
8. An ability to adapt quickly to the global changes and contemporary practices.
9. An ability to engage in life-long learning.

## B.E. - MECHANICAL ENGINEERING

## CURRICULUM

**TOTAL NUMBER OF CREDITS: 195**

| Category | Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|---|
| | | | **L**ecture | **T**utorial | **P**ractical | **C**redits |
| **SEMESTER 1** | | | | | | |
| AECC | 15GBE201 | Technical English | 3 | 0 | 0 | 3 |
| CORE | 15GBE001 | Mathematics – I | 3 | 1 | 0 | 3 |
| CORE | 15GBE002 | Engineering Physics | 3 | 1 | 0 | 3 |
| CORE | 15GBE003 | Fundamentals of Computing | 3 | 1 | 0 | 3 |
| CORE | 15GBE004 | Engineering Graphics | 2 | 0 | 3 | 4 |
| CORE | 15GBE005 | Engineering Practices Laboratory | 0 | 0 | 3 | 2 |
| CORE | 15GBE006 | Engineering Physics Lab | 0 | 0 | 3 | 2 |
| CORE | 15GBE007 | Computer Practice Laboratory | 0 | 0 | 3 | 2 |
| | | **Total** | **14** | **3** | **12** | **22** |
| **SEMESTER 2** | | | | | | |
| Category | Code No. | Course | Hours / Week | | | Credits |
| | | | **L**ecture | **T**utorial | **P**ractical | **C**redits |
| AECC | 15GBE202 | Communication Skills | 3 | 0 | 0 | 3 |
| CORE | 15GBE008 | Mathematics – II | 3 | 1 | 0 | 3 |
| CORE | 15GBE009 | Engineering Chemistry | 3 | 1 | 0 | 3 |
| CORE | 15GBE010 | Material Science | 3 | 0 | 0 | 3 |
| CORE | 15EME021 | Engineering Mechanics | 3 | 1 | 0 | 3 |
| CORE | 15EME022 | Basic Electrical and Electronics Engineering | 3 | 0 | 0 | 3 |
| CORE | 15GBE011 | Engineering Chemistry Laboratory | 0 | 0 | 3 | 2 |
| AECC | 15GBE203 | Language Laboratory | 0 | 0 | 3 | 2 |
| CORE | 15CBME23 | Computer Aided Drafting Laboratory | 0 | 0 | 3 | 2 |
| | | **Total** | **18** | **3** | **9** | **24** |

## B.E. - MECHANICAL ENGINEERING

## CURRICULUM

| Category | Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | |
| **SEMESTER 3** | | | | | | |
| AECC | 15CBME32 | Environmental Science and Engineering | 3 | 0 | 0 | 3 |
| CORE | 15CBME31 | Mathematics – III | 3 | 1 | 0 | 3 |
| CORE | 15CBME34 | Engineering Thermodynamics | 3 | 1 | 0 | 3 |
| DSE | 15DBME__ | Discipline Specific Elective I | 3 | 0 | 0 | 3 |
| DSE | 15DBME__ | Discipline Specific Elective II | 3 | 0 | 0 | 3 |
| GE | 15GBME__ | Generic Elective I | 3 | 0 | 0 | 3 |
| SEC | 15SUPD__ | Skill Enhancement Elective I | 2 | 0 | 0 | 2 |
| CORE | 15PBME31 | Electrical Engineering Laboratory | 0 | 0 | 3 | 2 |
| CORE | 15PBME32 | Computer aided Machine Design Laboratory | 0 | 0 | 3 | 2 |
| | | **Total** | **20** | **2** | **6** | **24** |
| **SEMESTER 4** | | | | | | |
| Category | Code No. | Course | Hours / Week | | | Credits |
| | | | Lecture | Tutorial | Practical | |
| CORE | 15GBE015 | Statistics and numerical methods | 3 | 1 | 0 | 3 |
| CORE | 15CBME42 | Fluid Mechanics and Machinery | 3 | 0 | 0 | 3 |
| CORE | 15CBME43 | Strength of Materials | 3 | 1 | 0 | 3 |
| DSE | 15DBME__ | Discipline Specific Elective III | 3 | 0 | 0 | 3 |
| DSE | 15DBME__ | Discipline Specific Elective IV | 3 | 0 | 0 | 3 |
| GE | 15GBME__ | Generic Elective II | 3 | 0 | 0 | 3 |
| SEC | 15SUPD__ | Skill Enhancement Elective II | 2 | 0 | 0 | 2 |
| CORE | 15PBME41 | Fluid Mechanics and Strength of Materials Laboratory | 0 | 0 | 3 | 2 |
| CORE | 15PBME42 | Manufacturing Technology Laboratory | 0 | 0 | 3 | 2 |
| CORE | 15BESY41 | Basic Life Skills | 1 | 0 | 1 | 2 |
| | | **Total** | **21** | **2** | **7** | **26** |

**B.E. - MECHANICAL ENGINEERING**

**CURRICULUM**

| Category | Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|---|
| | | | **L**ecture | **T**utorial | **P**ractical | **C**redits |
| **SEMESTER 5** | | | | | | |
| CORE | 15CBME51 | Engineering Metrology and Measurements | 3 | 1 | 0 | 3 |
| CORE | 15CBME52 | Design of Machine Elements | 3 | 1 | 0 | 3 |
| CORE | 15CBME53 | Dynamics Of Machinery | 3 | 1 | 0 | 3 |
| DSE | 15DBME___ | Discipline Specific Elective V | 3 | 0 | 0 | 3 |
| DSE | 15DBME___ | Discipline Specific Elective VI | 3 | 0 | 0 | 3 |
| GE | 15GBME___ | Generic Elective III | 3 | 0 | 0 | 3 |
| SEC | 15SUPD__ | Skill Enhancement Elective III | 2 | 0 | 0 | 2 |
| CORE | 15PBME51 | Metrology and Measurements Laboratory | 0 | 0 | 3 | 2 |
| CORE | 15PBME52 | Dynamics Laboratory | 0 | 0 | 3 | 2 |
| CORE | 15CBME54 | Industrial Safety | 2 | 0 | 0 | 2 |
| | | **Total** | **22** | **3** | **6** | **26** |
| **SEMESTER 6** | | | | | | |
| Category | Code No. | Course | Hours / Week | | | Credits |
| | | | **L**ecture | **T**utorial | **P**ractical | **C**redits |
| CORE | 15CBME61 | Finite Element Analysis | 3 | 1 | 0 | 3 |
| CORE | 15CBME62 | Thermal Engineering | 3 | 1 | 0 | 3 |
| CORE | 15CBME63 | Design of Transmission Systems | 3 | 1 | 0 | 3 |
| DSE | 15DBME__ | Discipline Specific Elective VII | 3 | 0 | 0 | 3 |
| DSE | 15DBME__ | Discipline Specific Elective VIII | 3 | 0 | 0 | 3 |
| GE | 15GBME__ | Generic Elective IV | 3 | 0 | 0 | 3 |
| SEC | 15SUPD__ | Skill Enhancement Elective IV | 2 | 0 | 0 | 2 |
| CORE | 15PBME61 | Thermal Engineering Laboratory | 0 | 0 | 3 | 2 |
| CORE | 15PBME62 | CAM Laboratory | 0 | 0 | 3 | 2 |
| CORE | 15PBME63 | In-Plant Training | 0 | 0 | 0 | 2 |
| | | **Total** | **20** | **3** | **6** | **26** |

## B.E. - MECHANICAL ENGINEERING

## CURRICULUM

| Category | Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|---|
| | | | **L**ecture | **T**utorial | **P**ractical | **C**redits |
| **SEMESTER 7** | | | | | | |
| CORE | 15CBME71 | Mechatronics | 3 | 0 | 0 | 3 |
| CORE | 15CBME72 | Computer Integrated Manufacturing | 3 | 0 | 0 | 3 |
| CORE | 15CBME73 | Power Plant Engineering | 3 | 0 | 0 | 3 |
| DSE | 15DBME___ | Discipline Specific Elective IX | 3 | 0 | 0 | 3 |
| DSE | 15DBME___ | Discipline Specific Elective X | 3 | 0 | 0 | 3 |
| GE | 15GBME___ | Generic Elective V | 3 | 0 | 0 | 3 |
| SEC | 15SUPD___ | Skill Enhancement Elective V | 2 | 0 | 0 | 2 |
| CORE | 15PBME71 | Computer Aided Simulation and Analysis Laboratory | 0 | 0 | 3 | 2 |
| CORE | 15PBME72 | Mechatronics Laboratory | 0 | 0 | 3 | 2 |
| CORE | 15PBME73 | Mini Project & Seminar | 0 | 0 | 3 | 2 |
| | | **Total** | **20** | **0** | **9** | **26** |
| **SEMESTER 8** | | | | | | |
| Category | Code No. | Course | Hours / Week | | | Credits |
| | | | **L**ecture | **T**utorial | **P**ractical | **C**redits |
| DSE | 15DBME___ | Discipline Specific Elective XI | 3 | 0 | 0 | 3 |
| DSE | 15DBME___ | Discipline Specific Elective XII | 3 | 0 | 0 | 3 |
| GE | 15GBME___ | Generic Elective VI | 3 | 0 | 0 | 3 |
| CORE | 15CBME81 | Project Work | 0 | 0 | 21 | 12 |
| | | **Total** | **9** | **0** | **21** | **21** |

## B.E. - MECHANICAL ENGINEERING

## CURRICULUM

### List of Discipline Elective Courses

| Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| 15DBME31 | Special Casting Techniques | 3 | 0 | 0 | 3 |
| 15DBME32 | Failure Analysis and Design | 3 | 0 | 0 | 3 |
| 15DBME33 | Manufacture and Inspection of Gears | 3 | 0 | 0 | 3 |
| 15DBME34 | Refrigeration and Air Conditioning | 3 | 0 | 0 | 3 |
| 15DBME35 | Kinematics of Machinery | 3 | 0 | 0 | 3 |
| 15DBME36 | Production Technology | 3 | 0 | 0 | 3 |
| 15DBME41 | Manufacturing Technology | 3 | 0 | 0 | 3 |
| 15DBME42 | Engineering Materials and Metallurgy | 3 | 0 | 0 | 3 |
| 15DBME43 | Heat and Mass Transfer | 3 | 0 | 0 | 3 |
| 15DBME44 | Cryogenic Engineering | 3 | 0 | 0 | 3 |
| 15DBME45 | Renewable Energy Sources | 3 | 0 | 0 | 3 |
| 15DBME51 | Automobile Engineering | 3 | 0 | 0 | 3 |
| 15DBME52 | Applied Hydraulics and Pneumatics | 3 | 0 | 0 | 3 |
| 15DBME53 | Design of Pressure Vessels and Piping | 3 | 0 | 0 | 3 |
| 15DBME54 | Vibration and Noise Engineering | 3 | 0 | 0 | 3 |
| 15DBME55 | Gas Dynamics and Jet Propulsion | 3 | 0 | 0 | 3 |
| 15DBME61 | Industrial Automation, CNC and Robotics | 3 | 0 | 0 | 3 |
| 15DBME62 | Unconventional Machining Processes | 3 | 0 | 0 | 3 |
| 15DBME63 | Design of Jigs, Fixtures and Press Tools | 3 | 0 | 0 | 3 |
| 15DBME64 | Manufacture of Automotive Components | 3 | 0 | 0 | 3 |
| 15DBME65 | Design of Heat Exchangers | 3 | 0 | 0 | 3 |
| 15DBME71 | Rapid Prototyping, Tooling and Manufacture | 3 | 0 | 0 | 3 |
| 15DBME72 | Process Planning and Cost Estimation | 3 | 0 | 0 | 3 |
| 15DBME73 | Micro Electro Mechanical Systems | 3 | 0 | 0 | 3 |
| 15DBME74 | Design and Analysis of Composites | 3 | 0 | 0 | 3 |
| 15DBME75 | Additive Manufacturing | 3 | 0 | 0 | 3 |
| 15DBME81 | Non Destructive Testing and Materials | 3 | 0 | 0 | 3 |
| 15DBME82 | Advanced I.C. Engines | 3 | 0 | 0 | 3 |
| 15DBME83 | Waste Heat Recovery and Co-Generation | 3 | 0 | 0 | 3 |
| 15DBME84 | Fundamentals of Nano science | 3 | 0 | 0 | 3 |
| 15DBME85 | Product Development and Manufacture | 3 | 0 | 0 | 3 |

## B.E - Mechanical Engineering

## CURRICULUM

### List of Generic Elective Courses

| Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| 15GBME31 | Electrical Drives and Control | 3 | 0 | 0 | 3 |
| 15GBME41 | Entrepreneurship Development | 3 | 0 | 0 | 3 |
| 15GBME51 | Principles of Management and Professional Ethics | 3 | 0 | 0 | 3 |
| 15GBME52 | Operations Research | 3 | 0 | 0 | 3 |
| 15GBME61 | Quality Control and Reliability Engineering | 3 | 0 | 0 | 3 |
| 15GBME62 | Value Analysis and Value Engineering | 3 | 0 | 0 | 3 |
| 15GBME71 | Total Quality Management | 3 | 0 | 0 | 3 |
| 15GBME72 | Energy Audit and Energy Conservation Methods | 3 | 0 | 0 | 3 |
| 15GBME81 | Supply Chain Management | 3 | 0 | 0 | 3 |
| 15GBME82 | Industrial Marketing and Market Research | 3 | 0 | 0 | 3 |

### List of Skill Enhancement Elective Courses

| Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| 15SUPD31 | PERSONALITY DEVELOPMENT I | 2 | 0 | 0 | 2 |
| 15SUPD41 | PERSONALITY DEVELOPMENT II | 2 | 0 | 0 | 2 |
| 15SUPD51 | PERSONALITY DEVELOPMENT III | 2 | 0 | 0 | 2 |
| 15SUPD61 | PERSONALITY DEVELOPMENT IV | 2 | 0 | 0 | 2 |
| 15NSS255 | NSS I | 2 | 0 | 0 | 2 |
| 15NSS256 | NSS II | 2 | 0 | 0 | 2 |
| 15NSS257 | NSS III | 2 | 0 | 0 | 2 |
| 15NSS258 | NSS IV | 2 | 0 | 0 | 2 |
| 15NSS259 | NSS V | 2 | 0 | 0 | 2 |
| 15NSS260 | NSS VI | 2 | 0 | 0 | 2 |

# SYLLABUS
# CORE COURSES

| 15GBE201 | TECHNICAL ENGLISH | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To develop listening skills for academic and professional purposes.
- To acquire the ability to speak effectively in English in real life situations.
- To inculcate reading habit and to develop effective reading skills.
- To improve their active and passive vocabulary.
- To write letters and reports effectively in formal and business situations.

**UNIT I INTRODUCTION TO BASIC GRAMMAR AND VOCABULARY 9**

General Vocabulary – Changing words from one form to another, Nouns- Compound nouns, Pronouns - Relative pronouns, Demonstrative pronouns, Adjectives - Comparative adjectives, Verbs- Modal verbs, Linking verbs, Adverbs, Word Links – Connectives, Sequence words, Introducing oneself, Interactive grammar exercises.

**UNIT II BASIC SKILL – LISTENING AND INTERPRETATION 9**

Listening Skills - Note Making and Note-Taking, Transformation of Sentences – Positive, Comparative, Superlative, Affirmative, Negative, Interrogative and Assertive, Formation of Questions. Information Transfer - Chart – Flow chart, Bar chart, Pie chart. Pair works, SAM sessions.

**UNIT III BASIC SKILL-WRITING SKILL AND STRUCTURES 9**

Creative thinking and speaking, Tenses – Present Tense – simple present, present continuous, present perfect, present perfect continuous, Past Tense - simple past, past continuous, past perfect, past perfect continuous, Future Tense -simple future, future continuous, future perfect, future perfect continuous, Autobiographical writing, JAM session.

**UNIT IV BASIC SKILLS: READING AND WRITING SKILL 9**

Reading Skills- Skimming and Scanning, Comprehension Passage Paragraph Writing – Descriptive paragraph, Argumentative paragraph, Persuasive paragraph, Demonstrative paragraph, Compare and contrast, Conversations.

**UNIT V BASIC SKILL: SPEAKING SKILL AND VOCABULARY 9**

Vocabulary, Prefixes and Suffixes, Cause and Effect relationship, Clauses and Phrases, Super-ordinates and Hyponyms, Expressing Causal Relation, Article, Prepositions, Preposition phrases, Speaking about the future plans, Reading comprehensions, Situational dialogues.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Technical English course, the student will be able to

**CO1:** Improve the language proficiency of a technical under-graduate in English with emphasis on Learn, Speak, Read and Write skills.

**CO2:** Develop listening skills for academic and professional purposes.

**CO3:** Acquire the ability to speak effectively in English in real life situations.

**CO4:** Provide learning environment to practice listening, speaking, reading and writing skills.

**CO5:** Assist and carry on the tasks and activities through guided instructions and materials.

**CO6:** Inculcate reading habit and to develop effective reading skills.

**CO7:** Improve their active and passive vocabulary.

**CO8:** Effectively integrate English language learning with employability skills and training.

**CO9:** Provide hands-on experience through case-studies, mini-projects, group and individual presentations.

**CO10:** Write letters and reports effectively in formal and business situations.

**CO11:** Variety of self-instructional modes of language learning and develop learner autonomy.

**TEXT BOOKS:**


1. Department of English, Anna University, Mindscapes, 'English for Technologists and Engineers', Orient Longman Pvt. Ltd, Chennai: 2012.
2. Department of Humanities and Social Sciences, Anna University, 'English for Engineers and Technologists' Combined Edition (Volumes 1 and 2), Chennai: Orient Longman Pvt. Ltd., 2006.


**REFERENCES:**


1. N. Lakshmana Perumal, Technical English-I, Second Edition, Hitech Publishing company PVT. Ltd, 2009.
2. Sumant. S, 'Technical English', Second Edition, McGraw-Hill Education (India) Pvt. Ltd., 2008.
3. T.M. Farhathullah, "Communication Skills for Technical Students", Orient Blackswan Private Limited., 2008.

| 15GBE001 | MATHEMATICS - I | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 |

**COURSE OBJECTIVE:**

- To develop the skills in the areas of Matrices, Three dimensional Analytical Geometry, Differential calculus, Functions of several Variables and Multiple Integrals. To serve as a pre-requisite mathematics course for post graduate courses, specialized studies and research.

**UNIT I MATRICES 12**

Characteristic equation – Eigen values and eigenvectors of a real matrix – Properties – Cayley-Hamilton theorem (excluding proof) – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.

**UNIT II THREE DIMENSIONAL ANALYTICAL GEOMETRY 12**

Equation of a sphere – Plane section of a sphere – Tangent Plane – Equation of a cone – Right circular cone – Equation of a cylinder – Right circular cylinder.

**UNIT III DIFFERENTIAL CALCULUS 12**

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes – Evolute as envelope of normals.

**UNIT IV FUNCTIONS OF SEVERAL VARIABLES 12**

Partial derivatives – Euler's theorem for homogenous functions – Total derivatives – Differentiation of implicit functions – Jacobians – Taylor's expansion – Maxima and Minima – Method of Lagrange's multipliers.

**UNIT V MULTIPLE INTEGRALS 12**

Double integration – Cartesian and polar coordinates – Change of order of integration – Change of variables between Cartesian and polar coordinates – Triple integrals – Area as double integral

**TOTAL: 60 Hours**

**COURSE OUTCOMES:**

After successful completion of the Mathematics – I course, the student will be able to

**CO1:** Able to solve the 1st order differential equations in different fields.

**CO2:** Identify and solve a 2nd and higher order differential equations and perform simple applications in Engineering.

**CO3:** Calculate grad, divergence, curl; a line, surface and volume integral.

**CO4:** To find work done, area, and volume.

**CO5:** Apply the vector integral theorems to evaluate multiple integrals. Find the maxima and minima of two variable functions under different constraints.

**CO6:** Solve the single and multiple integrals and calculate the moment of inertia.

**CO7:** Develop the skills in the areas of matrices to calculate the three-dimensional analytical geometry.

**CO8:** Know about the functions of several variables and multiple integrals.

**CO9:** Serve as a pre-requisite mathematics course for postgraduate courses.

**CO10:** Specialized in studies and research.

**CO11:** Orthogonal transformation of a symmetric matrix to diagonal form.

**TEXT BOOKS:**


1. Grewal. B.S, "Higher Engineering Mathematics", Khanna Publications, Delhi, 43rd Edition, 2013.
2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi,6th reprint, 2008.


**REFERENCES:**


1. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 3rd Edition, 2012.
2. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", Narosa Publishing House ,4th Edition,2014

| 15GBE002 | ENGINEERING PHYSICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 |

**COURSE OBJECTIVE:**

- To learn the basics of Ultrasonic, Lasers, Fiber optics and applications, Quantum physics and crystal physics etc., and to apply these fundamental principles to solve practical problems related to materials used for engineering applications.

**UNIT I ULTRASONICS 9**

Introduction – Production – magnetostriction effect – magnetostriction generator – piezoelectric effect – piezoelectric generator – Detection of ultrasonic waves– properties – Cavitations – Velocity measurement – acoustic grating – Industrial applications – drilling, welding, soldering and cleaning – Non Destructive Testing – pulse echo system through transmission and reflection modes – A, B and C scan displays- SONAR – Medical applications – Sonograms.

**UNIT II LASERS 9**

Introduction – Principle of Spontaneous emission and stimulated emission – Population inversion, pumping - Einstein's A and B coefficients – derivation – Types of lasers – He-Ne, CO2 ,Nd-YAG, Semiconductor lasers homojunction and heterojunction (Qualitative) - Industrial Applications – Lasers in welding, heat treatment, cutting – Medical applications – Holography (construction and reconstruction).

**UNIT III FIBRE OPTICS AND APPLICATIONS 9**

Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle – Types of optical fibres (material, refractive index, mode) – fibre manufacturing (Double crucible technique) – Splicing, Loss in optical fibre – attenuation, dispersion, bending – Fibre optical communication system (Block diagram) – Light sources – Detectors –PIN Photo diode- Fibre optic sensors – temperature and displacement – Endoscope.

**UNIT IV QUANTUM PHYSICS 9**

Black body radiation – Planck's radiation law (derivation) – Deduction of Wien's displacement law and Rayleigh – Jeans Law from Planck's theory – Compton effect – Theory and experimental verification – Matter waves – Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box – Electron microscope - Scanning electron microscope – Transmission electron microscope.

**UNIT V CRYSTAL PHYSICS 9**

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – NaCl, ZnS, diamond and graphite structures – Polymorphism and allotropy – Crystal defects – point, line and surface defects – Burger vector.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Engineering Physics course, the student will be able to

**CO1:** Apply the fundamental principles to solve practical problems related to materials used for engineering applications.

**CO2:** Formulate general mechanics parameters and distinguish between central and non-central forces.

**CO3:** Learn the basics of Ultrasonic.

**CO4:** Understanding about the Fiber optics.

**CO5:** Explain types of waves and interference of light

**CO6:** Derive thermodynamic parameters and apply fundamental laws to solve thermodynamic problems

**CO7:** Differentiate between the terms atomic number, atomic mass, isotopes, etc. and apply various rules such as rules, octet rules, and Bohr's energy levels.

**CO8:** Know about various applications of Lasers.

**CO9:** Basic information in Quantum physics and crystal physics etc.,

**CO10:** Categorize between various environmental pollutants, study the harmful effects of pollutants, and elaborate the concepts such as global warming, BOD, COD, ozone depletion and acid rain.

**TEXT BOOKS:**


1. Gaur, R. K. and Gupta, S.C., 'Engineering Physics' DhanpatRai Publications, New Delhi 2013.
2. Avadhanulu, M.N. and Kshirsagar, P.G., 'A Text book of Engineering Physics', S.Chand and Company, Ltd., New Delhi, 2013.


**REFERENCES:**


1. Frank J. Faly, "Foundations of Engineering Accoustics", Elsevier Academic press, 2005.
2. Williams T.Silfrast, "Laser Fundamentals", Cambridge University press, 2004.
3. John Gowar, "Optical communication systems", Prentice Hall publications, 1993.
4. Murugesan R and Sivaprasath K, Modern Physics, S. Chand Ltd., 2008.

| 15GBE003 | FUNDAMENTALS OF COMPUTING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 |

**COURSE OBJECTIVE:**

- To understand the concepts of Programming language - C and Html
- To learn the basics of C declarations, operators, expressions and html tags
- To learn on the manipulation of strings, functions and pointers

**UNIT I INTRODUCTION TO COMPUTERS 9**

Introduction – Characteristics, Classification and Evolution of Computers – Computer Generations – Basic Computer organization – Number Systems – Computer Software – Types of Software – Software Development Steps.

**UNIT II PROBLEM SOLVING AND OFFICE APPLICATION SOFTWARE 9**

Planning the Computer Program – Purpose – Algorithm – Flow Charts – Pseudo code – Application Software Packages – Introduction to Office Packages – Internet basics: Internet evolution, Html tags- Forms- Frames.

**UNIT III INTRODUCTION TO C 9**

Overview of C: Constants, Variables, Keywords, Data Types – Compilation and Execution – Input and Output functions – Operators – C Instructions – Control Instructions: Decision control structure, Loop Control structure, Case Control Structure.

**UNIT IV FUNCTIONS AND POINTERS 9**

Functions: Library functions, User defined functions, call by value, call by reference, recursive functions – Pointers – Arrays: one dimensional array, multi-dimensional array, arrays using pointers – Strings: library string functions – pointers in strings.

**UNIT V STRUCTURES AND FILES 9**

Structures – Unions – Storage classes – Dynamic memory allocation – Files: file Operations, Preprocessor directives – use of type def.– Command line arguments.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Fundamentals of Computing, the student will be able to

**CO1:** Understand the characteristics, classification and evolution of computers.

**CO2:** Learn the generation of computers and their architecture.

**CO3:** Be well versed in Numbers Systems and their conversions.

**CO4:** Determine the advantages and limitations of algorithm, flowchart and pseudo code.

**CO5:** Explain the features of application software packages and evolution of internet.

**CO6:** Develop programs using various control instructions and operator precedence in C programming.

**CO7:** Handle string manipulations, array and functions for various applications using C programming constructs.

**CO8:** Analyze the merits of pointers in C.

**CO9:** Understand the difference in memory allocation while using structure and union in C programming.

**CO10:** Learn the various file operations in C.

**TEXT BOOKS:**


1. Yashavant Kanetkar, “Let Us C”, BPB Publications, Thirteenth Edition 2013.
2. Balagurusamy, E., “Computing fundamentals and C Programming”, Tata McGraw-Hill Publishing Company Limited, 2010.
3. Thomno A. Powell, “The Complete Reference HTML and CSS”, fifth edition, Tata McGrawHill, 2010.


**REFERENCE:**


1. Ashok. N. Kamthane, “Computer Programming”, Pearson Education (India) 2009.

| 15GBE004 | ENGINEERING GRAPHICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 3 | 4 |

**COURSE OBJECTIVE:**

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

**CONCEPTS AND CONVENTIONS (Not for Examination)**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

**UNIT I LANE CURVES AND FREE HAND SKETCHING 12**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves, Scales: Construction of Diagonal and Vernier scales. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects.

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 12**

Orthographic projection – principles - Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

**UNIT III PROJECTION OF SOLIDS 12**

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

**UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OFSURFACES 12**

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

**UNIT V SOMETRIC AND PERSPECTIVE PROJECTIONS 12**

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

**COMPUTER AIDED DRAFTING (**Demonstration Only**)**

Introduction to drafting packages and demonstration of their use.

**TOTAL: 60 Hours**

**COURSE OUTCOMES:**

After successful completion of the Engineering Graphics course, the student will be able to

**CO1:** Understand the theory of projection.

**CO2:** Able to know and understand the conventions and the methods of engineering drawing.

**CO3:** Improve their visualization skills so that they can apply these skills in developing new products.

**CO4:** Able to prepare the simple layout of factory buildings.

**CO5:** Impart and inculcate a proper understanding of the theory of projection.

**CO6:** Improve the visualization skills.

**CO7:** Understand the various concepts like dimensioning, conventioning and standards related to working drawings in order to become professionally efficient.

**CO8:** Impart the knowledge for understanding and drawing of simple residential/office buildings.

**CO9:** Ability to produce engineered drawings will improve.

**CO10:** Ability to convert sketches into engineered drawings will increase.

**TEXT BOOK:**


1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.


**REFERENCES:**


1. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
2. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.
4. Venugopal K. and Prabhu Raja V., "Engineering Graphics", NewAge International (P) Limited, 2008.
5. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
6. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.


**Publication of Bureau of Indian Standards**:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

**Special points applicable to University Examinations on Engineering Graphics:**

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

| 15GBE005 | ENGINEERING PRACTICES LABORATORY | L | T | P | C |
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## GROUP A – MECHANICAL AND CIVIL ENGINEERING PRACTICES

**COURSE OBJECTIVE:**

- To study bench fitting drawings for making male and female fittings as per the given dimensions and Tolerances.
- To study Arc welding drawings for making common weld joints as per the given dimensions.
- To study sheet metal development drawings for making common metal parts/components as per the given dimensions.

## LIST OF EXPERIMENTS

**MECHANICAL ENGINEERING PRACTICE**

**1. Welding**

To make single V, butt, lap and T fillet joint by arc welding with the back hand and fore hand welding techniques as per the given dimensions.

**2. Basic Machining**

To make Simple Turning and Taper turning in the lathe.

**3. Fitting Work**

To make square, hexagonal, V joint in bench fitting as per the given dimensions and Tolerances.

**4. Sheet Metal Work**

To make simple Cubical blocks, Rectangular trays in sheet metal with the jigs as per the given dimensions.

**CIVIL ENGINEERING PRACTICE**

**1. Buildings**

a. Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

**2. Plumbing Works**

a. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

b. Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Engineering Practices Laboratory course, the student will be able to

**CO1:** Able to make various joints in the given object with the available work material.

**CO2:** Able to know how much time a joint will take for the assessment of time.

**CO3:** Familiarity with different types of woods used and tools used in wood Working technology.

**CO4:** Familiarity with different types of tools used in sheet metal working.

**CO5:** Developments of sheet metal jobs from GI sheets, knowledge of basic concepts of soldering.

**CO6:** Familiarity with different types of tools used in forging technology.

**CO7:** Knowledge of different types of furnaces like coal-fired, electrical furnaces etc.

**CO8:** Familiarity with different types of tools used in fitting technology.

**CO9:** Utilize the hands-on experience in various fields.

**CO10:** Basic Engineering Practices in Civil, Mechanical, Electrical and Electronics Engineering.

| 15GBE006 | ENGINEERING PHYSICS LABORATORY | L | T | P | C |
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**COURSE OBJECTIVE:**

- To study and understand the basic physics concepts and study the young's modulus of the uniform and non uniform bending of the materials.

**LIST OF EXPERIMENTS**

1. Determination of Young's modulus of the material – Non uniform bending.
2. Determination of Band Gap of a semiconductor material.
3. Determination of specific resistance of a given coil of wire – Carey Foster Bridge.
4. Determination of viscosity of liquid – Poiseuille's method.
5. Spectrometer – Dispersive power of a prism.
6. Determination of Young's modulus of the material – Uniform bending.
7. Torsional Pendulum – Determination of Rigidity modulus.
8. Ultrasonic Interferometer – Velocity of ultrasonic waves and compressibility of liquids.
9. Spectrometer – Grating – Wavelength of mercury spectrum.
10. Determination of wavelength of LASER and particle size using Grating.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Engineering Physics Laboratory course, the student will be able to

**CO1:** Ability to Design and Conduct experiments as well as to Analyze and Interpret Data.

**CO2:** Ability to Identify, Formulate, and Solve Engineering Problems.

**CO3:** Ability to use Techniques and Skills associated with Modern Engineering Tools such as Lasers and Fiber Optics.

**CO4:** Provide pre requisite hands-on experience for engineering laboratories.

**CO5:** Study and understand the basic physics concepts and study the Young's modulus of the uniform and nonuniform bending of the materials.

**CO6:** Develop skills to impart practical knowledge in real time solution.

**CO7:** Understand principle, concept, working, and application of new technology and comparison of results with theoretical calculations.

**CO8:** Design new instruments with practical knowledge.

**CO9:** Gain knowledge of new concept in the solution of practically oriented problems and

**CO10:** To understand more deep knowledge about the theoretical solution problems.

**CO11:** Understand measurement technology, usage of new instruments and real-time applications in engineering studies.

| 15GBE007 | COMPUTER PRACTICE LABORATORY | L | T | P | C |
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**COURSE OBJECTIVE:**

The student should be made to:

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

**A) WORD PROCESSING**

1. Document creation, Text manipulation with Scientific notations.
2. Table creation, Table formatting and Conversion.
3. Mail merge and Letter preparation.
4. Drawing - flow Chart.

**B) SPREAD SHEET**

1. Chart - Line, XY, Bar and Pie.
2. Formula - formula editor.
3. Spread sheet - inclusion of object, Picture and graphics, protecting the document and sheet.
4. Sorting and Import / Export features.

**C) POWERPOINT**

1. Any presentation of minimum five slides.

**D) SIMPLE C PROGRAMMING ***

1. Data types, Expression Evaluation, Condition Statements.
2. Arrays.
3. Structures and Unions.
4. Functions and Pointers.
5. File Operations.

- For programming exercises Flow chart and pseudo-code are essential

**E) HTML PROGRAMMING***

1. Create a webpage to embed an image in that page using HTML tags.
2. HTML program for Table creation.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Computer Practice Laboratory course, the student will be able to

**CO1:** Get exposed by use of Office software.

**CO2:** Send a personalized letter or email to many different people by using mail merge option.

**CO3:** Analyze data using spreadsheet

**CO4:** Utilize the presentation and visualization tool using power point.

**CO5:** Get exposed to problem-solving techniques and flow charts.

**CO6:** Understand the basics of C programming.

**CO7:** Demonstrate major algorithms and data

**CO8:** Execution of array operations

**CO9:** Execution of binary tree functions

**CO10:** Execution of linked list functions

**CO11:** Execution of union operations

| 15GBE202 | COMMUNICATION SKILLS | L | T | P | C |
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**COURSE OBJECTIVE:**

- To develop listening skills for academic and professional purposes.
- To acquire the ability to speak effectively in English in real life situations.
- To inculcate reading habit and to develop effective reading skills.
- To improve their active and passive vocabulary.
- To write letters and reports effectively in formal and business situations.

**UNIT I TECHNICAL VOCABULARY 9**

Technical Vocabulary, Punctuation, Numerical Expressions, Expanding Acronyms and Abbreviations, Concord, 'If' clauses, Infinitives. Homonyms, Homographs and Homophones, Telephone conversations, Reading, comprehensions, Making of an advertisement.

**UNIT II READING AND INTERPRETATION 9**

Reading and interpretation, Intensive reading,. Writing reviews on books and films, Descriptions, Process description, Summarizing, Instructions, Oral presentations. Debate.

**UNIT III LETTER AND NON-VERBAL COMMUNICATION DRAFTING 9**

Letters – formal, informal, Cover Letter and CV , Synonyms and Antonyms, Indefinite Adjectives, Non-verbal communication, Interactive sessions. Role Plays, Critical reading Listening and Note taking.

**UNIT IV DIALOGUE WRITING AND GROUP ACTIVITIES 9**

Active and Passive Voice, Impersonal Passive, Essay Writing, Comprehension Passage, Editing, Correction of errors, Direct and Indirect, Conversations , Dialogue writing, Discourse Markers. Group activities.

**UNIT V LISTENING AND COMPREHENDING THE CONVERSATIONS 9**

Reports – Types, structure, data collection, content, form, Definitions, extended definition, Recommendations, Memos and Checklists. Group Discussions, Listening and comprehending the conversations.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Communication Skills Laboratory course, the student will be able to

**CO1:** Formulate and practice effective reading strategy to enhance technical communication.

**CO2:** Get assess strengths in writing skills and set goals for future growth

**CO3:** Practice and perceive the full repertoire of listening strategies by using authentic listening tasks.

**CO4:** Can create learning situations to develop speaking skills based on sound educational and communication theories.

**CO5:** Discover an understanding of the process of oral communication and originate knowledgeable audience-centered speaking.

**CO6:** Formulate a significant training ground to develop the abilities in public speaking.

**CO7:** Work with multiple opportunities to practice and share their reading skills in the development.

**CO8:** Know about the improve critical thinking and analytical skills

**CO9:** Develop a milestone for leadership and group participation through communication skills

**CO10:** Speak in group discussion without any fear.

**TEXT BOOKS:**


1. Department of English, Anna University, Mindscapes, 'English for Technologists and Engineers', Orient Longman Pvt. Ltd, Chennai: 2012.
2. Department of Humanities and Social Sciences, Anna University, ''English for Engineers and Technologists'' Combined Edition (Volumes 1 and 2), Chennai: Orient Longman Pvt. Ltd., 2006.
3. M. AshrafRizvi, "Effective Technical Communication", Tata McGraw-Hill Publishing Company Limited, New Delhi.2009.


**REFERENCES:**


1. Sumant. S, 'Technical English', Second Edition, McGraw-Hill Education (India) Pvt. Ltd., 2008.
2. Dr. M. Hariprasad," Communicative English "Third Edition, Neelkamal Publications, PVT. LTD., 2007.
3. Sangeeta Sharma, Binod Mishra, 'Communication Skills for Engineers and Scientists, PHI Learning Private Limited., New Delhi, 2009.

| 15GBE008 | MATHEMATICS-II | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 |

**COURSE OBJECTIVE**

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

**UNIT I ORDINARY DIFFERENTIAL EQUATIONS 12**

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

**UNIT II VECTOR CALCULUS 12**

Gradient Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and stoke's theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

**UNIT III ANALYTIC FUNCTIONS 12**

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy – Riemann equation and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping : w= z+c, cz, 1/z, and bilinear transformation.

**UNIT IV COMPLEX INTEGRATION 12**

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor and Laurent expansions – Singular points – Residues – Residue theorem – Application of residue theorem to evaluate real integrals – Unit circle and semi-circular contour(excluding poles on boundaries).

**UNIT V LAPLACE TRANSFORM 12**

Laplace transform – Conditions for existence – Transform of elementary functions – Basic properties – Transform of derivatives and integrals – Transform of unit step function and impulse functions – Transform of periodic functions. Definition of Inverse Laplace transform as contour integral – Convolution theorem (excluding proof) – Initial and Final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

**TOTAL: 60 Hours**

**COURSE OUTCOMES:**

After successful completion of the Mathematics – II course, the student will be able to

**CO1:** Evaluate double integral and triple integral to compute area, volume of two dimensional and three-dimensional solid structure.

**CO2:** Know the gradient, divergence and curl, related theorems useful for engineering applications.

**CO3:** Test the analyticity and to construct the analytic function and transform complex functions from one plane to another plane graphically.

**CO4:** Evaluate real and complex integrals over suitable closed paths or contours.

**CO5:** Know the Applications of Laplace transform and its properties & to solve certain linear differential equations using Laplace transform technique

**CO6:** Understand doubles and triple integrations and enable them to find the area and volume using multiple integrals.

**CO7:** Know the basics of vector calculus comprising gradient, divergence and curl and line, surface and volume integrals.

**CO8:** Understand analytic functions of complex variables and conformal mappings.

**CO9:** Know the basics of residues, complex integration and contour integration.

**CO10:** Understand Laplace transforms and use it to represent system dynamic models and evaluate their time responses.

**TEXT BOOKS:**


1. Grewal. B.S, "Higher Engineering Mathematics", Khanna Publications ,Delhi,43rd Edition, 2013.
2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi,6th reprint, 2008.


**REFERENCES:**


1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 9th Edition, 2011.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education , 3rd Edition, 2012.
3. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", Narosa Publishing House ,4th Edition,2014

| 15GBE009 | ENGINEERING CHEMISTRY | L | T | P | C |
|---|---|---|---|---|---|
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**COURSE OBJECTIVE:**

- To learn the basics of chemistry and application of water technology, principles of electrochemistry, nuclear chemistry, Nano chemistry, engineering materials, polymer and composites, corrosion and storage devices etc., and to apply these fundamental principles to solve practical problems related to materials used for engineering applications.

**UNIT I WATER TECHNOLOGY 9**

Characteristics – alkalinity – types of alkalinity and determination – hardness – types of estimation by EDTA method (problem) – Domestic water treatment – disinfection methods (Chlorination, ozonation. UV treatment) – Boiler feed water – requirements – disadvantages of using hard water in boilers – internal conditioning (phosphate, calgon and carbonate conditioning methods) – external conditioning – de mineralization process – desalination and reverse osmosis.

**UNIT II ELECTROCHEMISTRY, NUCLEAR CHEMISTRY AND NANO CHEMISTRY 9**

Introduction -Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf – Single electrode potential – Nernst equation (problem) – reference electrodes – Standard Hydrogen electrode – Calomel electrode – Ion selective electrode – glass electrode and measurement of pH - Nuclear energy – fission and fusion reactions and light water nuclear reactor for power generator (block diagram only) – Breeder reactor, Nano materials – introduction to Nano chemistry – carbon Nano tubes and their applications.

**UNIT III ENGINEERING MATERIALS 9**

Refractories – classification – acidic, basic and neutral refractoriness – properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling) – manufacture of alumina, magnetite and zirconia bricks and their applications. Abrasives – natural and synthetic abrasives – quartz, corundum, emery, garnet, diamond, silicon carbide and boron carbide. Lubricants – mechanism of lubrications – properties – viscosity index – flash and fire points, cloud and pour points – oiliness – solid lubricants – graphite and molybdenum disulphide.

**UNIT IV POLYMERS AND COMPOSITES 9**

Polymers – definition – polymerization – types – addition and condensation polymerization –free radical polymerization and mechanism – Plastics, classification – preparation, properties and uses of PVC, Teflon, polycarbonate, polyurethane, nylon-6,6, PET – Rubber – vulcanization of rubber. Synthetic rubbers. Composites – definition, types, polymer matrix composites – FRP only Conducting polymers, semiconducting polymers, molecular switches—examples, mechanism and applications.

**UNIT V CORROSION, CORROSION CONTROL AND STORAGE DEVICES 9**

Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion – factors influencing corrosion – corrosion control – sacrificial anode and impressed cathodic current methods – corrosion inhibitors – protective coatings – paints – constituents and functions – metallic coatings – electroplating (Au) and electroless (Ni) plating. Solar energy conversion – solar cells – wind energy – fuel cells –hydrogen – oxygen fuel cell – Batteries – alkaline batteries – lead – acid batteries – nickel – cadmium batteries and lithium batteries.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Engineering Chemistry course, the student will be able to

**CO1:** To know about characteristics of water and estimation of hardness using EDTA Titration

**CO2:** Determine alkalinity and its types of alkalinity using neutralization reaction

**CO3:** Explain different types of Nuclear reactions, stability of Nucleus and Nuclear forces

**CO4:** Distinguish between Daniel cell, Voltaic cell, batteries etc.

**CO5:** Define refractories, abrasives, lubricants and its classifications.

**CO6:** Define polymers, Classifications of polymers and its synthetic applications.

**CO7:** Distinguish between Chemical and Electrochemical Corrosion and method of prevention.

**CO8:** Gain knowledge about different sources of energy and types of batteries

**CO9:** Understand the method of synthesis and different types of Nanotubes and its application.

**TEXT BOOKS:**


1. B.Sivasankar “Engineering Chemistry” Tata McGraw-Hill Pub.Co.Ltd, New Delhi 2008.
2. B.K.Sharma “Engineering Chemistry” Krishna Prakasan Media (P) Ltd., Meerut 2001.
3. Puri and Sharma “A text book of Physical chemistry “, Chand and Co., New Delhi


**REFERENCES:**


1. Jain P.C. and Monica Jain, “Engineering Chemistry”, Dhanpat Rai publishing Company (P) Ltd., New Delhi, 2010.
2. Dara S.S, Umare S.S, “Engineering Chemistry”, S. Chand & Company Ltd., New Delhi 2010.

**15GBE010** **MATERIAL SCIENCE**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 3 |

**COURSE OBJECTIVE:**

- To learn the basics of conducting materials, semiconducting materials, magnetic super conducting materials, Dielectric materials and Modern Engineering Materials etc., and to apply these fundamental principles to solve practical problems related to materials used for engineering applications

**UNIT I CONDUCTING MATERIALS 9**

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Drawbacks of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi function – Density of energy states – carrier concentration in metals.

**UNIT II SEMICONDUCTING MATERIALS 9**

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 – variation of Fermi level with temperature and impurity concentration – compound semiconductors – Hall effect – Determination of Hall coefficient – Applications.

**UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS 9**

Origin of magnetic moment – Bohr magneton – Dia and para magnetism – Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites, applications – magnetic recording and readout, storage of magnetic data, tapes, floppy and magnetic disc drives. Superconductivity - properties – Types of superconductors – BCS theory of superconductivity(Qualitative) – High Tc superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

**UNIT IV DIELECTRIC MATERIALS 9**

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarisation – frequency and temperature dependence of polarisation – internal field – Clausius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferroelectricity and applications.

**UNIT V MODERN ENGINEERING MATERIALS 9**

Metallic glasses: preparation, properties and applications. Shape memory alloys (SMA): Characteristics, properties, application, advantages and disadvantages of SMA. Nano materials: synthesis – plasma arcing – chemical vapour deposition – sol-gels – electro deposition – ball milling – properties of nano particles and applications, Carbon nano tubes: fabrication.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Material Science course, the student will be able to

**CO1:** Apply general math, science and engineering skills to the solution of engineering problems.

**CO2:** Aware of the social, safety and environmental consequences of their work, and be able to engage in public debate regarding these issues.

**CO3:** Apply core concepts in Materials Science to solve engineering problems.

**CO4:** Knowledgeable of contemporary issues relevant to Materials Science and Engineering.

**CO5:** Able to select materials for design and construction.

**CO6:** Understand the importance of lifelong learning.

**CO7:** Design and conduct experiments, and to analyze data.

**CO8:** Understand the professional and ethical responsibilities of a materials scientist and engineer.

**CO9:** Communicate effectively while speaking, employing graphics and writing.

**CO10:** Possess the skills and techniques necessary for modern materials engineering practice.

**TEXT BOOKS:**


1. Rajendran, V, and Marikani A, 'Materials Science' Tata McGraw Hill publications, New Delhi 2011.
2. Vijaya, M. and Rangarajan G, 'Materials Science' Tata McGraw Hill publications, New Delhi 2006.


**REFERENCES:**


1. Charles Kittel 'Introduction to Solid State Physics', John Wiley and sons, 7th edition, Singapore 2008.
2. Kasap S.O, " Principles of Electronic Materials", 3rd edition, McGrawHill Higher Education, 2005.
3. Pradeep T, "A text book of Nanoscience and Nano technology, McGrawHill Higher Education, 2012.
4. Palanisamy P.K, 'Materials Science', Scitech publications, Chennai, 2007.


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| 15EME021 | ENGINEERING MECHANICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 |

**COURSE OBJECTIVE:**

- At the end of this course the student should be able to understand the vectorial and scalar representation of forces and moments, static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions. Further, he should understand the principle of work and energy. He should be able to comprehend the effect of friction on equilibrium. He should be able to understand the laws of motion, the kinematics of motion and the interrelationship. He should also be able to write the dynamic equilibrium equation. All these should be achieved both conceptually and through solved examples.

**UNIT I BASICS AND STATICS OF PARTICLES 12**

Introduction – Units and Dimensions – Laws of Mechanics – Lame's theorem, Parallelogram and triangular Law of forces – Vectors – Vectorial representation of forces and moments – Vector operations: additions, subtraction, dot product, cross product – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility – Single equivalent force.

**UNIT II EQUILIBRIUM OF RIGID BODIES 12**

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions – Examples

**UNIT III PROPERTIES OF SURFACES AND SOLIDS 12**

Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, Angle section, Hollow section by using standard formula – second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia – Mass moment of inertia – Derivation of mass moment of inertia for rectangular section, prism, sphere from first principle – Relation to area moments of inertia.

**UNIT IV DYNAMICS OF PARTICLES 12**

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies.

**UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 12**

Frictional force – Laws of Coulomb friction – simple contact friction – Rolling resistance – Belt friction. Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.

**TOTAL: 60 Hours**

**COURSE OUTCOMES:**

After successful completion of the Engineering Mechanics course, the students have the ability to

**CO1:** Solve engineering problems dealing with force, displacement, velocity and acceleration.

**CO2:** Solve rigid body subjected to dynamic forces.

**CO3:** Analyze the magnitude and forces in any structures.

**CO4:** Use of scalar and vector analytical techniques for analyzing the forces in statically determinate structures.

**CO5:** Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.

**CO6:** Comprehensive, theory-based understanding of the underpinning natural and physical sciences and the engineering fundamentals.

**CO7:** Understanding the friction and elements of rigid body dynamics.

**CO8:** Understanding the rolling and belt friction.

**CO9:** Understanding the General Plane of motion.

**CO10:** Apply an application of established engineering methods to complex engineering problems solving.

**TEXT BOOKS:**


1. Beer, F.P and Johnson Jr. E.R. “Vector Mechanics for Engineers”, Vol. 1 Statics and Vol. 2 Dynamics, McGraw-Hill International Edition, 1997.
2. Rajasekaran. S, Sankarasubramanian. G., “Fundamentals of Engineering Mechanics”, Vikas Publishing House Pvt. Ltd., 2000.


**REFERENCES:**


1. Hibbeller, R.C., “Engineering Mechanics”, Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., 2000.
2. Palanichamy, M.S., Nagam, S., “Engineering Mechanics – Statics and Dynamics”, Tata McGraw-Hill, 2001.
3. Irving H. Shames, “Engineering Mechanics – Statics and Dynamics”, IV Edition – Pearson Education Asia Pvt. Ltd., 2003.
4. Ashok Gupta, “Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)”, Pearson Education Asia Pvt., Ltd., 2002.

**15EME022 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**

| L | T | P | C |
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**COURSE OBJECTIVE:**

- To provide exposure to the students of basic electrical and electronics engineering.

**UNIT I ELECTRICAL CIRCUITS AND MEASURMENTS 12**

Ohm's Law – Kirchhoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Three Phase Balanced Circuits. Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

**UNIT II ELECTRICAL MACHINES 12**

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, 1-Phase Transformer, 3-phase Induction Motors.

**UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 12**

Characteristics of PN Junction Diode –Half wave and Full wave Rectifiers – Zener Effect – Zener Diode and its Characteristics – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier.

**UNIT IV DIGITAL ELECTRONICS 12**

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion (single concepts).

**UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING 12**

Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations. Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

**TOTAL: 60 Hours**

**COURSE OUTCOMES:**

After successful completion of the Basic Electrical and Electronics Engineering course, the student will be able to

**CO1:** Understand the basics of electrical circuits and measurements.

**CO2:** Understand the Ohm's and Kirchhoff's Laws.

**CO3:** Understand the principle and construction of DC motor and generator.

**CO4:** Understand the principle and construction of single phase and three phase induction motors.

**CO5:** Understand the basics of semiconductor devices and applications

**CO6:** Understand characteristics of PN junction diode and a Zener diode.

**CO7:** Understand and construct the Half wave and Full wave rectifiers circuits.

**CO8:** Understand Elementary Treatment of Small Signal Amplifier.

**CO9:** Understand the basics of digital electronics and applications.

**CO10:** Understand the techniques of analog to digital and digital to analog Conversion.

**CO11:** Understand the basic fundamentals of communication engineering.

**CO12:** Understand the basic Principles of Amplitude and Frequency Modulations.

**TEXT BOOKS:**


1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, “Basic Electrical, Electronics and Computer Engineering”, Tata McGraw Hill, Second Edition, 2006.
2. Murugesh Kumar,K., and Jaganathan, V., “Basic Electrical and Electronics Engineering”, Vikas Publishing House PVT Ltd, New Delhi 2001.


**REFERENCES:**


1. Nagsarkar T K and Sukhija M S, “Basics of Electrical Engineering”, Oxford press 2005.
2. Mehta V K, “Principles of Electronics”, S.Chand and Company Ltd, 1995.

| 15GBE011 | ENGINEERING CHEMISTRY LABORATORY | L | T | P | C |
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**COURSE OBJECTIVE:**

- To acquire practical skills in the determination of water quality parameters through volumetric analysis.
- To determine the molecular weight of a polymer by viscometry.

## LIST OF EXPERIMENTS

1. Determine the total, permanent and temporary hardness of the given water sample by EDTA method. A standard hard water and EDTA solutions are provided.
2. Determine the type and amount of alkalinity present in the given water sample. A standard solution of sodium hydroxide of strength 0.1N is given.
3. Estimate the amount of chloride present in the water sample by Argentometric analysis. A standard solution of strength 0.01N and sodium chloride solutions are provided
4. Determination of molecular weight of given polymer solution by Ostwald viscometer method.
5. Determine the amount of strong acid and weak acid (HCl and CH3COOH) present in 1 litre of the given mixture of acid solution by conducto-metric titration using standard NaOH of normality 0.2N.
6. Determine the amount of barium chloride present in 1 litre of the given solution by conductometric titration using standard solution of sodium sulphate of normality 0.2N.
7. Estimate the amount of ferrous ion present in the whole of the given solution. A standard solution of potassium dichromate of strength 0.1N is provided.
8. Determine the strength of the given hydrochloric acid by pH-metry with 0.2N sodium hydroxide solution.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Engineering Chemistry Laboratory course, the student will be able to

**CO1:** Estimate different types of hardness of water using complexometric titrations of given water sample.

**CO2:** Determine the amount of alkalinity of the given water sample using standard NaOH.

**CO3:** Find out the amount of chloride ion present in the given solution using argentometric method.

**CO4:** Calculate the molecular weight of the unknown polymer solution using viscosity method.

**CO5:** Determine the amount of strong acid present in the given mixture of acid solution using conductometric titrations.

**CO6:** Estimate the amount of strong and weak acid present in the mixture solution using conductometric titrations.

**CO7:** Estimate the amount of barium chloride present in the given solutions using conductometric titrations.

**CO8:** Estimate the amount of ferrous ion present in the given solution using conductometric titrations.

**CO9:** Determine the strength of the given acid by using PH-metry titrations.

| 15GBE203 | LANGUAGE LABORATORY | L | T | P | C |
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**COURSE OBJECTIVE:**

- To gain effective speaking and listening skills in communication.
- To develop the soft skills and interpersonal skills to excel in their job.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment exercises.

**A. ENGLISH LANGUAGE LAB** **18 Hours**

**I. PC based session (Weight age 40%)** **24 Hours**

**1. LISTENING COMPREHENSION** **6**

Listening and typing – Listening and sequencing of sentences – Filling in the blanks - Listening and answering
questions.

**2. READING COMPREHENSION** **6**

Filling in the blanks - Close exercises – Vocabulary building - Reading and answering questions.

**3. SPEAKING** **6**

Phonetics: Intonation – Ear training - Correct Pronunciation – Sound recognition exercises – Common Errors in English. Conversations: Face to Face Conversation – Telephone conversation – Role play activities (Students take on roles and engage in conversation)

**B. DISCUSSION OF AUDIO-VISUAL MATERIALS** **6 Hours**

**(Samples are available to learn and practice)**

**1. RESUME / REPORT PREPARATION / LETTER WRITING (1)**

Structuring the resume / report - Letter writing / Email Communication - Samples.

**2. PRESENTATION SKILLS: (1)**

Elements of effective presentation – Structure of presentation – Presentation tools – Voice Modulation – Audience analysis - Body language – Video samples

**3. SOFT SKILLS: (2)**

Time management – Articulateness – Assertiveness – Psychometrics – Innovation and Creativity - Stress Management & Poise - Video Samples

**4. GROUP DISCUSSION: (1)**

Why is GD part of selection process ? - Structure of GD – Moderator – led and other GDs - Strategies in GD – Team work - Body Language - Mock GD –Video samples

**5. INTERVIEW SKILLS: (1)**

Kinds of interviews – Required Key Skills – Corporate culture – Mock interviews- Video samples.

1. Resume / Report Preparation / Letter writing: Students prepare their own resume and report. (2)
2. Presentation Skills: Students make presentations on given topics. (8)
3. Group Discussion: Students participate in group discussions. (6)
4. Interview Skills: Students participate in Mock Interviews (8)

**II. Practice Session (Weight age – 60%)** **24 Hours**

**COURSE OUTCOMES:**

After successful completion of the Language Laboratory course, the student will be able to

**CO1:** Improve the listening capability.

**CO2:** Get the writing capability through the practices.

**CO3:** Engage to improve the language capability for reading and writing.

**CO4:** Use strong vocabulary and fluently like foreigners.

**CO5:** Prepare their, own resume in professional method.

**CO6:** Understand the Structure of presentation and the tools available in the power point presentation.

**CO7:** Present the given topics or their own topic of interest.

**CO8:** Participates in group discussion without any hesitation.

**CO9:** Participate in mock interviews to remove the fear factors.

**CO10:** Get all types of training to prepare them for interview.

**TEXT BOOKS:**

1. Anderson, P.V, Technical Communication, Thomson Wadsworth, Sixth Edition, New Delhi, 2007.
2. Prakash, P, Verbal and Non-Verbal Reasoning, Macmillan India Ltd., Second Edition, New Delhi, 2004.

**REFERENCES:**

1. John Seely, The Oxford Guide to Writing and Speaking, Oxford University Press, New Delhi, 2004.
2. Evans, D, Decisionmaker, Cambridge University Press, 1997.
3. Thorpe, E, and Thorpe, S, Objective English, Pearson Education, Second Edition, New Delhi, 2007.
4. Turton, N.D and Heaton, J.B, Dictionary of Common Errors, Addison Wesley.

| 15CBME23 | COMPUTER AIDED DRAFTING LABORATORY | L | T | P | C |
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**COURSE OBJECTIVE:**

- To develop the student's graphic skill for communication of concepts, ideas and design of engineering products and expose them to existing CAD Packages related to technical drawings.

**List of Exercises using software capable of Drafting**

1. Importance of graphics in engineering applications – BIS conventions and specifications – Size and layout of drawing sheets – Lettering and dimensioning. Study of capabilities of CAD Packages for drafting – Coordinate systems. (Theory)
2. Creation of simple figures like polygon and general multi-line figures.
3. Construction of ellipse, Parabola and hyperbola.
4. Construction of involutes of square and polygon.
5. Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations.
6. Projection of polygonal surface and circular lamina inclined to one reference planes.
7. Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.
8. Sectioning of simple solids like prisms, pyramids, cylinder and cone in vertical position by cutting planes inclined to one reference plane and perpendicular to the other.
9. Draw the orthographic projection in the 1st angle for the objects such as step block, solid bearing block, gland as per the dimensions given.
10. Draw the isometric view or 3D model of a V – block, shaft bracket, jig plate as per the dimensions given.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Computer Aided Drafting Laboratory course, the student will be able to

**CO1:** Understand the role of CAD in mechanical component and system design by creating geometric models and engineering drawings.

**CO2:** Understand the basic mathematics fundamental to CAD software.

**CO3:** Work in teams to design a mechanical system and fabricate a prototype of their design.

**CO4:** Create the different wireframe primitives using parametric representations.

**CO5:** Create surface primitives using parametric modeling.

**CO6:** Create the different solid primitives using the different representation schemes.

**CO7:** Apply geometric transformations on the created wireframe, surface and solid models.

**CO8:** Effective user of a CAD/CAM system.

**CO9:** Contemporary computer design tools for aerospace and mechanical engineers.

**CO10:** Sketch in 2D Dimension and constrain sketch entities. Evaluate the validity of the sketch for later operations.

**TEXT BOOKS:**


1. DhananjayA.Jolhe, “Engineering Drawing with an introduction to AutoCAD” Tata McGraw Hill Publishing Company Limited 2008.
2. K. Venugopal& V. Prabhu Raja, “Engineering Graphics”, New Age International (P) Limited 2008.


**REFERENCES:**


1. N.D. Bhatt, “Engineering Drawing” Charotar Publishing House, 46th Edition, 2003.
2. M.S. Kumar, “Engineering Graphics”, D.D. Publications, 2007.
3. M.B. Shah and B.C. Rana, “Engineering Drawing”, Pearson Education 2005.
4. S. Gowri and T. Jeyapoovan, “Engineering Graphics”, 6th Edition, Vikas Publishing house Pvt Ltd 2011.

| 15CBME32 | ENVIRONMENTAL SCIENCE AND ENGINEERING | L | T | P | C |
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**OBJECTIVE**

- At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity. The role of government and non – governmental organization in environmental managements.

**UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9**

Definition – Scope and importance – Need for public awareness – Concepts of an Ecosystem – Structure and Function of an Ecosystem –Producers, Consumers and Decomposers – Energy Flow in the Ecosystem – Ecological Succession – Food Chains, Food Webs and Ecological Pyramids – Introduction, Types, Characteristic Features, Structure and Function of the (A) Forest Ecosystem (B) Grassland Ecosystem (C) Desert Ecosystem (D) Aquatic Ecosystems (Ponds, Streams, Lakes, Rivers, Oceans, Estuaries) – Introduction to Biodiversity – Definition: Genetic, Species and Ecosystem Diversity – Biogeographical Classification of India – Value of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values – Biodiversity at Global, National and Local Levels – India as a Mega-Diversity Nation – Hot-Spots of Biodiversity – Threats to Biodiversity: Habitat Loss, Poaching of Wildlife, Man-Wildlife Conflicts – endangered and Endemic Species of India – Conservation of Biodiversity: In-Situ and Ex-Situ conservation of Biodiversity.

Field Study of Common Plants, Insects and Birds. Field study of simple ecosystems - pond, river, hill slopes, etc.

**UNIT II ENVIRONMENTAL POLLUTION 9**

Definition – Causes, Effects and Control Measures of (A) Air Pollution (B) Water Pollution (C) Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution (G) Nuclear Hazards – Solid Waste Management:- Causes, Effects and Control Measures of municipal solid Wastes – Role of an Individual in Prevention of Pollution – Pollution Case Studies – disaster Management - Floods, Earthquake, Cyclone and Landslides.

Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

**UNIT III NATURAL RESOURCES 9**

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 and Exploitation, Environmental Effects of Extracting and Using Mineral Resources, Case Studies – Food Resources: World Food Problems, Changes caused by Agriculture and Overgrazing, Effects of Modern Agriculture, Fertilizer- Pesticide Problems, Water Logging, salinity, Case Studies – Energy Resources:- Growing Energy Needs, Renewable and Non Renewable Energy Sources, Use of Alternate Energy Sources, Case Studies – Land Resources - Land as a Resource, Land Degradation, Man Induced Landslides, Soil Erosion and Desertification – Role of an Individual in Conservation of Natural Resources – Equitable use of Resources for Sustainable Lifestyles.
Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

**UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 9**

From Unsustainable To Sustainable Development – Urban Problems Related to energy – Water conservation, Rain Water Harvesting, Watershed Management – Resettlement and Rehabilitation of People, its Problems and Concerns, Case Studies Role of non – governmental

organization - Environmental Ethics- Issues and Possible Solutions – Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Studies – Wasteland Reclamation – Consumerism and Waste Products – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – enforcement machinery involved in environmental Legislation – Central and state pollution control boards - Public Awareness.

**UNIT V HUMAN POPULATION AND THE ENVIRONMENT 9**

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: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Environmental Science and Engineering course, the student will be able to

**CO1:** Understand constitutes the environment and precious resources in the environment.

**CO2:** Understand the conserves the natural resources,

**CO3:** Understand the role of a human being in maintaining a clean environment.

**CO4:** Explain how to the useful environment for the future generations.

**CO5:** Explain how to maintain ecological balance and preserve biodiversity.

**CO6:** Understand the role of government and non – governmental organization in environmental managements.

**CO7:** Explain the Scope and importance of public awareness of the ecosystem.

**CO8:** Understand the impact of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution

**CO9:** Explain the role of an Individual in the conservation of natural resources and use of resources for sustainable lifestyles.

**CO10:** Understand the Environment Production Act, Air (Prevention and Control of Pollution) Act and Water (Prevention and Control of Pollution) Act and Forest Conservation Act.

**TEXT BOOKS:**


1. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw- Hill,NewDelhi, (2006).


**REFERENCES:**


1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol.I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan. R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005)

| 15CBE031 | MATHEMATICS - III | L | T | P | C |
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**COURSE OBJECTIVE:**

- To introduce Fourier series analysis, which is central to many applications in engineering apart from its use in solving boundary value problems. The understanding of the mathematical principles on Fourier series and transforms, partial differential equations and Z transform would provide them the ability to formulate and solve some of the physical problems of engineering.

**UNIT I FOURIER SERIES 12**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Parseval's identity – Harmonic Analysis.

**UNIT II FOURIER TRANSFORM 12**

Fourier integral theorem (without proof) – Fourier transform pair – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

**UNIT III PARTIAL DIFFERENTIAL EQUATIONS 12**

Formation of partial differential equations - singular integrals- Solutions of standard types of first order partial differential equations – Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non- homogeneous types.

**UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12**

Classification PDE-Method of separation of variables - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional heat equation (excluding Insulated edges).

**UNIT V Z -TRANSFORM AND DIFFERENCE EQUATIONS 12**

Z-transform - Elementary properties – Inverse Z-transform(using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z-transform.

**Total: 60 Hours**

**COURSE OUTCOMES:**

After successful completion of the Engineering Mathematics – III course, the student will be able to

**CO1:** Understand the Fourier series analysis, which is central to many applications in engineering apart from its use in solving boundary value problems.

**CO2:** Understand about the Half range sine series and cosine series.

**CO3:** Understand the mathematical principles of Fourier series and transforms would provide them the ability to formulate and solve some of the physical problems of engineering.

**CO4:** Understand the Convolution theorem.

**CO5:** Understand the Parseval's identity.

**CO6:** Understand the types of first order partial differential equations.

**CO7:** Understand the Linear partial differential equations of second and higher order with constant coefficients of homogeneous and non- homogeneous types.

**CO8:** Understand the One-dimensional equation of heat conduction.

**CO9:** Understand the Steady state solution of the two-dimensional heat equation.

**CO10:** Understand the mathematical principles of partial differential equations and Z transform solve some of the physical problems of engineering.

**TEXTBOOKS:**


1. Grewal. B.S, "Higher Engineering Mathematics", KhannaPublications ,Delhi,43rd Edition, 2013.
2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 6th reprint,2008.


**REFERENCES:**


1. Bali.N.P. and Manish Goyal 'A Text book of Engineering Mathematics', Laxmi Publications, 9th edition,2011.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 9th Edition, 2011.
3. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education ,3rd Edition, 2012.
4. SivaramakrishnaDas.P&Vijayakumari.C ,A Text book of Engineering Mathematics-III (Transforms &Partial Differential equations), Pearson Eduaction Limited ,5th Edition ,2013.

| 15CBME034 | ENGINEERING THERMODYNAMICS | L | T | P | C |
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**COURSE OBJECTIVE:**

To familiarize the students to understand the fundamentals of thermodynamics and to perform thermal analysis on their behavior and performance.(Use of Standard and approved Steam Table, Mollier Chart, Compressibility Chart and Psychrometric Chart permitted

**UNIT I BASIC CONCEPT AND FIRST LAW 9**

Basic concepts - concept of continuum, macroscopic approach, thermodynamic systems - closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics – concept of temperature and heat, Concept of ideal and real gases, First law of thermodynamics – application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipments.

**UNIT II SECOND LAW AND ENTROPY 9**

Second law of thermodynamics – Kelvin's and Clausius statements of second law, Reversibility and irreversibility. Carnot theorem, Carnot cycle, reversed carnot cycle, efficiency, COP, Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy.

**UNIT III THERMODYNAMIC AVAILABILITY 9**

Basics – Energy in non-flow processes: Expressions for the Energy of a closed system- Equivalence between mechanical energy forms and Energy – Flow of energy associated with heat flow – Energy consumption and entropy generation. Energy in steady flow processes: Expressions for Energy in steady flow processes – Energy dissipation and entropy generation.

**UNIT IV PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 9**

Properties of pure substances – Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in non-flow and flow processes, Standard Rankine cycle, Reheat and regenerative cycle.

**UNIT V PSYCHROMETRY 9**

Psychrometry and psychrometric charts, property calculations of air vapour mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling, problems.

**TOTAL: 45 Hours**

(Use of standard thermodynamic tables, Mollier diagram, Psychrometric chart and refrigerant property tables are permitted)

After successful completion of the Engineering Thermodynamics course, the student will be able to

**CO1:** Understand the fundamental of the first and second laws of thermodynamics and their application.

**CO2:** Understanding the state, path and processes.

**CO3:** Analyze the work and heat interactions associated with a prescribed process path, and to perform a first law analysis of a flow system.

**CO4:** Evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations.

**CO5:** Familiarity with calculations of the efficiencies of heat engines and other engineering devices.

**CO6:** Understanding of the use of the Gibbs and Helmholtz free energies as equilibrium criteria, and the statement of the equilibrium condition for closed and open systems.

**CO7:** Understanding of the interrelationship between thermodynamic functions and an ability to use such relationships to solve practical problems.

**CO8:** Understand about thermodynamic properties of steam.

**CO9:** Understand about Standard Rankine cycle, Reheat and regenerative cycle.

**CO10:** Understand about psychrometry and psychrometric charts.

**CO11:** Evaluate the property calculations of air vapour mixtures.

**TEXT BOOKS:**

1. Nag.P.K., “Engineering Thermodynamics”, Tata McGraw-Hill, New Delhi, 1998.
2. Lynn D Russell, George A, Adebiyi “Engineering Thermodynamics” Indian Edition, Oxford University Press, New Delhi, 2007.

**REFERENCES:**

1. Yunus A angel and Michael Boleo, Thermodynamics an Engineering Approach.
2. E.Ratha Krishnan, Fundamentals of Engineering Thermodynamics, 2nd Edition, Prentice Hall of India Pvt. Ltd,
3. Arora C.P, “Thermodynamics”, Tata McGraw-Hill, New Delhi, 2003.
4. Merala C, Pother, Craig W, Somerton, “Thermodynamics for Engineers”, Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.
5. Venwylen and Sontag, “Classical Thermodynamics”, Wiley Eastern, 1987
6. Holman.J.P., “Thermodynamics”, 3rd Ed. McGraw-Hill, 1995.

| 15PBME31 | ELECTRICAL ENGINEERING LABORATORY | L | T | P | C |
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**COURSE OBJECTIVE:**

To provide exposure to the students with hands on experience on various basic engineering practices in Electrical Engineering.

**LIST OF EXPERIMENTS**

1. Speed Control of DC Shunt Motor
2. Load Test on DC Shunt Motor
3. Study of DC Motors
4. Swinbuirne's Test
5. Load Test on DC Series Motor
6. Load Test on DC Compound Motor
7. Load Test on 3 Phase Induction Motor
8. Study of AC Motor Starters
9. No load and Blocked Rotor Test on 3 Phase Induction Motor

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Electrical Engineering Laboratory course, the student will be able to

**CO1:** Measure power in three phase circuits.

**CO2:** Distinguish between the effects of Eddy current and hysteresis losses in magnetic materials.

**CO3:** Measure performance characteristics of DC generators and three-phase induction motors.

**CO4:** Perform power transformer open and short circuit tests and determine the values of elements of the equivalent circuit.

**CO5:** Design the experiments for measuring characteristics of different semiconductor diodes.

**CO6:** Measuring characteristics and efficiency of a solar cell.

**CO7:** Extract model parameters of diodes and solar sell form measured I-V characteristics.

**CO8:** Design the experiments and measure characteristics of transistors.

**CO9:** Extract transistor model parameters from the measured characteristics.

**CO10:** Write a professional quality laboratory report describing their work, results and analysis.

| 15PBME32 | COMPUTER AIDED MACHINE DESIGN LABORATORY | L | T | P | C |
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**COURSE OBJECTIVE:**

- To develop skill to use software to create 2D and 3D models.

**INTRODUCTION**

Introduction to machine components and interpret drawings of machine component so as to prepare assembly drawing either manually and using standard CAD packages.

**DRAWING STANDARDS**

Code of practice for engineering drawing, BIS specifications-conventional representation of details-Welding symbols, riveted joints, keys, Fasteners. Reference to hand book for the selection of standard components like-bolts, nuts, washers, screws, cotters, pins, circlips, bearings, gears, springs and flanges.

**2-D DRAWINGS**

Limits, Fits- Tolerancing of Individual Dimensions-Specification of Fits -Manual preparation of production drawings and reading of part and assembly drawings.

**CAD PRACTICE (USING APPLICATION PACKAGES)**

Drawing , Editing, Dimensioning, Plotting Commands, Layering Concepts, Hatching, Detailing, Assembly, Basic principles of GD&T (geometric dimensioning & tolerancing).

**ASSEMBLY DRAWING (MANUAL & USING APPLICATION PACKAGES)**

Making free hand sketches of typical subassemblies-Plummer block, Screw jack, Lathe Tailstock, Universal Joint-Machine Vice-Stuffing Box-safety Valves-rolling element bearings, keyed joints, cotter joints, C clamp.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Computer aided Machine Design Laboratory course, the student will be able to

**CO1:** Perform both 2-D and 3-D drawings of any components using softwares such as Auto CAD / Any modeling software.

**CO2:** Visualize and model the parts of machines.

**CO3:** Construct assemblies such as vice, screw jack and tailstock of the lathe, etc. from the concepts learned using drafting software.

**CO4:** Create the different wireframe primitives using parametric representations.

**CO5:** Create surface primitives using parametric modeling.

**CO6:** Create the different solid primitives using the different representation schemes.

**CO7:** Apply geometric transformations on the created wireframe, surface and solid models.

**CO8:** Effective user of a CAD system.

**CO9:** Get exposure to the contemporary computer design tools for aerospace and mechanical engineers.

**CO10:** Sketch in 2D, Dimension and constrain sketch entities. Evaluate the validity of the sketch for later operations.

**TEXT BOOKS:**

1. Gopalakrishna K R, "Machine Drawing", Seventeenth Edition, Subhas Stores, Bangalore, 2003.
2. CAD/CAM Manual, PSG College of Technology, Coimbatore, 2002.

**REFERENCES:**

1. Varghese P I and John K C, "Machine Drawing", Jovast Publishers, Thrissur, 2007.
2. BIS, SP: 46-2003 – “Engineering Drawing Practice for Schools and Colleges", New Delhi, 2003.
3. Faculty of Mechanical Engineering, PSG College of Technology," Design Data Book", M/s. DPV Printers, Coimbatore, 1993.
4. ASME Y 14.5M-1994, “Dimensioning and Tolerancing”, ASME, New York, 1995.

| 15GBE015 | STATISTICS AND NUMERICAL METHODS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 |

**COURSE OBJECTIVE:**

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

**UNIT I TESTING OF HYPOTHESIS 12**

Sampling distributions - Tests for single mean, Proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – chi-square test for goodness of fit – Independence of attributes.

**UNIT II DESIGN OF EXPERIMENTS 12**

Completely randomized design – Randomized block design – Latin square design -22 factorial design.

**UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12**

Newton-Raphson method- Gauss Elimination method – Pivoting - Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigenvalues of a matrix by Power method .

**UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 12**

Lagrange's and Newton's divided difference interpolation –Newton's forward and backward difference interpolation - Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal and Simpson's 1/3 rules.

**UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12**

Taylor's series method -Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first and second order equations -Milne's and Adams predictor-corrector methods for solving first order equations .

**Total: 60 Hours**

**COURSE OUTCOMES:**

After successful completion of the Statistics and Numerical Methods the student will be able to

**CO1:** Understanding the statistical methods and data analysis in the context of Engineering.

**CO2:** Understand the large sample test based on normal distribution for single mean and difference of means

**CO3:** Understanding and use of the contingency table of statistics.

**CO4:** Improve the working knowledge in numerical techniques with some of the underpinning theoretical ideas.

**CO5:** Derive the solutions to the equations using various scientific approaches.

**CO6:** Perform an error analysis for a given numerical method.

**CO7:** Solve a differential equation using an appropriate numerical method.

**CO8:** Solve a linear system of equations using an appropriate numerical method.

**CO9:** Prove results for numerical root finding methods.

**CO10:** Calculate a definite integral using an appropriate numerical method.

**TEXT BOOKS:**


1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 9th Edition, KhannaPublishers, New Delhi, 2012.(For units 3, 4 and 5).
2. Johnson R.A. and Gupta C.B, "Miller and Freund's Probability and Statistics for Engineers", Pearson
3. Education, Asia, 7th edition, 2007 (For units 1 and 2).


**REFERENCES:**


1. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", Tata McGraw-Hill, New Delhi, 7th Edition,2014.
2. Walpole R.E, Myers R.H, Myers S.L, and Ye. K, "Probability and Statistics for Engineersand Scientists", Pearson Education, Asia , 9th edition, 2011.
3. Dr.Kandasamy .P,Dr.Thilagavathi,Dr.Gunavathi.K,"Statistics and numerical methods",s.chand and company,first edition,2010.

**15CBME043** **STRENGTH OF MATERIALS** **L T P C**
**3 0 0 3**

**COURSE OBJECTIVE:**

- To understand the stresses developed in bars, compounds bars, beams, shafts, cylinders and spheres.

**UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9**

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – 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 – Effect of shape of beam section on stress induced – Shear stresses in beams – Shear flow.

**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 – stresses in helical coil springs under torsion loads.

**UNIT IV BEAM DEFLECTION 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 and its types – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns.

**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.

**TOTAL : 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Strength of Materials course, the student will be able to

**CO1:** Understanding the basic concepts and principles of strength of materials.

**CO2:** Understand the rigid bodies and deformable solids.

**CO3:** Apply the knowledge of strength of materials for engineering applications and design problems to related tensile, compressive and shear stresses.

**CO4:** Understand the concepts of stress and strain at a point as well as the stress-strain relationships for homogenous, isotropic materials.

**CO5:** Calculate the stresses and strains in an axially-loaded members, circular torsion members, and members subject to flexural loadings.

**CO6:** Calculate the stresses and strains associated with cylindrical pressure vessels and helical coil springs.

**CO7:** Analyses the principal stresses, maximum shearing stress, and the stresses acting on a structural member.

**CO8:** Determine the deflections and rotations produced by the three fundamental types of loads: axial, torsional, and flexural.

**CO9:** Analyze slender, long columns subjected to axial loads.

**CO10:** Design simple bars, beams, and circular shafts for allowable stresses and loads.

**TEXT BOOKS:**

1. Popov E.P, “Engineering Mechanics of Solids”, Prentice-Hall of India, New Delhi, 1997.
2. Beer F. P. and Johnston R, “Mechanics of Materials”, McGraw-Hill Book Co, Third Edition, 2002.

**REFERENCES:**

1. Nash W.A, “Theory and problems in Strength of Materials”, Schaum Outline Series, McGraw-Hill Book Co, New York, 1995
2. Kazimi S.M.A, “Solid Mechanics”, Tata McGraw-Hill Publishing Co, New Delhi, 1981
3. Ryder G.H, “Strength of Materials”, Macmillan India Ltd., Third Edition, 2002
4. Ray Hulse, Keith Sherwin & Jack Cain, “Solid Mechanics”, Palgrave ANE Books, 2004.
5. Singh D.K “Mechanics of Solids” Pearson Education 2002.
6. Timoshenko S.P, “Elements of Strength of Materials”, Tata McGraw-Hill, New Delhi 1997.

| 15CBME042 | FLUID MECHANICS AND MACHINERY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 |

**COURSE OBJECTIVE:**

The applications of the conservation laws to flow through pipes and hydraulic machines arestudied

- To understand the importance of dimensional analysis.
- To understand the importance of various types of flow in pumps and turbines.

**UNIT I INTRODUCTION 9**

Units & Dimensions. Properties of fluids – Specific gravity, specific weight, viscosity, compressibility, vapour pressure and gas laws – capillarity and surface tension. Flow characteristics: concepts of system and control volume. Application of control volume to continuity equation, energy equation, momentum equation and moment of momentum equation.

**UNIT II FLOW THROUGH CIRCULAR CONDUITS 9**

Laminar flow through circular conduits and circular annuli, Boundary layer concepts, Boundary layer thickness. Hydraulic and energy gradient, Darcy – Weisbach equation, Friction factor and Moody diagram, Commercial pipes, Minor losses, Flow through pipes in series and in parallel.

**UNIT III DIMENSIONAL ANALYSIS 9**

Dimension and units: Buckingham's π theorem, Discussion on dimensionless parameters, Models and similitude, Applications of dimensionless parameters.

**UNIT IV ROTO DYNAMIC MACHINES 9**

Homologus units, Specific speed, Elementary cascade theory, Theory of turbo machines, Euler's equation, Hydraulic efficiency, Velocity components at the entry and exit of the rotor. Velocity triangle for single stage radial flow and axial flow machines, Centrifugal pumps, turbines, performance curves for pumps and turbines.

**UNIT V POSITIVE DISPLACEMENT MACHINES 9**

Positive displacement pumps and classification of pumps, Reciprocating pumps, characteristics of reciprocating pump, Indicator diagrams, Work saved by air vessels. Rotory pumps, Classification, Working and performance curves.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Fluid Mechanics and Machinery course, the student will be able to

**CO1:** Understand and apply the basic concepts of Fluid Mechanics to carry out professional engineering activities in the field of fluids.

**CO2:** Apply scientific method strategies to fluid mechanics: analyzed qualitatively and quantitatively the problem situation, propose hypotheses and solutions.

**CO3:** Use specific vocabulary and terminology and the appropriate means to effectively communicate knowledge, procedures, results, skills and aspects inherent to fluid mechanics.

**CO4:** Work efficiently in a group, integrating skills and knowledge to make decisions in the performance of fluid mechanics tasks, adopting a responsible and organized attitude to work and a willingness to learn.

**CO5:** Plan and carry out dimensional analysis, similitude and model analysis in accordance with the relevant specific technology

**CO6:** Understand the major and minor losses in flow through circular conduits.

**CO7:** Understand the conservation laws to flow through pipes and hydraulic machines.

**CO8:** Understand the importance of various types of flow in pumps and turbines.

**CO9:** Understand about the laminar and turbulent boundary layer fundamentals.

**CO10:** Understand the potential flow theory to solve problems in fluid mechanics.

**TEXT BOOKS:**

1. Streeter. V. L., and Wylie, E.B., Fluid Mechanics, McGraw Hill, 1983.

2. Rathakrishnan. E, Fluid Mechanics, Prentice Hall of India (II Ed.), 2007.

**REFERENCES:**

1. Ramamritham. S, Fluid Mechanics, Hydraulics and Fluid Machines, DhanpatRai&Sons,Delhi, 1988.

2. Kumar. K.L., Engineering Fluid Mechanics (VII Ed.)Eurasia Publishing House (P) Ltd., New Delhi, 1995.

3. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd., New Delhi.

**15PBME41 FLUID MECHANICS AND STRENGTH OF MATERIALS LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 2 |

## FLUID MECHANICS

**COURSE OBJECTIVE**

- Upon Completion of this subject, the students can able to have hands on experience in flow measurements using different devices and also perform calculation related to losses in pipes and also perform characteristic study of pumps, turbines etc.,
- After completion of this laboratory the students can ability to use the measurement equipments for flow measurement and they can ability to do performance trust on different fluid machinery

**LIST OF EXPERIMENTS**

1. Calibration of Flow Measuring instruments – venturimeter, orifice meter, rotometer,
2. Calibration of flows in open channels – weirs and notches.
3. Estimation of friction factor in flow through pipes.
4. Determination of performance characteristics of pumps – centrifugal pumps, submersible pumps, turbine pumps and positive displacement pumps and reciprocating and gear pumps.
5. Determination of performance characteristics of turbines – reaction turbines and impulse turbines.

**TOTAL: 45 Hours**

## STRENGTH OF MATERIALS

**COURSE OBJECTIVE:**

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

**LIST OF EXPERIMENTS**

1. Tension test on mild steel rod.
2. Double shear test on metals.
3. Torsion test on mild steel rod.
4. Impact test on metal specimen.
5. Hardness test on metals.
6. Compression test on helical spring.
7. Deflection test on carriage spring.

**TOTAL: 45 Hours**

After successful completion of the Fluid Mechanics and Strength of Materials Laboratory course, the student will be able to

**CO1:** Understanding of the fundamental principles of mechanics of materials and determining the strength of materials under externally applied loads.

**CO2:** Do the tension test on a mild steel rod, double shear test on Mild Steel and aluminium rods.

**CO3:** Do the deflection test on beams and compression test on helical springs.

**CO4:** Measure deformations, forces, and strains under a variety of loading conditions, including tension, compression, bending.

**CO5:** Identify the suitable materials with required properties.

**CO6:** Understand fluid mechanics system, especially in flow measurements using different devices.

**CO7:** Determine the fluid coefficient of discharge of giving Orifice and Venturi meter.

**CO8:** Conduct the experiments and draw characteristic curves of centrifugal and reciprocating pumps.

**CO9:** Conduct the experiments and draw characteristic curves of Francis and Kaplan turbines.

**CO10:** Demonstrate the limitations and applicability of theory.

| 15PBME42 | MANUFACTURING TECHNOLOGY LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |

**COURSE OBJECTIVE:**

- To Study and practice the various operations that can be performed in lathe, shaper, drilling, milling machines etc. and to equip with the practical knowledge required in the core industries.

**LIST OF EXPERIMENTS**

1. Assembly of core and cavity
2. Assembly of die and punch
3. Machining an internal keyway using slotting machine
4. Shaping round to square
5. Surface grinding
6. Keyway milling
7. Drilling and tapping
8. Turning and cylindrical grinding

**TOTAL: 45 Hours**

**LIST OF EQUIPMENT**

1. Center lathe - 14 Nos.
2. Capstan lathe - 01 No.
3. Turret lathe - 01 No.
4. Pillar type drilling machine - 01 No.
5. Radial drilling machine - 01 No.
6. Shaper - 02 Nos.
7. Surface grinding machine - 01 No.
8. Cylindrical grinding machine - 01 No.
9. Gear hobbing machine - 01 No.
10. Horizontal milling machine - 02 Nos.
11. Slotting machine - 01 No.

**COURSE OUTCOMES:**

After successful completion of the Manufacturing Technology Laboratory course, the student will be able to

**CO1:** Impart knowledge on Mechanics of metal cutting & Machining Operations

**CO2:** Study and practice the various operations that can be performed in lathe machines.

**CO3:** Understand the concept of shaper machines and its functions

**CO4:** Study the drilling operations performed in different types of drilling machine and its applications.

**CO5:** Study and practice the milling machines for various operations that can be performed in milling machine.

**CO6:** Equip with the practical knowledge required in the core industries.

**CO7:** Study of the construction details of different types of machines used in manufacturing process.

**CO8:** Different types of tools used in machines and the measuring instruments.

**CO9:** Propose the most economical route to fabricate the required engineering component.

**CO10:** Predict and develop a methodology and establish a manufacturing sequence to fabricate engineering components.

| 15BESY41 | BASIC LIFE SKILLS | L | T | P | C |
|---|---|---|---|---|---|
| | | 1 | 0 | 1 | 2 |

**OBJECTIVE:**

Providing value education to improve the students' character - understanding of principled life and physical health - maintaining youthfulness - measures and methods in five aspects of life

**UNIT I PHYSICAL HEALTH 6**

1. Manavalakalai (SKY) Yoga: Introduction - Education as a means for youth empowerment - Greatness of Education - Yoga for youth Empowerment.
2. Simplified Physical Exercises: Hand, Leg, Breathing, Eye exercises - Kapalabathi, Makarasana Part I, Makarasana Part II, Body Massage, Acu pressure, Relaxation exercises - Benefits.
3. Yogasanas: Pranamasana - Hastha Uttanasana - Pada Hasthasana – AswaSanjalana Asana - Thuvipatha asva Sanjalana asana - Astanga Namaskara - Bhujangasana - Atha Muktha Savasana - Aswa Sanjalana Asana - Pada Hasthasana - Hastha Uttanasana - Pranamasana.
4. Pranayama : Naddi suddi - Clearance Practice - Benefits.

**UNIT II LIFE FORCE 6**

1. Reasons for Diseases - Natural reasons (Genetic / imprints, Planetary Position, Natural calamities and climatic changes) - Unnatural reasons (Food habits, Thoughts, Deeds)
2. Philosophy of Kaya kalpa - Physical body - Sexual vital fluid - Life force - Bio-Magnetism - Mind.
3. Maintaining youthfulness : Postponing old age - Transformation of food into seven components - Importance of sexual vital fluid –
4. Measure and method in five aspects of life - Controlling undue Passion.
5. Kayakalpa practice - Aswini Mudra - Ojas breath - Benefits of Kaya Kalpa.

**UNIT III MENTAL HEALTH 6**

1) Mental Frequencies - Beta, Apha, Theta and Delta wave - Agna Meditation explanation - benefits.
2) Shanthi Meditation explanation - Benefits
3) Thuriya Meditation explanation - Benefits
4) Benefits of Blessing - Self blessing (Auto suggestion) - Family blessing - Blessing the others - World blessing - Divine protection

**UNIT IV VALUES 6**

- Human Values:
  1) Self control - Self confidence - Honesty
  2) Contentment - Humility - Modesty
  3) Tolerance - Adjustment - Sacrifice - Forgiveness
  4) Purity (Body, Dress, Environment) - Physical purity - Mental purity - Spiritual purity
- Social Values:
  1) Non violence - Service
  2) Patriotism - Equality
  3) Respect for parents and elders - care and protection - Respect for teacher
  4) Punctuality - Time Management

**UNIT V MORALITY** (VIRTUES) **6**

1) Importance of Introspection - I - Mine (Ego, Possessiveness).
2) Six Evil Temperaments - Greed - Anger - Miserliness - Immoral sexual passion - Inferiority and superiority Complex – Vengeance.

3) Maneuvering of Six Temperaments - Contentment - Tolerance - Charity - Chastity - Equality - Pardon (Forgiveness).
4) Five essential Qualities acquired through Meditation: Perspicacity - Magnanimity - Receptivity - Adaptability – Creativity.
5) Improved Memory Power - Success in the Examination.

**TOTAL: 30 Hours**

**COURSE OUTCOMES:**

After successful completion of the Basic Life Skills course, the student will be able to

**CO1:** Develop communication competence in prospective engineers.

**CO2:** Explain the moral value of human's life and their psychological bag round.

**CO3:** Instill moral and social values, loyalty and also to learn to appreciate the rights of others.

**CO4:** Provide value education to improve the health by yoga etc.

**CO5:** Understand the concept of negative and positive energies, measurement and method in five aspects of life.

**CO6:** Improve the mental health and stability by meditation.

**CO7:** Provide an outline of personal values and time management principles for success in life.

**CO8:** Get exposer to the significance of interpersonal relationships and techniques to maintain them.

**CO9:** Provide an overview of the role of stress and its impact on individual behavior and the techniques to manage them.

**CO10:** Understand the process of decision making and its implementation.

**REFERENCE BOOKS:**


1. Vethathiri Maharishi, 16th Edi.2013, Yoga for Modern Age, Vethathiri Publications, Erode.
2. Vethathiri Maharishi, 2014, Simplified Physical Exercises, Vethathiri Publications, Erode.
3. Vethathiri Maharishi, 3rd Edi.2014, Kayakalpam, Vethathiri Publications, Erode.
4. Rev.Dr.G.U.pope, 2016, Thirukkural, Giri Trading Agency,
5. Vethathiri Maharishi, 1994, Mind, Vethathiri Publications, Erode.
6. Chandrasekaran.K, 1999, Sound Health through yoga, Sedapati, Tamilnadu, Premkalyan Publications.
7. Iyengar, B.K.S. 2008, Light on Yoga, Noida, UP India, Harber Collins Publishing India Ltd.,

**15CBME51 ENGINEERING METROLOGY AND MEASUREMENTS**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 3 |

**COURSE OBJETCTIVE:**

- To provide knowledge on various Metrological equipments available to measure the dimension of the components.
- To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.

**UNIT I CONCEPT OF MEASUREMENT 9**

General concept – Generalised measurement system-Units and standards-measuring instruments: sensitivity, stability, range, accuracy and precision-static and dynamic response-repeatability-systematic and random errors-correction, calibration - Introduction to Dimensional and Geometric Tolerancing – interchangeability

**UNIT II LINEAR AND ANGULAR MEASUREMENT 9**

Definition of metrology-Linear measuring instruments: Vernier, micrometer, Slip gauges and classification, - Tool Makers Microscope - interferometery, optical flats, - Comparators: limit gauges Mechanical, pneumatic and electrical comparators, applications. Angular measurements: -Sine bar, Sine center, bevel protractor and angle Decker.

**UNIT III FORM MEASUREMENT 9**

Measurement of screw threads: Thread gauges, floating carriage micrometer-measurement of gear tooth thickness: constant chord and base tangent method-Gleason gear testing machine – radius measurements-surface finish: equipment and parameters, straightness, flatness and roundness measurements.

**UNIT IV LASER AND ADVANCES IN METROLOGY 9**

Precision instruments based on laser-Principles- laser interferometer-application in measurements and machine tool metrology- Coordinate measuring machine (CMM): need, construction, types, applications- computer aided inspection.

**UNIT V MEASUREMENT OF MECHANICAL PARAMETERS 9**

Force, torque, power:-mechanical, pneumatic, hydraulic and electrical type-Pressure measurement - Flow: Venturi, orifice, rotameter, pitot tube –Temperature: bimetallic strip, thermocouples, pyrometer, electrical resistance thermistor.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Engineering metrology and measurements course, the student will be able to

**CO1:** Get the knowledge of various meteorological equipments and measure the dimension of the components.

**CO2:** Grant knowledge on the correct procedure to be adopted to measure the dimension of the components.

**CO3:** Know the fundamental science and engineering principles relevant to the measurements.

**CO4:** Have the experimental and computational skills for a professional career or graduate study in mechanical instruments.

**CO5:** Apply core concepts in measuring to solve engineering measurement problems.

**CO6:** Knowledge on the correct procedure to be adapted to measure the linear & angular dimensions and using corresponding instruments.

**CO7:** Demonstrate the use of advanced measurement techniques.

**CO8:** Select and employ suitable instruments for measurement.

**CO9:** Understand various Advancements in meteorological and measurement systems.

**CO10:** General math, science and engineering skills to design and conduct experiments, and to analyze data.

**TEXT BOOKS:**


1. Jain R.K., “Engineering Metrology”, Khanna Publishers, 2005
2. Alan S. Morris, “The Essence of Measurement”, Prentice Hall of India, 1997


**REFERENCES:**


1. Gupta S.C, “Engineering Metrology”, Dhanpatrai Publications, 2005
2. Jayal A.K, “Instrumentation and Mechanical Measurements”, Galgotia Publications 2000
3. Beckwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education, 2006.
4. Donald Deckman, “Industrial Instrumentation”, Wiley Eastern, 1985.

| 15CBME052 | DESIGN OF MACHINE ELEMENTS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 |

**COURSE OBJECTIVE:**

- To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
- To understand the standard procedure available for Design of Transmission of Mechanical elements.
- To learn to use standard data and catalogues.

**UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9**

Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – Design of curved beams – crane hook and 'C' frame - Factor of safety - theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations.

**UNIT II DESIGN OF SHAFTS AND COUPLINGS 9**

Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys and key ways - Design of rigid and flexible couplings – Introduction to gear and shock absorbing couplings - design of knuckle joints.

**UNIT III DESIGN OF FASTENERS AND WELDED JOINTS 9**

Threaded fasteners - Design of bolted joints including eccentric loading – Design of welded joints for pressure vessels and structures - theory of bonded joints.

**UNIT IV DESIGN OF SPRINGS AND LEVERS 9**

Design of helical, leaf, disc and torsional springs under constant loads and varying loads – Concentric torsion springs - Belleville springs – Design of Levers.

**UNIT V DESIGN OF BEARINGS AND FLYWHEELS 9**

Design of bearings – sliding contact and rolling contact types – Cubic mean load – Design of journal bearings – Mckees equation – Lubrication in journal bearings – calculation of bearing dimensions – Design of flywheels involving stresses in rim and arm.

**TOTAL: 45 Hours**

Note: *(Use of P S G Design Data Book is permitted in the University examination)*

**COURSE OUTCOMES:**

After successful completion of the Dynamics of Machinery course, the student will be able to

**CO1:** Known the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.

**CO2:** Known the undesirable effects of unbalances resulting from prescribed motions in mechanism.

**CO3:** Known the effect of dynamics of undesirable vibrations.

**CO4:** Solve balancing problems in rotating and reciprocating machinery.

**CO5:** Understand principle mechanism used for speed control and stability control.

**CO6:** Analyze free response of one and two degree freedom systems.

**CO7:** Understand the gyroscopic effects in ships, aero planes and road vehicles.

**CO8:** Determine the natural frequencies of continuous systems starting from the general equation of displacement.

**CO9:** Characterize Force transmissibility and amplitude transmissibility.

**CO10:** Analyze the Gyroscopic effects in Automobiles, ships and airplanes.

**TEXT BOOKS:**


1. Juvinall R.C, and Marshek K.M, “Fundamentals of Machine Component Design”, John Wiley & Sons, Third Edition, 2002.
2. Bhandari V.B, “Design of Machine Elements”, Tata McGraw-Hill Book Co, 2003.


**REFERENCES:**


1. Norton R.L, “Design of Machinery”, Tata McGraw-Hill Book Co, 2004.
2. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003.
3. Ugural A.C, “Mechanical Design – An Integral Approach, McGraw-Hill Book Co, 2004.
4. Spotts M.F., Shoup T.E “Design and Machine Elements” Pearson Education, 2004.

| 15CBME53 | DYNAMICS OF MACHINERY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 |

**COURSE OBJECTIVE:**

- To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- To understand the effect of Dynamics of undesirable vibrations.
- To understand the principles in mechanisms used for speed control and stability control.

**UNIT I FORCE ANALYSIS 12**

Rigid Body dynamics in general plane motion – Equations of motion - Dynamic force analysis - Inertia force and Inertia torque – D'Alemberts principle - The principle of superposition - Dynamic Analysis in Reciprocating Engines – Gas Forces - Equivalent masses - Bearing loads - Crank shaft Torque - Turning moment diagrams - Fly wheels –Engine shaking Forces - Cam dynamics - Unbalance, Spring, Surge and Windup.

**UNIT II BALANCING 12**

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine - Balancing Multi-cylinder Engines - Partial balancing in locomotive Engines - Balancing linkages - balancing machines

**UNIT III FREE VIBRATION 12**

Basic features of vibratory systems - idealized models - Basic elements and lumping of parameters - Degrees of freedom - Single degree of freedom - Free vibration - Equations of motion - natural frequency - Types of Damping - Damped vibration critical speeds of simple shaft - Torsional systems; Natural frequency of two and three rotor systems.

**UNIT IV FORCED VIBRATION 12**

Response to periodic forcing - Harmonic Forcing - Forcing caused by unbalance - Support motion – Force transmissibility and amplitude transmissibility - Vibration isolation.

**UNIT V MECHANISMS FOR CONTROL 12**

Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors –Characteristics - Effect of friction - Controlling Force - other Governor mechanisms. Gyroscopes - Gyroscopic forces and Torques - Gyroscopic stabilization - Gyroscopic effects in Automobiles, ships and airplanes.

**TOTAL: 60 Hours**

**COURSE OUTCOMES:**

After successful completion of the Design of Machine Elements course, the student will be able to

**CO1:** Design a machine component by using theories of failure.

**CO2:** Known the principles and procedure for the design of mechanical components.

**CO3:** Design shafts, coupling, keys, cotters, couplings and joints including riveted, bolted and welded joints.

**CO4:** Analyze the stresses and strains induced in a machine element.

**CO5:** Understand component behavior subjected to loads and identify the failure criteria

**CO6:** Use standard data and catalogues.

**CO7:** Understand the customers' need, formulate the problem statement.

**CO8:** Gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.

**CO9:** Find functional and strength requirements which will enable them to successfully design a machine component.

**CO10:** Design bearings and flywheels.

**TEXT BOOK:**

1. Rattan S.S., "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1994

**REFERENCES:**

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2. Ghosh A. and Mallick A.K., "Theory of Mechanisms and Machines", Affiliated East-West Press Pvt. Ltd., New Delhi, 1988.
3. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw-Hill, Inc., 1995.
4. Rao J.S. and Dukkipati R.V., "Mechanism and Machine Theory ", Wiley-Eastern Limited, New Delhi, 1992.
5. John Hannah and Stephens R.C., "Mechanics of Machines", Viva low-Priced Student Edition, 1999.
6. Sadhu Singh "Theory of Machines" Pearson Education, 2002.

| 15PBME51 | METROLOGY AND MEASUREMENTS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |

**COURSE OBJECTIVE:**

- To familiar with different measurement equipments and use of this industry for quality Inspection and Ability to handle different measurement tools and performs measurements in quality impulsion.

**LIST OF EXPERIMENTS**

1. Calibration of Vernier / Micrometer / Dial Gauge
2. Checking Dimensions of part using slip gauges
3. Measurements of Gear Tooth Dimensions
4. Measurement of Angle using sine bar / sine center / tool makers microscope
5. Measurement of straightness and flatness
6. Measurement of thread parameters
7. Setting up of comparators for inspection (Mechanical / Pneumatic / Electrical)
8. Measurement of Temperature using Thermocouple / Pyrometer
9. Measurement of Displacement
10. Measurement of Force
11. Measurement of Torque
12. Measurement of Vibration / Shock

**TOTAL: 45 Hours**

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

| | | |
|---|---|---|
| Micrometer | - | 5 Nos. |
| Vernier Caliper | - | 5 Nos. |
| Vernier Height Gauge | - | 2 Nos. |
| Vernier depth Gauge | - | 2 Nos. |
| Slip Gauge Set | - | 1 No. |
| Gear Tooth Vernier | - | 1 No. |
| Sine Bar | - | 1 No. |
| Sine Center | - | 1 No. |
| Bevel Protractor | - | 1 No. |
| Floating Carriage Micrometer | - | 1 No. |
| Profile Projector / Tool Makers Microscope | - | 1 No. |
| Mechanical / Electrical / Pneumatic Comparator | - | 1 No. |
| Autocollimator | - | 1 No. |
| Temperature Measuring Setup | - | 1 No. |
| Displacement Measuring Setup | - | 1 No. |
| Force Measuring Setup | - | 1 No. |
| Torque Measuring Setup | - | 1 No. |
| Vibration / Shock Measuring Setup | - | 1 No. |

**COURSE OUTCOMES:**

After successful completion of the Metrology and Measurements Laboratory course, the student will be able to

**CO1:** Familiarized with different measurement equipment's and use of this for quality Inspection.

**CO2:** Handle different measurement tools and performs measurements in quality impulsion.

**CO3:** Handle the limit gauges.

**CO4:** Identify methods and devices for measurement of length, angle, and gear and thread parameters, surface roughness and geometric features of parts.

**CO5:** Estimate errors and uncertainty in measurements using statistical analysis.

**CO6:** Identify sensors for measurement of vibration, thermo-physical properties and radiation properties of surfaces.

**CO7:** Interpret International Standards of measurements (ITS-90) and identify.

**CO8:** Internationally accepted measuring standards for measurements.

**CO9:** Known working principles in the measurement of field quantities.

**CO10:** Handle the thermocouple

**CO11:** Handle the Pyrometer.

| 15PBME52 | DYNAMICS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |

**COURSE OBJECTIVE:**

- To supplement the principles learnt in kinematics and Dynamics of Machinery.
- To understand how certain measuring devices are used for dynamic testing.

**LIST OF EXPERIMENTS**

1. Governors - Determination of sensitivity, effort, etc. for Watt, Porter, Proell, Hartnell governors
2. Cam - Study of jump phenomenon and drawing profile of the cam.
3. Motorised Gyroscope-Verification of laws -Determination of gyroscopic couple.
4. Whirling of shaft-Determination of critical speed of shaft with concentrated loads.
5. Balancing of reciprocating masses.
6. Balancing of rotating masses.
7. Determination of moment of inertia by oscillation method for connecting rod and flywheel.
8. Vibrating system - spring mass system-Determination of damping co-efficient of single degree of freedom system.
9. Determination of influence co-efficients for multidegree freedom suspension system.
10. Determination of transmissibility ratio - vibrating table.
11. Determination of torsional frequencies for compound pendulum and flywheel system with lumped Moment of inertia.
12. Transverse vibration –free- Beam. Determination of natural frequency and deflection of beam

**TOTAL: 45 Hours**

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

1. Cam analyzer.
2. Motorised gyroscope.
3. Governor apparatus - Watt, Porter, Proell and Hartnell governors.
4. Whirling of shaft apparatus.
5. Dynamic balancing machine.
6. Static and dynamic balancing machine.
7. Vibrating table
8. Vibration test facilities apparatus

**COURSE OUTCOMES:**

After successful completion of the Dynamics Laboratory course, the student will be able to

**CO1:** Understand the principles of kinematic and dynamic behavior of machine parts.

**CO2:** Analyze how certain measuring devices are used for dynamic testing.

**CO3:** Demonstrate the effect of unbalances resulting from rotary motions.

**CO4:** Understand vibrations in single and multi degree of freedom system.

**CO5:** Able to learn working principle of the governor /gyroscope and demonstrate the effect of forces and moments on their motion.

**CO6:** Evaluate cutting forces acting on machine elements using a dynamometer.

**CO7:** Analyze moment of inertia by an oscillation method for connecting rod and flywheel.

**CO8:** Understand determination of torsional frequencies for compound pendulum and flywheel system with lumped Moment of inertia.

**CO9:** Exposure on cam, governor, balancing masses and rotating masses.

**CO10:** Known effect of forces on various equipments based on theoretical and experimental methods.

| 15CBME54 | INDUSTRIAL SAFETY | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 2 |

**COURSE OBJECTIVE:**

- Effectively communicate information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities.
- Competent safety Engineer rendering expertise to the industrial and societal needs at national and global level.
- Provide knowledge on safety in various maintenance situations, personal protective equipment and fire safety.

**UNIT I SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES 6**

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines.

**UNIT II PRINCIPLES OF MACHINE GUARDING 6**

Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening.

Selection and suitability: lathe-drilling-boring-milling -grinding-shaping

**UNIT III SAFETY IN WELDING AND GAS CUTTING 6**

Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – leak detection-pipe line safety-storage and handling of gas cylinders.

**UNIT IV SAFETY IN COLD FARMING AND HOT WORKING OF METALS 6**

Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls.

Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills Safety in gas furnace operation.

**UNIT V SAFETY IN FINISHING, INSPECTION AND TESTING 6**

Heat treatment operations, electro plating, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing.

Health and welfare measures in engineering industry-pollution control in engineering industry-industrial waste disposal.

**TOTAL: 30 Hours**

**COURSE OUTCOMES:**

After successful completion of the Industrial safety course, the student will be able to

**CO1:** Familiar with standard workplace hazard/warning signs and labels.

**CO2:** Understand the standard categories of hazardous materials.

**CO3:** Understanding the documentation used with hazardous materials.

**CO4:** Describe the different levels of danger that exist with electrical shock.

**CO5:** Describe several appropriate actions to take in the event of an electrical accident.

**CO6:** Describe the situations under which static electricity may cause damage to electrical components (ESD - electrostatic discharge).

**CO7:** Describe appropriate practices for handling and working with electrical components or electrical equipment.

**CO8:** Understand the functions of the safety in cold forming and hot working of metals.

**CO9:** Describe the examples of product design characteristics of electrical safety requirements.

**CO10:** Exposure on general safety rules.

**CO11:** Learnt safety in finishing, inspection and testing.

**REFERENCES:**


1. "Accident Prevention Manual" – NSC, Chicago, 1982.
2. "Occupational safety Manual" BHEL, Trichy, 1988.
3. "Safety Management by John V. Grimaldi and Rollin H. Simonds, All India Travelers Book seller, New Delhi, 1989.
4. "Safety in Industry" N.V. Krishnan Jaico Publishery House, 1996.
5. Indian Boiler acts and Regulations, Government of India.
6. Safety in the use of wood working machines, HMSO, UK 1992.
7. Health and Safety in welding and Allied processes, welding Institute, UK, High Tech. Publishing Ltd., London, 1989.

| 15CBME61 | FINITE ELEMENT ANALYSIS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 |

**COURSE OBJECTIVE:**

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To appreciate the use of FEM to a range of Engineering Problems.

**UNIT I FINITE ELEMENT FORMULATION OF BOUNDARY VALUE PROBLEMS 9**

Weighted residual methods –general weighted residual statement – weak formulation of the weighted residual statement –comparisons – piecewise continuous trial functions- example of a bar finite element –functional and differential forms – principle of stationary total potential – Rayleigh Ritz method – piecewise continuous trial functions – finite element method – application to bar element.

**UNIT II ONE DIMENSIONAL FINITE ELEMENT ANALYSIS 9**

General form of total potential for 1-D applications – generic form of finite element equations – linear bar element – quadratic element –nodal approximation – development of shape functions –element matrices and vectors – example problems – extension to plane truss– development of element equations – assembly – element connectivity – global equations – solution methods –beam element – nodal approximation – shape functions – element matrices and vectors – assembly – solution – example problems.

**UNIT III TWO DIMENSIONAL FINITE ELEMENT ANALYSIS 9**

Introduction – approximation of geometry and field variable – 3 noded triangular elements – four noded rectangular elements – higher order elements – generalized coordinates approach to nodal approximations – difficulties – natural coordinates and coordinate transformations – triangular and quadrilateral elements – iso-parametric elements – structural mechanics applications in 2-dimensions – elasticity equations – stress strain relations – plane problems of elasticity – element equations – assembly – example problems in plane stress, plane strain and axisymmetric applications.

**UNIT IV DYNAMIC ANALYSIS USING FINITE ELEMENT METHOD 9**

Introduction – vibrational problems – equations of motion based on weak form – longitudinal vibration of bars – transverse vibration of beams – consistent mass matrices – element equations –solution of eigen value problems – vector iteration methods – normal modes – transient vibrations – modeling of damping – mode superposition technique – direct integration methods.

**UNIT V APPLICATIONS IN HEAT TRANSFER & FLUID MECHANICS 9**

One dimensional heat transfer element – application to one-dimensional heat transfer problems-scalar variable problems in 2-Dimensions – Applications to heat transfer in 2-Dimension – Application to problems in fluid mechanics in 2-Dimensional.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Finite Element Analysis course, the student will be able to

**CO1:** Understand the concepts of Mathematical Modeling of Engineering Problems.

**CO2:** Apply finite element method to solve problems in solid mechanics.

**CO3:** Apply finite element method to solve problems in fluid mechanics.

**CO4:** Apply finite element method to solve problems in heat transfer.

**CO5:** Formulate and solve problems in one dimensional structures including trusses, beams and frames.

**CO6:** Formulate Finite element characteristic equations for two dimensional elements and analyze plain stress problems.

**CO7:** Understand to find the solution for longitudinal and transverse vibration problems.

**CO8:** Formulate finite element characteristic equation for analyzing plain strain, Axi-symmetric and plate bending problems.

**CO9:** Known different types of elements and nodes in FEM.

**CO10:** Understand the basic principle involved in ANSYS or other analysis software.

**TEXT BOOK:**

1. P.Seshu, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007. ISBN-978-203-2315-5

**REFERENCES:**

1. J.N.Reddy, “An Introduction to the Finite Element Method”, McGraw-Hill International Editions (Engineering Mechanics Series), 1993.
2. Chandrupatla & Belagundu, “Introduction to Finite Elements in Engineering”, 3rd Edition, Prentice-Hall of India, Eastern Economy Editions.
3. David V.Hutton, “Fundamentals of Finite Element Analysis”, Tata McGraw-Hill Edition 2005.
4. Cook,Robert.D., Plesha, Michael.E & Witt, Robert.J. “Concepts and Applications of Finite Element Analysis”, Wiley Student Edition, 2004.

| 15CBME62 | THERMAL ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 |

**COURSE OBJECTIVE:**

- To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes.
- To apply the thermodynamic concepts into various thermal application like IC engines, Steam Turbines, Compressors and Refrigeration and Air conditioning systems.

**UNIT I GAS POWER CYCLES 9**

Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure and air standard efficiency, Actual and theoretical PV diagram of Four stroke engines, Actual and theoretical PV diagram of two stroke engines.

**UNIT II INTERNAL COMBUSTION ENGINES 9**

Classification of IC engine, IC engine components and functions. Valve timing diagram and port timing diagram. Comparison of two stroke and four stroke engines. Fuel supply systems, Ignition Systems, Performance calculation. Comparison of petrol & diesel engine. Fuels, Air-fuel ratio calculation, Knocking and Detonation. Lubrication system and cooling system. Exhaust gas analysis.

**UNIT III STEAM NOZZLES AND TURBINES 9**

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and reaction principles, compounding, velocity diagrams for simple and multistage turbines, speed regulations-governors and nozzle governors.

**UNIT IV AIR COMPRESSOR 9**

Classification and working principle, work of compression with and without clearance. Volumetric efficiency, Isothermal efficiency and isentropic efficiency of reciprocating air compressors. Multistage air compressor and inter cooling – work of multistage air compressor, various types of compressors (Descriptive treatment only).

**UNIT V REFRIGERATION AND AIR-CONDITIONING 9**

Vapour compression Refrigeration cycle – super heat, sub cooling, performance calculations. Working principle of vapour absorption system. Ammonia – water, Lithium bromide – water systems, Comparison between vapour compression and absorption systems. Psychrometry, Psychometric chart, Cooling load calculations. Concept of RSHF, GSHF, ESHF, Air conditioning systems.

**TOTAL : 45 Hours**

*(Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant property tables are permitted in the examination)*

**COURSE OUTCOMES:**

After successful completion of the Thermal Engineering course, the student will be able to

**CO1:** Understand the thermodynamic concepts into various thermal applications like IC engines, Steam Turbines.

**CO2:** Learned the concepts, laws and methodologies from the first course in thermodynamics into an analysis of cyclic processes.

**CO3:** Evaluate the performance of an internal combustion engine and various gas power cycles.

**CO4:** Understand the principles involved in air-conditioning systems and able to Estimate cooling loads.

**CO5:** Understand computational aspects of isentropic flow through variable area.

**CO6:** Analyse gas turbine cycles and able to compare the operational aspects of jet engines.

**CO7:** Known the different cycles used in thermal engineering.

**CO8:** Get exposure on internal combustion engine and able to analyze their performance.

**CO9:** Study the vapour compression and absorption system.

**CO10:** Calculate cooling load calculation for Refrigeration and Air conditioning systems.

**TEXT BOOKS:**


1. Rajput, “Thermal Engineering”, S. Chand publishers, 2000**.**
2. Rudramoorthy R, “Thermal Engineering”, Tata McGraw-Hill, New Delhi, 2003.


**REFERENCES:**


1. Kothandaraman.C.P.,Domkundwar.S. and A.V.Domkundwar., “A course in Thermal Engineering”, DhanpatRai& Sons, Fifth edition, 2002
2. Holman. J.P., “Thermodynamics”, McGraw-Hill, 1985.
3. Rogers, Meyhew, “Engineering Thermodynamics”, ELBS, 1992.
4. Arora.C.P., “Refrigeration and Air conditioning”, TMH, 1994.
5. Sarkar B.K, “Thermal Engineering”, Tata McGraw-Hill, 1998.

| 15CBME63 | DESIGN OF TRANSMISSION SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 |

**COURSE OBJECTIVE:**

- To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
- To understand the standard procedure available for Design of Transmission of Mechanical elements.
- To learn to use standard data and catalogues.

**UNIT I DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS 12**

Selection of V belts and pulleys – selection of Flat belts and pulleys - Wire ropes and pulleys – Selection of Transmission chains and Sprockets, Design of pulleys and sprockets.

**UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 12**

Gear Terminology-Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects - Fatigue strength - Factor of safety - Gear materials – Module and Face width-power rating calculations based on strength and wear considerations - Parallel axis Helical Gears – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces and stresses, Estimating the size of the helical gears.

**UNIT III BEVEL, WORM AND CROSS HELICAL GEARS 12**

**Straight bevel gear:** Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears.
**Worm Gear:** Merits and demerits- terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair.
**Cross helical:** Terminology-helix angles-Estimating the size of the pair of cross helical gears.

**UNIT IV DESIGN OF GEAR BOXES 12**

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box -Constant mesh gear box. – Design of multi speed gear box.

**UNIT V DESIGN OF CAM CLUTCHES AND BRAKES 12**

Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-internal and external shoe brakes.

**TOTAL : 60 Hours**

**NOTE:** (Usage of P.S.G Design Data Book is permitted in the University examination)

**COURSE OUTCOMES:**

After successful completion of the Design of Transmission Systems course, the student will be able to

**CO1:** Understand the principles and procedure for the design of Mechanical power Transmission components.

**CO2:** Use standard data and catalogues.

**CO3:** Find standard procedure available for designing transmission elements.

**CO4:** Get exposure on different parts used in the automobile transmission system.

**CO5:** Able to select and apply a suitable material for the design of a system.

**CO6:** Understand various failure theories to design the transmission elements.

**CO7:** Design friction clutches and brakes.

**CO8:** Design positive power transmission elements for machinery and equipments.

**CO9:** Design flexible and friction drives.

**CO10:** Design the various gears and gear box.

**TEXT BOOKS:**


1. Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, Sixth Edition, Tata McGraw-Hill , 2003.
2. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.


**REFERENCES:**


1. Maitra G.M., Prasad L.V., “Hand book of Mechanical Design”, II Edition, Tata McGraw-Hill, 1985.
2. Bhandari, V.B., “Design of Machine Elements”, Tata McGraw-Hill Publishing Company Ltd., 1994.
3. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000,
4. Hamrock B.J., Jacobson B., Schmid S.R., “Fundamentals of Machine Elements”, McGraw-Hill Book Co., 1999.
5. Ugural A, C, "Mechanical Design, An Integrated Approach", McGraw-Hill , 2003.

| 15PBME61 | THERMAL ENGINEERING LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |

**COURSE OBJECTIVE:**

- To study the value timing-V diagram and performance of IC Engines.
- To Study the characteristics of fuels/Lubricates used in IC Engines.
- To study the Performance of steam generator/ turbine.

## LIST OF EXPERIMENTS

**I.C ENGINE LAB AND FUELS LAB**

Valve Timing and Port Timing Diagrams

Performance Test on 4-stroke Diesel Engine.

Heat Balance Test on 4-stroke Diesel Engine

Morse Test on Multi cylinder Petrol Engine

Determination of Viscosity – Red Wood Viscometer

Determination of Flash Point and Fire Point

Study of Steam Generators and Turbines

**HEAT TRANSFER**

Thermal conductivity of pipe insulation using lagged pipe apparatus

Natural convection heat transfer from a vertical cylinder

Forced convection inside tube

Determination of Stefan-Boltzmann constant

Effectiveness of Parallel/counter flow heat exchanger

**REFRIGERATION AND AIR CONDITIONING**

Determination of COP of a refrigeration/ air conditioning system

Performance test on single/two stage reciprocating air compressor

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Thermal Engineering Laboratory course, the student will be able to

**CO1:** Analyze the performance of internal combustion Engines.

**CO2:** Characterize the fuels and Lubrication used in IC Engines.

**CO3:** Interpret the valve timing diagram of internal combustion engine.

**CO4:** Estimate the performance of different thermal equipments like reciprocating compressors, refrigeration and air conditioning systems.

**CO5:** Demonstrate the Performance of the steam generator.

**CO6:** Analyze and estimate the energy distribution by conducting heat balance test on IC engines.

**CO7:** Find natural convective heat transfer coefficient for pin fin.

**CO8:** Grant knowledge of constant speed and variable speed tests on IC engines and interpret their performance.

**CO9:** Determine the efficiency of a reciprocating compressor.

**CO10:** Understand the thermodynamic concepts and able to apply thermal systems.

| 15PBME62 | CAM LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |

**COURSE OBJECTIVE:**

- To gain practical experience in handling 2D drafting and 3D modeling software systems.
- To study the features of CNC Machine Tool.
- To expose students to modern control systems (Fanuc, Siemens etc.,)
- To know the application of various CNC machines like CNC lathe, CNC Vertical Machining centre, CNC EDM and CNC wire-cut and studying of Rapid prototyping.

1. **MANUAL CNC PART PROGRAMMING**(Ex: Manual CNC Part Programming Using Standard G and M Codes - Tool Path Simulation – Exposure to Various Standard Control Systems- Machining simple components by Using CNC machines.

2. **COMPUTER AIDED PART PROGRAMMING**
   **(** Ex**:** CL Data Generation by Using CAM Software– Post Process Generation for Different Control System – Machining of Computer Generated Part Program by Using Machining Center and Turning Center.)
3. **STUDY EXPERIMENTS**

   Multi-axial Machining in CNC Machining Center –EDM – EDM Wire Cut - Rapid Prototyping

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

| S.No. | Description of Equipment | Quantity Required |
|---|---|---|
| **HARDWARE** | | |
| 1. | Computer Server | 1 No. |
| 2. | Computer nodes or systems (High end CPU with at least 1 GB main memory) networked to the server | 30 Nos. |
| 3. | A3 size plotter | 1 No. |
| 4. | Laser Printer | 1 No. |
| 5. | Trainer CNC Lathe | 1 No. |
| 6. | Trainer CNC milling | 1 No. |
| **SOFTWARE** | | |
| 7. | CAD/CAM software (Pro-E or IDEAS or Unigraphics or CATIA) | 15 licenses |
| 8. | CAM Software (CNC Programming and tool path simulation for FANUC /Sinumeric and Heiden controller) | 15 licenses |
| 9. | Licensed operating system | Adequate |
| 10. | AutoCAD | |
| 11. | ANSYS | |
| 12. | Master CAM | |

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Cam Laboratory course, the student will be able to

**CO1:** Get Practical experience in handling two dimensional drafting software systems.

**CO2:** Get knowledge on three dimensional modeling software systems.

**CO3:** Understand the features of CNC Machine Tool.

**CO4:** Get exposure of the modern control systems to Fanuc, Siemens etc.

**CO5:** Known and familiarized in computer numerical control Vertical Machining center.

**CO6:** Write CNC Programming for different mechanical components using G codes and M codes.

**CO7:** Operate a modern industrial CNC machine tool for actual machining of simple and complex mechanical parts.

**CO8:** Be known the program and experimentation of CNC wire-cut.

**CO9:** Get knowledge on Rapid prototyping.

**CO10:** Know the computer numerical control (CNC) in electrical discharge machining.

| 15CBME71 | MECHATRONICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To impart knowledge about the elements and techniques involved in Mechatronics systems Which are very much essential to understand the emerging field of automation.

**UNIT I MECHATRONICS, SENSORS AND TRANSDUCERS 9**

Introduction to Mechatronics Systems – Measurement Systems – Control Systems – Microprocessor based Controllers. Sensors and Transducers – Performance Terminology – Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors – Selection of Sensors

**UNIT II ACTUATION SYSTEMS 9**

Pneumatic and Hydraulic Systems – Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and pawl – Belt and Chain Drives – Bearings. Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – Construction and working principle of DC and AC Motors – speed control of AC and DC drives, Stepper Motors-switching circuitries for stepper motor – AC & DC Servo motors

**UNIT III SYSTEM MODELS AND CONTROLLERS 9**

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational – Transnational Systems, Electromechanical Systems – Hydraulic – Mechanical Systems. Continuous and discrete process Controllers – Control Mode – Two – Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – Digital Controllers – Velocity Control – Adaptive Control – Digital Logic Control – Micro Processors Control.

**UNIT IV PROGRAMMING LOGIC CONTROLLERS 9**

Programmable Logic Controllers – Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Analogs Input / Output – Selection of a PLC.

**UNIT V DESIGN OF MECHATRONICS SYSTEM 9**

Stages in designing Mechatronics Systems – Traditional and Mechatronic Design - Possible Design Solutions. Case studies of Mechatronics systems- Pick and place Robot- Autonomous mobile robot- Wireless surveillance balloon- Engine Management system- Automatic car park barrier.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Mechatronics course, the student will be able to

**CO1:** Understand the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.

**CO2:** Familiar to identify, analyze and control engineering systems.

**CO3:** Identify sensors, transducers and actuators to monitor and control the behavior of a process or product.

**CO4:** Analyze programmable logic control programs for a given task.

**CO5:** Select suitable Sensors and transducers for real life or industrial problems.

**CO6:** Design and develop Mechatronics systems and primary actuating systems.

**CO7:** Evaluate the performance of mechatronics systems.

**CO8:** Learned about the engine management system and automatic car park barrier.

**CO9:** Understand different symbols used in mechatronics system.

**CO10:** Apply the mechatronics principles to engineering application.

**TEXT BOOKS:**


1. Bolton,W, “Mechatronics” , Pearson education, sixth edition, 2015
2. Smaili.A and Mrad.F , " Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008


**REFERENCES:**


1. Rajput. R.K, A textbook of mechatronics, S. Chand & Co, 2007
2. Michael B. Histand and David G. Alciatore, “Introduction to Mechatronics and Measurement Systems”, McGraw-Hill International Editions, 2000.
3. Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, “Mechatronics”, Chapman and Hall, 1993.
4. Dan Necsulesu, “Mechatronics”, Pearson Education Asia, 2002.
5. Lawrence J. Kamm, “Understanding Electro – Mechanical Engineering”, An Introduction to Mechatronics, Prentice – Hall of India Pvt., Ltd., 2000.
6. Nitaigour Premchand Mahadik, “Mechatronics”, Tata McGraw-Hill publishing Company Ltd, 2003.

| 15CBME72 | COMPUTER INTEGRATED MANUFACTURING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To understand the application of computers in various aspects of manufacturing viz., design, proper planning, manufacturing cost, layout & material handling system.

**UNIT I COMPUTER AIDED DESIGN 9**

Concept of CAD as drafting and designing facility, desirable features of CAD package, drawing features in CAD – Scaling, rotation, translation, editing, dimensioning, labeling, Zoom, pan, redraw and regenerate, typical CAD command structure, wire frame modeling, surface modeling and solid modeling (concepts only) in relation to popular CAD packages.

**UNIT II COMPONENTS OF CIM 9**

CIM as a concept and a technology, CASA/SME model of CIM, CIM II, benefits of CIM, communication matrix in CIM, fundamentals of computer communication in CIM – CIM data transmission methods – serial, parallel, asynchronous, synchronous, modulation, demodulation, simplex and duplex. Types of communication in CIM – point to point (PTP), star and multiplexing. Computer networking in CIM – the seven layer OSI model, LAN model, MAP model, network topologies – star, ring and bus, advantages of networks in CIM

**UNIT III GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING 9**

History Of Group Technology – role of G.T in CAD/CAM Integration – part families- classification and coding – DCLASS and MCLASS and OPTIZ 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 systems.

**UNIT IV SHOP FLOOR CONTROL AND INTRODUCTION TO FMS 9**

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 system –FMS layout- computer control systems – applications and benefits.

**UNIT V COMPUTER AIDED PLANNING AND CONTROL AND COMPUTER MONITORING 9**

Production planning and control – cost planning and control – inventory management – material requirements planning (MRP) – shop floor control, Lean and Agile Manufacturing. Types of production monitoring systems – structure model of manufacturing – process control and strategies – direct digital control.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Computer Integrated Manufacturing course, the student will be able to

**CO1:** Application of computers in various aspects of manufacturing.

**CO2:** Exposure to the design of products by using computer systems

**CO3:** Familiarized in proper planning of computer integrated manufacturing.

**CO4:** Analyze approximate manufacturing cost.

**CO5:** Understand and draw the layout of a computerized manufacturing system.

**CO6:** Known the material handling system.

**CO7:** Known the different error rectification techniques.

**CO8:** Known different stages followed for manufacturing process.

**CO9:** Select and apply appropriate machining processes to develop products.

**CO10:** Analyze ways of reducing the time span for manufacture a component.

**CO11:** Understand the application of computers in various aspects of manufacturing operations and design.

**CO12:** Understand the application of computers in various aspects of proper planning.

**TEXT BOOK:**

1. Mikell. P. Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education 2001.

**REFERENCES:**

1. Mikell. P. Groover and Emory Zimmers Jr., “CAD/CAM”, Pearson Education India, 2006
2. James A. Regh and Henry W. Kreabber, “Computer Integrated Manufacturing”, Pearson Education second edition, 2005.
3. Chris McMahon and Jimmie Browne, “CAD CAM Principles, Practice and Manufacturing Management”, Pearson Education second edition, 2005.
4. Ranky, Paul G., “Computer Integrated Manufacturing”, Prentice hall of India Pvt. Ltd., 2005.
5. YoremKoren, “Computer Integrated Manufacturing”, McGraw Hill, 2005.
6. P N Rao, “CAD/CAM Principles and Applications”, TMH Publications, 2007.

| 15CBME73 | POWER PLANT ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

**UNIT I INTRODUCTION TO POWER PLANTS AND BOILERS 9**

Layout of Steam, Hydel , Diesel , MHD, Nuclear and Gas turbine Power Plants Combined Power cycles – comparison and selection , Load duration Curves Steam boilers and cycles – High pressure and Super Critical Boilers – Fluidized Bed Boilers

**UNIT II STEAM POWER PLANT 9**

Rankine Cycle: Classification – Reheat cycle – Regenerative cycle – Reheat – regenerative cycle. Fuel and ash handling, Combustion Equipment for burning coal, Mechanical Stokers. Pulveriser, Electrostatic Precipitator, Draught- Different Types, Surface condenser types, cooling Towers

**UNIT III NUCLEAR AND HYDEL POWER PLANTS 9**

Nuclear Energy-Fission , Fusion Reaction, Types of Reactors, Pressurized water reactor ,Boiling water reactor, Waste disposal and safety Hydel Power plant- Essential elements, Selection of turbines, governing of Turbines- Micro hydel developments

**UNIT IV DIESEL AND GAS TURBINE POWER PLANT 9**

Types of diesel plants, components, Selection of Engine type, applications- Gas turbine plant cycle – classification – simple cycle – regenerative cycle – reheat cycle – regenerative – reheat cycle – inter-cooling. Steam and gas turbine Power plants – cycle analysis

**UNIT V OTHER POWER PLANTS AND ECONOMICS OF POWER PLANTS 9**

Geo thermal- OTEC- Tidel- Pumped storage –Solar central receiver system Cost of electric Energy-Fixed and operating costs-Energy rates- Types tariffs- Economics of load sharing, comparison of various power plants.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Power Plant Engineering course, the student will be able to

**CO1:** Exposure an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

**CO2:** Known layout and components and working principle of nuclear power plant.

**CO3:** Familiarized on the thermal and oil based power plants.

**CO4:** Explain working principles of conventional and unconventional power plants.

**CO5:** Assess the performance of power plants.

**CO6:** Predict the fixed and operating costs of power plants.

**CO7:** Identify environmental hazards of various power plants

**CO8:** Evaluate the design layout and working of hydroelectric power plants.

**CO9:** Evaluate economic feasibility and its implications on power generating units.

**CO10:** Evaluate economic feasibility of the system

**CO11:** Analyze different components used in power plants and their functions.

**TEXT BOOKS:**


1. EI-Wakil M.M ,Power “Plant Technology,” Tata McGraw-Hill 1984
2. Nag P.K,”Power Plant Engineering”. Third edition Tata McGraw- Hill ,2007


**REFERENCES:**


1. Arora S.C and Domkundwar S, “A Course in Power Plant Engineering”, DhanpatRai , 2001
2. K.K.Ramalingam,“ Power Plant Engineering “, Scitech Publications, 2002
3. G.R, Nagpal, “Power Plant Engineering”, Khanna Publishers 1998.
4. G.D.Rai, “Introduction to Power Plant technology” Khanna Publishers,1995.

| 15PBME71 | COMPUTER AIDED SIMULATION ANDANALYSIS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |

**COURSE OBJECTIVE:**

- To give exposure to software tools needed to analyze engineering problems.
- To expose the students to different applications of simulation and analysis tools.

## LIST OF EXPERIMENTS

**A. SIMULATION**

1. Simulation of Air conditioning system with condenser temperature and evaporator temperatures as input to get COP using C /MAT Lab.
2. Simulation of Hydraulic / Pneumatic cylinder using C / MAT Lab.
3. Simulation of cam and follower mechanism using C / MAT Lab.

**B. ANALYSIS (SIMPLE TREATMENT ONLY)**

1. Stress analysis of a plate with a circular hole.
2. Stress analysis of rectangular L bracket
3. Stress analysis of an axi-symmetric component
4. Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
5. Mode frequency analysis of a 2 D component
6. Mode frequency analysis of beams (Cantilever, Simply supported, Fixed ends)
7. Harmonic analysis of a 2D component
8. Thermal stress analysis of a 2D component
9. Conductive heat transfer analysis of a 2D component
10. Convective heat transfer analysis of a 2D component

**TOTAL: 45 Hours**

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

| | |
|---|---|
| **Computer System** | 30 |
| 17” VGA Color Monitor | |
| Pentium IV Processor | |
| 40 GB HDD | |
| 512 MB RAM | |
| Color Desk Jet Printer | 01 |
| **Software** | |
| Suitable analysis software | 30 licenses |
| C / MATLAB | 5 licenses |

**COURSE OUTCOMES:**

After successful completion of the Computer Aided Simulation and Analysis Laboratory course, the student will be able to

**CO1:** Have exposure to software tools needed to analyze engineering problems.

**CO2:** Have known different applications of simulation and analysis tools.

**CO3:** Use suitable graphical entities to design a product.

**CO4:** Select suitable analysis software.

**CO5:** Exposure of computer system and printers.

**CO6:** Understand convective and conductive heat transfer analysis of a two dimensional component.

**CO7:** Analyze stress in different shape of the component.

**CO8:** Be familiarized in steps followed for stress analysis of beams.

**CO9:** Harmonic and thermal stress analysis of 2D component.

| 15PBME72 | MECHATRONICS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |

**COURSE OBJECTIVE:**

- To know the method of programming the microprocessor and also the design, modeling & analysis of basic electrical, hydraulic & pneumatic Systems which enable the students to understand the concept of mechatronics.

**LIST OF EXPERIMENTS**

1. Design and testing of pneumatic circuits to control
   (i) Velocity (ii) direction and (iii) force of single and double acting actuators
2. Design of circuits with logic sequence using Electro pneumatic trainer kits.
3. Simulation of basic Hydraulic, Pneumatic and Electric circuits using software
4. Circuits with multiple cylinder sequences in Electro pneumatic using PLC
5. Speed Control of AC & DC drives
6. Servo controller interfacing for DC motor
7. PID controller interfacing
8. Stepper motor interfacing with 8051 Micro controller
   (i) Full step resolution (ii) half step resolution
9. Modeling and analysis of basic electrical, hydraulic and pneumatic systems using LAB VIEW
10. Computerized data logging system with control for process variables like pressure flow and temperature.

**TOTAL: 45 Hours**

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

1. Basic Pneumatic Trainer Kit with manual and electrical controls/ PLC Control each - 1 No.
2. Basic Hydraulic Trainer Kit - 1 No.
3. Hydraulics and Pneumatics Systems Simulation Software / Automation studio sets - 10 Nos
4. 8051 - Microcontroller kit with stepper motor and drive circuit sets - 2 Nos.
5. LAB VIEW software with Sensors to measure Pressure, Flow rate, direction, speed, velocity and force. seats - 2 Nos

**COURSE OUTCOMES:**

After successful completion of the Mechatronics Laboratory course, the student will be able to

**CO1:** Understand measurement and mechatronics control systems.

**CO2:** Build pneumatic, hydraulic, electro pneumatic and electro-hydraulic circuits for automation Understand working principles of electromechanical devices.

**CO3:** Suggest actuators for mechatronic systems and design of a simple mechatronics system using PLC.

**CO4:** The method of programming the microprocessor and also the design, modeling and analysis of basic electrical, hydraulic & pneumatic Systems.

**CO5:** Measure load, displacement and temperature using analogue and digital sensors.

**CO6:** Develop PLC programs for control of traffic lights, water level, lifts and conveyor belts.

**CO7:** Develop microcontroller programming to guide a robot.

**CO8:** Simulate and analyze PID controllers for a physical system using MATLAB.

**CO9:** Choose and identify programmable logic controller.

**CO10:** Understand the stages in designing Mechatronics Systems.

**15PBME73 Mini Project & Seminar**

After successful completion of the mini project and seminar, the student will be able to

**CO1:** Identify a topic in advanced areas of Mechanical Engineering.

**CO2:** Review literature to identify gaps and define objectives & scope of the work.

**CO3:** Generate and implement innovative ideas for social benefit.

**CO4:** Develop a prototypes/models, experimental set-up and software systems necessary to meet the objectives.

**CO5:** Search and conclude the literature.

**CO6:** Understand by reading the literature and can able to identify the modifications.

**CO7:** Identify methods and materials to carry out experiments/develop code

**CO8:** Identify and compare technical and practical issues related to the area of course specialization.

**CO9:** Outline annotated bibliography of research demonstrating scholarly skills

**CO10:** Present seminars in front of grown without fairness.

**15CBME81 Project Work**

After successful completion of the project work, the student will be able to

**CO1:** Identify and compare technical and practical issues related to the area of course specialization.

**CO2:** Outline annotated bibliography of research demonstrating scholarly skills.

**CO3:** Prepare a well organized report employing elements of technical writing and critical thinking.

**CO4:** Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presenting.

**CO5:** Identify methods and materials to carry out experiments/develop code.

**CO6:** Reorganize the procedures with a concern for society, environment and ethics.

**CO7:** Analyze and discuss the results to draw valid conclusions.

**CO8:** Prepare a report as per recommended format and defend the work.

**CO9:** Explore the possibility of publishing papers in peer reviewed journals/conference proceedings.

**CO10:** Known process and steps involved in preparation of report and publish papers.

# SYLLABUS
# DISCIPLINE SPECIFIC ELECTIVE COURSES

| 15DBME31 | SPECIAL CASTING TECHNIQUES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To introduce the concepts of basic casting processes and fabrication techniques and study the various special casting technique such as shell moulding, investment casting, centrifugal and die-casting, etc..

**UNIT I INTRODUCTION 9**

Introduction to sand casting - Conventional mould and Core making - Need for special casting process – applications.

**UNIT II SHELL MOULDING 9**

Process - Machines - Pattern - Sand, resin and other materials - Process parameters characteristics of shell mould castings - 'D' Process - Applications.

**UNIT III INVESTMENT CASTING 9**

Process - Pattern and mould materials - Block mould and ceramic shell mould - Mercast and shaw process - Application.

**UNIT IV CENTRIFUGAL AND DIE-CASTING 9**

Types of Centrifugal processes - calculation of rotating speed of the mould - Equipment - Application.

**UNIT V CONTINOUS CASTING $CO_2$ SAND PROCESS AND FULL MOULD PROCESSES 9**

Reciprocating continuous mould process - Direct chill process - Use of steel, aluminium, brass material in continuous casting.$CO_2$mould / core hardening process - principles Full mould process - Applications. Other special process like squeeze casting and electro slag casting processes.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Special Casting Techniques course, the student will be able to

**CO1:** Understand the concepts of basic manufacturing processes such as casting and moulding.

**CO2:** Understand the casting patterns and casting materials

**CO3:** Explain casting process simulation.

**CO4:** Explain mould filling, solidification and cooling.

**CO5:** Understand the various special casting techniques.

**CO6:** Understand shell-moulding.

**CO7:** Understand investment casting such as counter-gravity casting and vacuum pressure casting.

**CO8:** Understand centrifugal casting and die-casting.

**CO9:** Understand continuous casting Co2 sand process.

**CO10:** Understand Rapid casting and permanent mould casting.

**TEXT BOOKS:**

1. Beeley, P. R., “Foundry Technology”, Butterworths, London, 1982.
2. Clegg. A J., “Precision Casting Processes”, Pergamon Press, London, U.K, 1991.

**REFERENCES:**


1. Heine, Loperand Rosenthal, “Principles of Metal Casting”, Tata McGraw-Hill Publishing’s Co., Ltd, New Delhi, 1995.
2. Dumond. T C, “Shell Moulding and Shell Moulded Castings”, Reinhold Publishing Corporation Inc, 1984.
3. Doehler.E.H, “Die Casting”, McGraw-Hill Book Co, New York, 1991.
4. Barton H K, “Die Casting Processes”, Odhams Press Ltd, 1985.
5. ASM Metals Hand Book, “Casting”, Volume 15, ASM International, 10th Edition, 1991.

| 15DBME32 | FAILURE ANALYSIS AND DESIGN | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To enable the student to understand the principles of failure analysis and design.

**UNIT I MATERIALS AND DESIGN PROCESS 9**

Factors affecting the behavior of materials in components, effect of component geometry and shape factors, design for static strength, stiffness, designing with high strength and low toughness materials, designing for hostile environments, material processing and design, processes and their influence on design, process attributes, systematic process selection, screening, process selection diagrams, ranking, process cost.

**UNIT II FRACTURE MECHANICS 9**

Ductile fracture, brittle fracture, Cleavage-fractography, ductile-brittle transition-Fracture mechanics approach to design-energy criterion, stress intensity approach, time dependent crack growth and damage.

**UNIT III LINEAR ELASTIC FRACTURE MECHANICS 9**

Griffith theory, Energy release rate, instability and R-curve, stress analysis of cracks-stress intensity factor, K-threshold, crack growth instability analysis, crack tip stress analysis. Crack tip opening displacement(CTOD), J integral, relationship between J and CTOD.

**UNIT IV DYNAMIC AND TIME-DEPENDENT FRACTURE 9**

Dynamic fracture, rapid loading of a stationary crack, rapid crack propagation, dynamic contour integral, Creep crack growth-C Integral, Visco elastic fracture mechanics, viscoelastic J integral, Experimental determination of plane strain fracture toughness, K- R curve testing, J measurement, CTOD testing, effect of temperature, strain rate on fracture toughness.

**UNIT V FAILURE ANALYSIS TOOLS 9**

Reliability concept and hazard function, life prediction, life extension, application of poisson, exponential and Weibull distribution for reliability, bath tub curve, parallel and series system, MTBF,MTTR, FMEA definition-Design FMEA, Process FMEA , analysis causes of failure, modes, ranks of failure modes, fault tree analysis, industrial case studies/projects on FMEA.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Failure Analysis and Design course, the student will be able to

**CO1:** Understand the theories of failure analysis for all types of materials.

**CO2:** Understand the basic principles and approaches for static loading and dynamic loading.

**CO3:** Identify the factors affecting the behavior of materials under various force condition.

**CO4:** Design the component based on statics strength and stiffness.

**CO5:** Understand different fracture mechanics of brittle and ductile materials

**CO6:** Determine stress intensity, time dependent crack growth on ductile materials

**CO7:** Understand Dynamic fracture mechanism

**CO8:** Approach fracture mechanics problems based on design-energy criterion

**CO9:** Identify different tools used for analysis of fracture mechanism

**CO10:** Understand reliability concept and hazard function

**CO11:** Get knowledge failure mode effective analysis (FMEA).

**TEXT BOOKS:**


1. John M Barsoom and Stanley T Rolte "Fracture and Fatigue Control in Structures", Prentice Hall, New Delhi, 1987.
2. Michael F Ashby, “Material Selection in Mechanical Design”, Butterworth – Heinemann, Third Edition, 2005.


**REFERENCES:**


1. Shigley and Mische, "Mechanical Engineering Design", McGraw Hill Inc., New York, 1992.
2. Mahmoud M Farag, “Material Selection for Engineering Design”, Prentice Hall, New Delhi, 1997.
3. Faculty of Mechanical Engineering, “Design Data Book”, PSG College of Technology, DPV Printers, Coimbatore, 1993.
4. ASM Metals Handbook, "Failure Analysis and Prevention", ASM Metals Park, Ohio, USA, Vol. 10, Tenth Edition, 1995.

**15DBME33 MANUFACTURE AND INSPECTION OF GEARS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To understand the basic terminology of gear and the various inspection techniques for checking of gears.

**UNIT I INTRODUCTIONTOGEARS AND GEARMATERIALS 9**

Types of gears, classification, gear drawings, gearboxes, application of gears, gear production methods, an overview. Non-metallic, ferrous and non-ferrous gears, Properties of gear materials, selection of material for typical gears and applications – blank preparation methods for different gears, size, type and material.

**UNIT II PRODUCTION OF GEARS & SCREW THREADS 9**

Gear milling different gears, cut quality obtainable. Gear hobbling, types of gears cut, hobbling cutters, workholding methods gear shaping, disc type and rack type gear shapers, Production of straight bevel gears and spiral gears, milling, and generation by straight bevel gear generator. Screw thread terminology, Types of screw thread, Methods of producing screw threads, Effect of pitch errors, measurement of various elements of screw threads. Thread rolling, Thread Grinding, Mass Production of Screws.

**UNIT III HEAT TREATMENT OF GEARS 9**

Through hardening, case hardening, flames hardening, induction hardening of gears, Nit riding of gears. Tuft riding of gears. Inspection of gears for hardening defects. Gear finishing advantages, finishing of gears by grinding, shaving, lapping, honing methods and cold rolling of gears, Description of machines, process and process parameters.

**UNIT IV GEAR INSPECTION 9**

Types of gear errors, gear quality standards tooth thickness and base tangent length measurement, pitch errors, radial run out errors, profile errors and pitch error measurement. Composite error measurement, Computerized gear inspection centers. Reasons and remedies for gear errors.

**UNIT V MODERN GEAR PRODUCTION METHODS 9**

Gear production by stamping, die casting, power metal process, injection and compression Moulding in plastics. Die casting, cold and hot rolling, mass production methods shear speed shaping. Gear broaching – Gleason. G-Trac Gear generation method

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Manufacture and Inspection of Gears course, the student will be able to

**CO1:** Understand the basic terminology of gear.

**CO2:** Understand various inspection techniques for checking of gears.

**CO3:** Understand manufacturing of gears through gear hobbing machines.

**CO4:** Understand Manufacturing of gears through milling machines.

**CO5:** Understand gear tooth parameters

**CO6:** Understand Manufacturing of various types of gears.

**CO7:** Understand Inspecting of manufactured gears through machine vision.

**CO8:** Check the total composite error and tooth thickness.

**CO9:** Measure and inspect the given specimen with micrometer.

**CO10:** Check composite, profile and Helix inspection.

**TEXT BOOKS:**


1. Watson, “Modern Gear Production”, Persman Press Oxford, 1984.
2. HMT, “Production Technology”, Tata McGraw Hill, New Delhi, 1992.


**REFERENCES:**


1. SAE, “Gear Design Manufacturing Inspection Manual”, SAE, 1990.
2. Weck M., “Hand Book of Machine Tools”, Technology & Sons, 1984.
3. Faydor L. Litvin, Alfonso Fuentes-Aznar, Ignacio Gonzãlez-Perez, and Kenichi Hayasaka, “Noncircular Gears: Design and Generation”, Cambridge University Press, 2009

| 15DBME34 | REFRIGERATION AND AIR CONDITIONING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- This course provides the knowledge about refrigeration and air conditioning system, and enables them to do simple design calculations and analysis of these systems.

**UNIT I REFRIGERATION CYCLES 9**

Air refrigeration cycles - reversed Carnot cycle, bell Coleman cycle, simple vapour compression Refrigeration cycle, compound compression refrigeration cycles, and cascade refrigeration cycles.

**UNIT II VAPOUR ABSORPTION 9**

Properties of refrigerant, classification of refrigerants - primary and secondary refrigerants, Performance analysis of aqua ammonia refrigeration system, study of lithium bromide water Refrigeration system, ozone friendly refrigerants.

**UNIT III SYSTEM COMPONENTS 9**

Refrigerant compressors - reciprocating, rotary and centrifugal compressors, evaporators- flooded, dry Expansion, shell and tube and double pipe evaporators, condensers - air cooled, water cooled and Evaporative condensers, expansion devices - automatic, capillary tube and thermostatic expansion Valve.

**UNIT IV AIR HANDLING 9**

Air distribution systems - study of different types of duct systems, methods of duct design, duct Insulation, air purity - air cleaning methods.

**UNIT V AIR CONDITIONING 9**

Psychometric, psychomotor, psychometric processes, moist air behavior, effective temperatures, Sensible heat factor ratio and cooling load estimation for an air conditioned space.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the refrigeration and air conditioning course, the student will be able to

**CO1:** Understand the basic working principle of refrigeration and air conditioning systems.

**CO2:** Explain the simple vapour compression Refrigeration cycle.

**CO3:** Discuss the difference of compound compression refrigeration cycles and cascade refrigeration cycles.

**CO4:** Classify the refrigerants and explain the primary and secondary refrigerants.

**CO5:** Understand the lithium bromide water refrigeration system.

**CO6:** Made simple calculations for design the refrigeration systems.

**CO7:** Analyze the design the refrigeration and air conditioning systems.

**CO8:** Understand the usage of air cooled, water cooled and evaporative condensers.

**CO9:** Understand the different air duct systems and cleaning methods.

**CO10:** Understand the sensible heat factor ratio and cooling load estimation for an air conditioned space.

**TEXT BOOKS:**


1. Arora C.P, “Refrigeration and Air Conditioning”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2006.
2. Jain V.K,”Refrigeration and Air Conditioning”, S.Chand and co, New Delhi, 1986.


**REFERENCES:**


1. Stocker, “Refrigeration and Air Conditioning”, Tata McGraw Hill Publishing Company Limited, New Delhi, 1982.
2. Roy J Dossat, “Principle of Refrigeration”, Wiley Eastern Limited, Fifth Edition 2001.
3. Manohar Prasad, “Refrigeration and Air Conditioning”, Wiley Eastern Limited, 2004.
4. Jordan and Prister,” Refrigeration and Air Conditioning”, Prentice Hall of India Limited, New Delhi, 1985.

| 15DBME35 | KINEMATICS OF MACHINERY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To understand the basic components and layout of linkages in the assembly of a system / machine.
- To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
- To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

**UNIT I BASICS OF MECHANISMS 9**

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four-bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission Angle – Description of some common mechanisms – Quick return mechanisms, Dwell mechanisms, Ratchets and Escapements, Universal Joint.

**UNIT II KINEMATICS OF LINKAGE MECHANISMS 9**

Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method –Velocity and acceleration polygons – Velocity analysis using instantaneous centres – Kinematic analysis by complex algebra methods – Vector approach –Coincident points – Coriolis component of Acceleration.

**UNIT III KINEMATICS OF CAM MECHANISMS 9**

Classification of cams and followers – Terminology and definitions – Displacement diagrams – Uniform velocity, parabolic, simple harmonic, cycloidal and polynomial motions – Derivatives of follower motions – Layout of plate cam profiles – Specified contour cams – Circular arc and tangent cams – Pressure angle and undercutting.

**UNIT IV GEARS AND GEAR TRAINS 9**

Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions –Gear tooth action – contact ratio – Interference and undercutting – Non-standard gear teeth – Helical, Bevel, Worm, Rack and Pinion gears – Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains – Differentials.

**UNIT V FRICTION 9**

Kinds of friction – Laws of friction – coefficient of friction - Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt and rope drives – Friction aspects in brakes.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the kinematics of machinery course, the student will be able to

**CO1:** Understand the difference between kinematic and kinetic motion.

**CO2:** Identify the basic relations between distance, time, velocity, and acceleration.

**CO3:** Apply vector and scalar mechanics as a tool for solving kinematic problems.

**CO4:** Understand the basic components and layout of linkages which is used in the assembly of a structure and machine.

**CO5:** Understand the principles in analyzing the assembly of machines with respect to the displacement, velocity, and acceleration at any point in a kinematic link of a mechanism.

**CO6:** Understand the motion resulting from a specified set of linkages, pairs, chains and design the linkage mechanisms such as four bar chain, slider crank etc.

**CO7:** Understand the concepts of cam mechanisms and their various types of cam-follower diagram used for specific output motions.

**CO8:** Understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

**CO9:** Create a schematic drawing of a real-world mechanism.

**CO10:** Determine the degrees-of-freedom (mobility) and Movability of a mechanism.

**CO11:** Use graphical and analytic methods to study the motion of a planar mechanism.

**CO12:** Design basic gear trains and design the basic cam systems.

**TEXT BOOKS:**

1. Ambekar A.G, "Mechanism and Machine Theory" Prentice Hall of India, New Delhi, 2007.
2. Shigley J.E., Pennock G.R.and Uicker.J.J., 'Theory of Machines and Mechanisms', Oxford University Press, 2003.

**REFERENCES:**

1. Thomas Bevan, 'Theory of Machines', CBS Publishers and Distributors, 1984.
2. Ghosh.A, and A.K.Mallick, 'Theory of Mechanisms and Machines', Affiliated East-West Pvt. Ltd., New Delhi, 1988.
3. Rao.J.S. andDukkipati.R.V. 'Mechanisms and Machine Theory', Wiley-Eastern Ltd., NewDelhi, 1992.
4. John Hannah and Stephens R.C., 'Mechanics of Machines', Viva Low-Prices Student Edition, 1999.
5. V.Ramamurthi, Mechanics of Machines, Narosa Publishing House, 2002.
6. Robert L.Norton, Design of Machinery, McGraw-Hill, 2004.

| 15DBME36 | PRODUCTION TECHNOLOGY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components.

**UNIT I METAL CASTING PROCESSES 12**

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 – Defects in Casting – Inspection methods.

**UNIT II JOINING PROCESSES 12**

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 – Weld defects – Brazing and soldering process – Methods and process capabilities – Filler materials and fluxes – Types of Adhesive bonding.

**UNIT III BULK DEFORMATION PROCESSES 12**

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

**UNIT IV SHEET METAL PROCESSES 12**

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 – Introduction to Explosive forming, Magnetic pulse forming, Peen forming, Super plastic forming.

**UNIT V MANUFACTURING OF PLASTIC COMPONENTS 12**

Types and characteristics of plastics -– Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding – Plunger and screw machines – compression moulding, Transfer moulding - Typical industrial applications – Introduction to Blow moulding – Rotational moulding – Film blowing – Extrusion - Thermoforming - Bonding of Thermoplastics.

**TOTAL: 60 Hours**

**COURSE OUTCOMES:**

After successful completion of the Production Technology course, the student will be able to

**CO1:** Understand the concepts of basic manufacturing processes such as casting and moulding.

**CO2:** Know about fabrication techniques, metal joining, and metal forming manufacture of plastic components.

**CO3:** Creating patterns the student will learn about the pattern materials and allowance for moulding and casting.

**CO4:** Understand the operating principle and basic equipment needed for metal joining process.

**CO5:** Describe the types of welding and weld defects.

**CO6:** Do the arc welding, spot welding and brazing; Mould the plastics by injection moulding.

**CO7:** Understand about hot and cold working process for metal forming processes.

**CO8:** Understand the defects in rolled parts for metal forming processes.

**CO9:** Gaining appropriate knowledge about sheet metal characteristics such as shearing, bending and drawing operations.

**CO10:** Gaining knowledge about explosive forming and magnetic pulse forming.

**CO11:** Manufacturing plastic components, processes used by injection moulding and compression moulding.

**TEXT BOOKS:**

1. Kalpakjian, S., "Manufacturing Engineering and Technology", Pearson Education India Edition, 2006.

2. S. Gowri, P. Hariharan, A. Suresh Babu, Manufacturing Technology I, Pearson Education, 2008

**REFERENCES:**

1. Roy. A. Lindberg, Processes and Materials of Manufacture, PHI / Pearson Education, 2006

2. HajraChoudhury S.K and HajraChoudhury. A.K., Elements of Workshop Technology, Volume I and II, Media Promoters and Publishers Private Limited,Mumbai, 1997.

3. Paul Degarma E, Black J.T. and Ronald A. Kosher, Elighth Edition, Materials and Processes, in Manufacturing Prentice – Hall of India, 1997.

4. Sharma, P.C., A Text book of Production Technology, S. Chand and Co. Ltd., 2004.

5. P.N. Rao, Manufacturing Technology Foundry, Forming and Welding, TMH-2003; 2nd Edition, 2003

| 15DBME41 | MANUFACTURING TECHNOLOGY | L | T | P | C |
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COURSE OBJECTIVE:

- The main objective of this course is to provide wider and depth knowledge to the students in machine tools cutting methodology of various manufacturing machines.

**UNIT I THEORY OF METAL CUTTING 12**

Introduction to types of machine tools, Theory of metal cutting -material removal processes: chip formation, orthogonal cutting and oblique cutting. Merchant circle-problems, cutting tool materials, tool wear, tool life-problems, surface finish, cutting fluids.

**UNIT II CENTRE LATHE AND SPECIAL PURPOSE LATHES 12**

Centre lathe, constructional features, cutting tools, various operations, taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes – automatic lathes: semi automatic, automats – single spindle : cutting off, swiss type, automatic screw type – multi spindle; cutting off, bar type

**UNIT III RECIPROCATING AND MILLING MACHINES 12**

Reciprocating machine tools: shaper, planer, slotter; milling: types, milling cutters, operations; hole making: drilling, reaming, boring, tapping

**UNIT IV SURFACE FINISHING PROCESSES 12**

Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centre less grinding – honing, lapping, super finishing, polishing and buffing, abrasive jet grinding

**UNIT V SAWING, BROACHING AND GEAR CUTTING 12**

Sawing machine: hack saw, band saw, circular saw; broaching machines: broach construction – push, pull, surface and continuous broaching machines, gear cutting: forming, generation, shaping, hobbing.

**TOTAL: 60 Hours**

**COURSE OUTCOMES:**

After successful completion of the Manufacturing Technology course, the student will be able to

**CO1:** Understand the concept and basic mechanics of metal cutting processes.

**CO2:** To understand the working of standard machine tools such as lathe, shaping and allied machines.

**CO3:** Ideas about cutting tool materials, tool wear, tool life.

**CO4:** Select machine tools for various requirements of products.

**CO5:** Explain the turning machines and constructional features and specifications.

**CO6:** Operate Numerical Control machines and Computer Numerical Control Machines

**CO7:** Explain about shaper, milling and gear cutting machines.

**CO8:** Select the appropriate tool for a particular operation and explain the properties of tooling.

**CO9:** Explain the gear hobbing and milling process

**CO10:** Explain abrasive and broaching process.

**TEXT BOOKS:**

1. Rao, P.N. “Manufacturing Technology”, Metal Cutting and Machine Tools, Tata McGraw–Hill, New Delhi, 2003.

2. Richerd R.Kibbe, John E. Neely, Roland O. Merges and Warren J. White, “Machine Tool Practices”, Prentice Hall of India, 2003.

**REFERENCES:**


1. HMT, “Production Technology”, Tata McGraw-Hill, 1998.
2. P.C.Sharma, “A Text Book of Production Engineering”, S.Chand and Co. Ltd, IV edition, 1993.
3. Hajra Choudry, “Elements of Work Shop Technology – Vol. II”, Media Promoters. 2002.
4. Geofrey Boothroyd, “Fundamentals of Metal Machining and Machine Tools”, McGraw Hill, 1984.

| 15DBME42 | ENGINEERING MATERIALS AND METALLURGY | L | T | P | C |
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**COURSE OBJECTIVE:**

- To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications

**UNIT I ALLOYS AND PHASE DIAGRAMS 8**

Constitution of alloys – Solid solutions, substitution and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – carbon equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application.

**UNIT II HEAT TREATMENT 10**

Definition – Full annealing, stress relief, recrystallisation and spheroidising – normalising, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR – Hardenability, Jominy end quench test - Austempering, martempering – case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening. .

**UNIT III FERROUS AND NON-FERROUS METALS 9**

Effect of alloying additions on steel- α and β stabilisers– stainless and tool steels – HSLA, Maraging steels – Cast Iron - Grey, white, malleable, spheroidal – alloy cast irons, Copper and copper alloys – Brass, Bronze and Cupronickel – Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys.

**UNIT IV NON-METALLIC MATERIALS 9**

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes)- Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON –Composites-Classifications-Metal Matrix and FRP - Applications of Composites.

**UNIT V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS 9**

Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), hardness tests, Impact test Izod and charpy, fatigue and creep failure mechanisms

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Engineering Materials and Metallurgy course, the student will be able to

**CO1:** Impart knowledge on the structure, properties, treatment, testing of materials.

**CO2:** Identify applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

**CO3:** Understand the crystal structure, Mechanical behavior of materials and necessity of alloying.

**CO4:** Understand the constitution of alloys and know about phase diagrams.

**CO5:** Understand about the Iron-carbon equilibrium diagram and heat treatment processes of steels.

**CO6:** Guiding knowledge effect of alloy additions on steel and precipitation strengthening treatment.

**CO7:** Understand the heat treatment processes and isothermal transformation diagrams.

**CO8:** Familiarize with cooling curves superimposed on I.T diagrams.

**CO9:** Understand flame and induction hardening.

**CO10:** Study the different types of polymers, commodity and engineering polymers.

**CO11:** Study the deformation mechanism.

**TEXT BOOKS:**


1. Avner,, S.H., “Introduction to Physical Metallurgy”, McGraw Hill Book Company,1994.
2. Williams D Callister, “Material Science and Engineering” Wiley India Pvt Ltd, Revised IndianEdition 2007.


**REFERENCES:**


1. Raghavan.V, “Materials Science and Engineering”, Prentice Hall of India Pvt. Ltd., 1999.
2. Kenneth G.Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4th Indian Reprint 2002.
3. Upadhyay. G.S. and AnishUpadhyay, “Materials Science and Engineering”, Viva Books Pvt. Ltd., New Delhi, 2006.
4. U.C.Jindal : Material Science and Metallurgy, "Engineering Materials and Metallurgy", First Edition, Dorling Kindersley, 2012

| 15DBME43 | HEAT AND MASS TRANSFER | L | T | P | C |
|---|---|---|---|---|---|
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**COURSE OBJECTIVE:**

- To understand the mechanisms of heat transfer under steady and transient conditions.
- To understand the concepts of heat transfer through extended surfaces.
- To learn the thermal analysis and sizing of heat exchangers and to understand the basic concepts of mass transfer. (Use of standard HMT data book permitted)

**UNIT I CONDUCTION 9**

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – General Differential equation of Heat Conduction – Fourier Law of Conduction – Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems – Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Use of Heislers Chart.

**UNIT II CONVECTION 9**

Basic Concepts – Convective Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection – Dimensional Analysis – External Flow – Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar and Turbulent Flow – Combined Laminar and Turbulent – Flow over Bank of tubes – Free Convection – Dimensional Analysis – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

**UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9**

Nusselts theory of condensation-pool boiling, flow boiling, correlations in boiling and condensation, Types of Heat Exchangers – LMTD Method of heat Exchanger Analysis – Effectiveness – NTU method of Heat Exchanger Analysis – Overall Heat Transfer Coefficient – Fouling Factors.

**UNIT IV RADIATION 9**

Basic Concepts, Laws of Radiation – surface emission properties - Stefan Boltzman Law, Kirchoff Law, Planks law, wien's displacement law –Black Body Radiation –Grey body radiation Shape Factor Algebra – Electrical Analogy – Radiation Shields –Introduction to Gas Radiation.

**UNIT V MASS TRANSFER 9**

Basic Concepts – Mass transfer coefficient - Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – General mass diffusion equation in stationary media - Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations

**TOTAL: 45 Hours**

**Note*:*** *(Use of standard heat and mass transfer data book is permitted in the University examination)*

**COURSE OUTCOMES:**

After successful completion of the Heat and Mass Transfer course, the student will be able to

**CO1:** Understand the mechanisms of heat transfer under steady and transient conditions.

**CO2:** Understand the concepts of heat transfer through extended surfaces.

**CO3:** Learn the thermal analysis and sizing of heat exchangers and to understand the basic concepts of mass transfer.

**CO4:** Understand about the General Differential equation of Heat conduction.

**CO5:** Design heat exchangers and mass transfer systems

**CO6:** Explain about Free and Forced Convection.

**CO7:** Explain about Phase change Heat Transfer and Heat Exchangers.

**CO8:** Understand about Black Body radiation and radiation through gases.

**CO9:** Illustrate the real time applications of Radiation Shields.

**CO10:** Relate the skill of mass transfer and its applications.

**TEXT BOOKS:**


1. Sachdeva R C, “Fundamentals of Engineering Heat and Mass Transfer” New Age International, 1995.
2. Yadav R “Heat and Mass Transfer” Central Publishing House, 1995.


**REFERENCES:**


1. Nag P.K, “ Heat Transfer”, Tata McGraw-Hill, New Delhi, 2002.
2. Holman J.P “Heat and Mass Transfer” Tata McGraw-Hill, 2000.
3. Kothandaraman C.P “Fundamentals of Heat and Mass Transfer” New Age International, New Delhi, 1998
4. Frank P. Incropera and David P. DeWitt, “Fundamentals of Heat and Mass Transfer”, John Wiley and Sons, 1998.
5. Velraj R, “Heat & Mass Transfer”, Ane Books, New Delhi, 2004.

| 15DME44 | CRYOGENIC ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
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**COURSE OBJECTIVE:**

- The main aim of this course is to make the students to know and understand the cryogenic engineering's various stages.

**UNIT I INTRODUCTION 9**

Insight on Cryogenics, Properties of Cryogenic fluids, Material properties at Cryogenic Temperatures. Applications of cryogenics in space, Food Processing, super Conductivity, Electrical Power, Biology, Medicine, Electronics and Cutting Tool Industry.

**UNIT II LIQUEFACTION CYCLES 9**

Carnot Liquefaction Cycle, F.O.M. and Yield of Liquefaction Cycles, Inversion Curve – Joule Thomson Effect. Linde Hampson Cycle, Precooled Linde Hampson Cycle, Claudes Cycle Dual Cycle, Helium Refrigerated Hydrogen Liquefaction Systems, Critical Components in Liquefaction Systems.

**UNIT III SEPARATION OF CRYOGENIC GASES 9**

Binary Mixtures, T-C and H-C Diagrams, Principle of Rectification, Rectification Column Analysis – McCabe Thiele Method, Adsorption Systems for purification.

**UNIT VI CRYOGENIC REFRIGERATORS 9**

Joule Thomson Cry coolers, Stirling Cycle Refrigerators, G.M.Cryocoolers, Pulse Tube Refrigerators. Regenerators used in Cryogenic Refrigerators, Magnetic Refrigerators.

**UNIT V STORAGE, INSULATION AND INSTRUMENTATION 9**

Cryogenic Storage vessels, Transportation, and Transfer Lines., Thermal insulation and their performance at cryogenic temperatures, Super Insulations, Vacuum insulation, Powder insulation and Cryo-pumping. Instrumentation to measure Pressure, Flow, Level and Temperature

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Cryogenic Engineering course, the student will be able to

**CO1:** Understand the principles of cryogenics systems and their application.

**CO2:** Understand low temperature processes and techniques related issues.

**CO3:** Evaluate the properties of material at low temperature.

**CO4:** Understand different types of cryogenic insulation techniques.

**CO5:** Explain Liquefaction Cycle and Critical Components in Liquefaction Systems.

**CO6:** Identify various methods of production of cryogenic fluids.

**CO7:** Known the applications of cryogenics in Space, Food processing, Super conductivity, Electrical power, Biology, Medicine, Electronics and Cutting Tool Industry.

**CO8:** Understand the fundamentals of cryogenic cycles and cryogenic refrigerator system.

**CO9:** Understand the fundamentals of Cryogenic Storage system and storage vessels.

**CO10:** Understand the method to transport cryogenic liquids.

**TEXT BOOKS:**


1. Randali F. Barron, Cryogenic Systems, McGraw-Hill, 1985
2. Scott R.B., Cryogenic Engineering, Van Nostrand and Co., 1962.


**REFERENCES:**


1. Klaus D. Timmerhaus and Thomas M. Flynn, Cryogenic Process Engineering, Plenum Press, New York, 1989
2. Guthree A, “High Vacuum Technology” New Age International Publication.
3. White G.K., “Experimental Techniques In two temp Physics “, Oxford University Press, England, 1959.

| 15DBME45 | RENEWABLE ENERGY SOURCES | L | T | P | C |
|---|---|---|---|---|---|
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**COURSE OBJECTIVE:**

- At the end of the course, the students are expected to identify the new methodologies / technologies for effective utilization of renewable energy sources.

**UNIT I SOLAR ENERGY 9**

Solar Radiation – Measurements of solar Radiation and sunshine – Solar Thermal Collectors – Flat Plate and Concentrating Collectors – Solar Applications – fundamentals of photo Voltaic Conversion – solar Cells – PV Systems – PV Applications.

**UNIT II WIND ENERGY 9**

Wind Data and Energy Estimation – wind Energy Conversion Systems – Wind Energy generators and its performance – Wind Energy Storage – Applications – Hybrid systems.

**UNIT III BIO – ENERGY 9**

Biomass, Biogas, Source, Composition, Technology for utilization – Biomass direct combustion – Biomass gasifier – Biogas plant – Digesters – Ethanol production – Bio diesel production and economics.

**UNIT IV OTEC, TIDAL, GEOTHERMAL AND HYDEL ENERGY 9**

Tidal energy – Wave energy – Data, Technology options – Open and closed OTEC Cycles – Small hydro, turbines – Geothermal energy sources, power plant and environmental issues.

**UNIT V NEW ENERGY SOURCES 9**

Hydrogen, generation, storage, transport and utilisation, Applications: power generation, transport – Fuel cells – technologies, types – economics and the power generation.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Renewable Energy Sources course, the student will be able to

**CO1:** Understand the Concepts of energy conversions.

**CO2:** Understand the chronological evaluation of solar energy system.

**CO3:** Understand the chronological evaluation of Wind energy system.

**CO4:** Understand the function and process involved in the Hydel energy system.

**CO5:** Understand the function and process involved in the Geo thermal energy system.

**CO6:** Explain the working principle of the Ocean thermal power plant.

**CO7:** Understand and explain actual load of the power system.

**CO8:** Understand and analyze the central reserve system.

**CO9:** Explain Cost analysis of energy system.

**CO10:** Analyze the various power fluctuation load system.

**TEXT BOOKS:**

1. Rai G.D., Non Conventional Energy Sources, Khanna Publishers, New Delhi, 1999.
2. Sukhatme S.P., Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.

**REFERENCES:**


1. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 1996.
2. Twidell, J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 1986.
3. Tiwari G.N., Solar Energy – Fundamentals Design, Modeling and applications, Narosa Publishing House, New Delhi, 2002
4. Freris L.L., Wind Energy Conversion systems, Prentice Hall, UK, 1990.

| 15DBME51 | AUTOMOBILE ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
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**COURSE OBJECTIVE:**

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system.

**UNIT I VEHICLE STRUCTURE AND ENGINES 9**

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, resistances to vehicle motion and need for a gearbox, components of engine-their forms, functions and materials

**UNIT II ENGINE AUXILIARY SYSTEMS 9**

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system, Turbo chargers, Engine emission control by three way catalytic converter system.

**UNIT III TRANSMISSION SYSYTEMS 9**

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel –torque converter, propeller shaft, slip joints, universal joints, Differential, and rear axle, Hotchkiss Drive and Torque Tube Drive.

**UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9**

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System and Traction Control

**UNIT V ALTERNATIVE ENERGY SOURCES 9**

Use of Natural Gas, Liquefied Petroleum Gas. Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Automobile Engineering course, the student will be able to

**CO1:** Improve their knowledge in the basic sciences for excelling in various disciplines of Automobile Engineering with the emphasis on Design, Thermal and Manufacturing.

**CO2:** Enhance professional practice to meet the global standards with ethical and social Responsibility.

**CO3:** Understand the engine auxiliary systems and Solve industrial, social, and environmental problems with modern engineering tools.

**CO4:** Understand the vehicle transmission systems.

**CO5:** Identify the different parts of the automobile engine.

**CO6:** Explain the working of various parts like engine, transmission, clutch and brakes.

**CO7:** Understand the operation of steering and the suspension systems.

**CO8:** Understand the environmental implications of automobile emissions.

**CO9:** Develop a strong base for understanding future developments in the automobile industry

**CO10:** Understand the combustion and emission characteristics of SI and CI engine alternative fuels.

**TEXT BOOKS:**


1. Kirpal Singh, “Automobile Engineering Vol 1 & 2 “, Standard Publishers, Seventh Edition, 1997, New Delhi
2. Jain,K.K., and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, New Delhi, 2002


**REFERENCES:**


1. Newton ,Steeds and Garet,” Motor Vehicles “, Butterworth Publishers,1989
2. Joseph Heitner, “Automotive Mechanics,”, Second Edition ,East-West Press ,1999
3. Martin W. Stockel and Martin T Stockle , “ Automotive Mechanics Fundamentals,” The Goodheart –Will Cox Company Inc, USA ,1978
4. Heinz Heisler , ‘Advanced Engine Technology,” SAE International Publications USA,1998
5. Ganesan V.” Internal Combustion Engines” , Third Edition, Tata Mcgraw-Hill, 2007.

| 15DBME52 | APPLIED HYDRAULICS AND PNEUMATICS | L | T | P | C |
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**COURSE OBJECTIVE:**

- To expose the learner to the fundamentals of hydraulic and pneumatic power control and their circuits with industrial applications

**UNIT I FLUID POWER SYSTEMS AND FUNDAMENTALS 12**

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids – Fluid power symbols. Basics of Hydraulics-Applications of Pascals Law- Laminar and Turbulent flow – Reynold's number – Darcy's equation – Losses in pipe, valves and fittings.

**UNIT II HYDRAULIC SYSTEM & COMPONENTS 12**

Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance – Variable displacement pumps. Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like tanden, Rodless, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators – Fluid motors, Gear, Vane and Piston motors.

**UNIT III HYDRAULIC CONTROL AND CIRCUITS 12**

Construction of Control Components : Director control valve – 3/2 way valve – 4/2 way valve – Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram. Accumulators and Intensifiers: Types and sizing of accumulators – intensifier – Applications of Intensifier. circuits for controlling single acting and double acting cylinders, Accumulators circuits – Intensifier circuit.

**UNIT IV PNEUMATIC CONTROL AND CIRCUITS 12**

Pneumatic Components: Properties of air – Compressors – Filter, Regulator, Lubricator Unit – Air control valves, Quick exhaust valves, pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Pneumo hydraulic circuit, Sequential circuit design for simple applications using cascade method.

**UNIT V SERVO SYSTEMS, FLUIDICS AND FLUID POWER TROUBLE SHOOTING 12**

Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves, Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting

**TOTAL: 60 Hours**

**COURSE OUTCOMES:**

After successful completion of the Applied Hydraulics and Pneumatics course, the student will be able to

**CO1:** Understand the hazards of hydraulic and pneumatic circuits and fluid power system and fundamentals.

**CO2:** Understand the concepts of fluid statics and dynamics applied to commercial and industrial applications.

**CO3:** Understand the hydraulic system and components.

**CO4:** Understand and troubleshoot basic fluid power, electro-hydraulic, and electro-pneumatic circuits using schematic diagrams.

**CO5:** Understand the operations, applications, and maintenance of common fluid power components such as pumps, compressors, valves, cylinders, motors, rotary actuators, accumulators, pipe, hose, and fittings.

**CO6:** Understand the various types of control valves and circuits.

**CO7:** Understand the specific energy and critical depth in an open channel and to determine the uniform flow depth and velocity in an open channel.

**CO8:** State the various types of flow profile and design various types of pumps.

**CO9:** Understand the meaning of fluid power and to list the various applications of fluid power and to differentiate between fluid power and transport systems.

**CO10:** Understand the servo system and fluid power trouble shooting.

**CO11:** Understand the pneumatic control and PLC applications.

**TEXT BOOKS**


1. Anthony Esposito, “Fluid Power with Applications”, Pearson Education 2000.
2. Majumdar S.R., “Oil Hydraulics”, Tata McGraw-Hill, 2000.


**REFERENCES**


1. Majumdar S.R., “Pneumatic systems – Principles and maintenance”, Tata McGraw Hill, 1995.
2. Anthony Lal, “Oil hydraulics in the service of industry”, Allied publishers, 1982.
3. Harry L. Stevart D.B, “Practical guide to fluid power”, Taraoeala sons and Port Ltd. Broadey, 1976.
4. Michael J, Prinches and Ashby J. G, “Power Hydraulics”, Prentice Hall, 1989.
5. Dudelyt, A. Pease and John T. Pippenger, “Basic Fluid Power”, Prentice Hall, 1987.

| 15DBME53 | DESIGN OF PRESSURE VESSELS AND PIPING | L | T | P | C |
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**COURSE OBJECTIVE:**

- To understand the different types of stresses and their effects in pressure vessel.
- To understand the piping layout and the stresses acting on it.

**UNIT I CYLINDRICAL SHELL AND VARIOUS CLOSURES 9**

Membrane theory for thin shells, stresses in cylindrical, spherical and conical shells, dilation of above shells, general theory of membrane stresses in vessel under internal pressure and its application to ellipsoidal and torispherical end closures. Bending of circular plates and determination of stresses in simply supported and clamped circular plate. Introduction to ASME code and formulae.

**UNIT II JUNCTION STRESSES, OPENING AND REINFORCEMENTS 9**

Discontinuity stresses. Stress concentration in plate having circular hole due to bi-axial loading. Theory of reinforced opening and reinforcement limits.

**UNIT III SUPPORT DESIGN 9**

Supports for vertical & horizontal vessels. Design of base plate and support lugs. Types of anchor bolt, its material and allowable stresses. Design of saddle supports.

**UNIT IV BUCKLING IN VESSELSB 9**

Buckling of vessels under external pressure. Elastic buckling of long cylinders, buckling modes, Collapse under external pressure. Design for stiffening rings. Buckling under combined external pressure and axial loading.

**UNIT V PIPING STRESS ANALYSIS 9**

Flow diagram, Piping layout and piping stress analysis. Flexibility factor and stress intensification factor. Design of piping system as per B31.1 piping code. Piping components – bends, tees, bellows and valves. Types of piping supports and their behavior.

**TOTAL : 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Design of Pressure Vessels and Piping course, the student will be able to

**CO1:** Do heat transfer analysis using LMTD or NTU method.

**CO2:** Identify the nature of problems with the available data.

**CO3:** Understand the ASME code and formulae for thermal design of heat exchangers.

**CO4:** Understand and Analyze thin plates and shells of various types of stresses, opening and reinforcement.

**CO5:** Design shells, end closures and nozzles of pressure vessels using ASME codes.

**CO6:** Understand the support for vertical and horizontal vessels.

**CO7:** DO case studies for the analysis of circular plates with hole.

**CO8:** Understand basic design procedure for low pressure vessel, using ASME code.

**CO9:** Understand Basic design procedure for high pressure vessel, using ASME code.

**CO10:** Understand design of nozzles, Design of supports for vessels and buckling of vessels under external Pressure.

**CO11:** Understand Piping stress analysis, buckling analysis of vessels, design of pipes for various applications.

**CO12:** Design a pressure vessel from the industrial data and compare your design with existing Design.

**TEXT BOOKS:**

1. Harvey J F , 'Pressure vessel design' CBS publication

2. Brownell. L. E & Young. E. D , 'Process equipment design', Wiley Eastern Ltd., India

**REFERENCES:**

**1.** ASME Pressure Vessel and Boiler code, Section VIII Div 1 & 2, 2003

**2.** American standard code for pressure piping , B 31.1

**3.** Henry H Bednar, Pressure vessel Design Hand book, CBS publishers and distributors Stanley M Wales, Chemical Process equipment, selection and design, Butter worths, series in Chemical Engineering,1988

**4.** William.j.,Bees,"Approximate methods in the Design and Analysis of pressurevessels and piping", ASME Pressure vessels and piping conference,1997.

| 15DBME54 | VIBRATIONS AND NOISE ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To familiarize the students with the sources of vibration and noise in machines and make design modifications to reduce the vibration and noise and improve the life of the components.

**UNIT I INTRODUCTION 9**

Relevance of and need for vibrational analysis, Mathematical modeling of vibrating systems-discrete and continuous systems-single-degree of freedom systems, free and forced vibrations, various damping models.

**UNIT II TWO DEGREES OF FREEDOM SYSTEMS 9**

Generalized co-ordinates, principal co-ordinates, derivation of equations of motion, co-ordinate coupling, and Lagrange's equation.

**UNIT III MULTI DEGREES OF FREEDOM SYSTEMS 9**

Derivation of equations of motion, influence coefficients, orthogonality principle, calculation of natural frequencies by Raleigh, Stodala, Dunkerley, Holzer and matrix iteration methods, branched system, geared system.

**UNIT IV VIBRATION MEASUREMENT AND CONTROL 9**

Measurement of vibration, FFT analyzer, Methods of vibration control - excitation reduction at source, balancing of rigid, flexible and variable mass rotors. Dynamic properties and selection of structural materials-viscoelastic polymers, vibration absorbers- tuned absorber, tuned and damped absorber (qualitative treatment only), unturned viscous damper, vibration isolation.

**UNIT V TRANSIENT VIBRATION AND NOISE 9**

Impulse and arbitrary excitation, base excitation, Laplace transform formulation, response spectrum, Properties of sound – sound level meter, Sound isolation- machine enclosures, silencers and mufflers.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Vibration and Noise Engineering course, the student will be able to

**CO1:** Identify the sources of vibration and noise in machines.

**CO2:** Make the design modifications to reduce the vibration and noise from the components to improve the life.

**CO3:** Identify the vibration analysis in machinery to safeguard the mechanism.

**CO4:** Create Mathematical modeling of single degree of freedom system.

**CO5:** Understand the difference between free and forced vibrations.

**CO6:** Understand the approach for analyzing two degrees of freedom system.

**CO7:** Understand the approach for analyzing multi degrees of freedom system.

**CO8:** Work on Vibration measurement instruments.

**CO9:** Identify different types of Vibration absorbers and its effect on vibration analysis.

**CO10:** Explain Transient vibration and its effects.

**TEXT BOOKS:**


1. Thomson W T, "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990.
2. Ashok Kumar Mallik, “Principles of Vibration Control”, Affiliated East-West Press Pvt. Ltd., New Delhi Press, 1990.


**REFERENCES:**


1. Ambekar A.G., “Mechanical Vibrations and Noise Engineering”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2006.
2. Lewis H Bell, “Industrial Noise Control Fundamentals and Applications”, Marcel Dekker, New York, 1982.
3. Rao S S, "Mechanical Vibrations", Addison Wesley, USA, 1995.
4. Tse Morse and Hinkle, “Mechanical Vibration”, Prentice Hall, New Delhi, 1987.
5. Grover G K, "Mechanical Vibrations ", New Chand and Brothers, Roorkey, 1989.
6. Seto, “Mechanical Vibrations ", Schaum Outline Series, McGraw Hill Inc., New York, 1990.

| 15DBME55 | GAS DYNAMICS AND JET PROPULSION | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To understand the basic difference between incompressible and compressible flow.
- To understand the phenomenon of shock waves and its effect on flow.
- To gain some basic knowledge about jet propulsion and Rocket Propulsion.
  (Use of Standard Gas Tables permitted)

**UNIT I COMPRESSIBLE FLOW – FUNDAMENTALS 9**

Energy and momentum equations for compressible fluid flows, various regions of flows, reference velocities, stagnation state, velocity of sound, critical states, Mach number, critical Mach number, types of waves, Mach cone, Mach angle, effect of Mach number on compressibility

**UNIT II FLOW THROUGH VARIABLE AREA DUCTS 9**

Isentropic flow through variable area ducts, Nozzle flow - T-s and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, chocked mass flow rate of the nozzle - effect of friction in flow through nozzles.

**UNIT III FLOW THROUGH CONSTANT AREA DUCTS 9**

Flow in constant area ducts with friction – Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length. Isothermal flow with friction in constant area ducts. Flow in constant area ducts with heat transfer, Rayleigh line and Rayleigh flow equation, variation of flow properties, maximum heat transfer.

**UNIT IV NORMAL SHOCK 9**

Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across the normal shock, Prandtl - Meyer equation, impossibility of shock in subsonic flows, flow in convergent and divergent nozzle with shock, normal shock in Fanno and Rayleigh flows, flow with oblique shock.

**UNIT V PROPULSION 9**

Aircraft propulsion – types of jet engines – energy flow through jet engines, study of turbojet engine components – diffuser, compressor, combustion chamber, turbine and exhaust systems, performance of turbo jet engines – thrust, thrust power, propulsive and overall efficiencies, thrust augmentation in turbo jet engine, ram jet and pulse jet engines. Rocket propulsion – rocket engines thrust equation – effective jet velocity specific impulse – rocket engine performance, solid and liquid propellants, comparison of different propulsion systems.

**TOTAL: 45 Hours**

**Note:***(Use of approved gas tables is permitted in the University examination)*

**COURSE OUTCOMES:**

After successful completion of the Gas Dynamics and Jet Propulsion course, the student will be able to

**CO1:** Understand the basic difference between incompressible and compressible flow.

**CO2:** Understand the phenomenon of shockwaves and effect on flow.

**CO3:** Study the basic concepts and isentropic flows.

**CO4:** Study the flow through constant area and variable area duct.

**CO5:** Identify the effect of friction in flow through nozzles.

**CO6:** Study the flow in convergent and divergent nozzles with shock

**CO7:** Understand the Thrust power and propulsive efficiency of jet propulsion.

**CO8:** Study about the different aircraft and jet propulsion system.

**CO9:** Understand the concept of rocket propulsion system.

**TEXT BOOKS:**


1. Yahya. S.M., “Fundamental of compressible flow”, New Age International (p) Ltd., New Delhi, 1996.
2. Patrich.H. Oosthvizen, William E.Carscallen, “Compressible fluid flow”, McGraw-Hill, 1997.


**REFERENCES:**


1. Cohen. H., Rogers R.E.C and Sravanamutoo, “Gas turbine theory”, Addison Wesley Ltd., 1987.
2. Ganesan. V., “Gas Turbines”, Tata McGraw-Hill, New Delhi, 1999.
3. Rathakrishnan.E, “Gas Dynamics”, Prentice Hall of India, New Delhi, 2001.

**15DBME61 INDUSTRIAL AUTOMATION,CNC AND ROBOTICS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

**UNIT I AUTOMATION 12**

Basic principles of automation; Hard Automation, Flexible Automation extending the capabilities of conventional machines through improved devices and manipulators; Transfer Machines for Assembly, Multi spindle Automatics

**UNIT II CNC 12**

Basic principles of numerical control; Methods of coding and programming; CNC, DNC and Machining Centres; Manual Programming, Computer Aided (APT) programming; Adaptive control; Economics of numerical control.

**UNIT III FUNDAMENTALS OF ROBOT 12**

Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Functions – Need for Robots – Different Applications.

**UNIT IV ROBOT DRIVE SYSTEMS AND END EFFECTORS 12**

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of Drives End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

**UNIT V SENSORS AND MACHINE VISION 12**

Requirements of a sensor, Principles and Applications of the following types of sensors – Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters), Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors, (Binary Sensors, Analog Sensors), Wrist Sensors, Compliance Sensors, Slip Sensors. Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis – Data Reduction: Edge detection, Feature Extraction and Object Recognition.

**TOTAL: 60 Hours**

**COURSE OUTCOMES:**

After successful completion of the Automation, CNC and Robotics course, the student will be able to

**CO1:** Understand the automation and brief history of robots and its applications.

**CO2:** Understand the functions of the basic components of a Robot.

**CO3:** Understand the familiarities with the kinematics of Robots.

**CO4:** Understand the knowledge about robot end effectors.

**CO5:** Understand the knowledge about CNC and DNC system.

**CO6:** Understand the Robot Programming methods & Languages of robots.

**CO7:** Understand the usages of Servo Motors and Stepper Motor applications in robots.

**CO8:** Understand automation and brief history of robot and applications.

**CO9:** Understand the Robot safety issues and economics.

**CO10:** Understand robot drive systems, end effectors, sensors and machine vision.

**TEXT BOOK:**

1. M.P.Groover, “Industrial Robotics – Technology, Programming and Applications”, McGraw-Hill, 2001.

**REFERENCES:**

1. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw-Hill Book Co., 1987.
2. YoramKoren, “Robotics for Engineers”, McGraw-Hill Book Co., 1992.
3. Janakiraman.P.A., “Robotics and Image Processing”, Tata McGraw-Hill, 1995.

| 15DBME62 | UNCONVENTIONAL MACHINING PROCESSES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications.

**UNIT I INTRODUCTION 9**

Need for non-traditional machining methods-Classification of modern machining processes – Considerations in process selection, Materials, Applications. Ultrasonic machining – Elements of the process, mechanics of metal removal process parameters, economic considerations, Applications and limitations, recent development.

**UNIT II MECHANICAL PROCESSES 9**

Abrasive jet machining, Water jet machining and abrasive water jet machining Basic principles, equipments, process variables, mechanics of metal removal, MRR, application and limitations. Ultrasonic Machining, AJM, WJM and USM, Working Principles – equipment used – Process parameters – MRR-Variation in techniques used – Applications.

**UNIT III ELECTRO – CHEMICAL PROCESSES 9**

Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, Tool design, Surface finish and accuracy economic aspects of ECM – Simple problems for estimation of metal removal rate. Fundamentals of chemical machining, advantages and applications.

**UNIT IV THERMAL METAL REMOVAL PROCESSES – I 9**

General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.

**UNIT V THERMAL METAL REMOVAL PROCESSES - II 9**

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes –General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut. Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries. Chemical machining-principle maskants –etchants- applications. Magnetic abrasive finishing, Abrasive flow finishing.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Unconventional Machining Processes course, the student will be able to

**CO1:** Understand various unconventional machining processes.

**CO2:** Identify various process parameters and their influence on performance and their applications.

**CO3:** Understand the Mechanical Energy based processes.

**CO4:** Understand the mechanism for metal removal process.

**CO5:** Get knowledge on electrical energy based processes.

**CO6:** Work Abrasive and water jet machines.

**CO7:** Get knowledge on the ultrasonic machining process.

**CO8:** Get exposure on electrochemical machine and its process.

**CO9:** Understand fundamental principle of chemical machining process.

**CO10:** Understand basic principles of thermal metal removal process.

**CO11:** Differentiate thermal and non-thermal process for machining operations.

**TEXT BOOKS:**

1. Vijay.K. Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd., New Delhi, 2002.
2. Benedict. G.F., “Nontraditional Manufacturing Processes” Marcel Dekker Inc., New York, 1987.

**REFERENCES:**

1. Pandey P.C. and Shan H.S. “Modern Machining Processes”, Tata McGraw-Hill, New Delhi. 1980.
2. McGeough, “Advanced Methods of Machining”, Chapman and Hall, London, 1998.

| 15DBME63 | DESIGN OF JIGS, FIXTURES AND PRESS TOOLS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To understand the functions and design principles of Jigs, fixtures and press tools
- To gain proficiency in the development of required views of the final design.

**UNIT I LOCATING AND CLAMPING PRINCIPLES 8**

COURSE OBJECTIVE of tool design- Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping –Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.

**UNIT II JIGS AND FIXTURES 10**

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

**UNIT III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 10**

Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Dieset, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

**UNIT IV BENDING AND DRAWING DIES 10**

Difference between bending and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads ironing– Design and development of bending, forming, drawing, reverse redrawing and combinationdies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double actiondies.

**UNIT V OTHER FORMING TECHNIQUES 7**

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction - tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies – Poka Yoke.

**TOTAL: 45 Hours**

**Note:** (Use of P S G Design Data Book is permitted in the University examination)

**COURSE OUTCOMES:**

After successful completion of the Design of Jigs, Fixtures and Press Tools course, the student will be able to

**CO1:** Understand the principles of designing jigs, fixtures and press tools.

**CO2:** Understand the parts in various designs.

**CO3:** Adopt a standard procedure for the design of Jigs.

**CO4:** Understand the fixtures and press tools.

**CO5:** Understand the press working terminologies and elements of cutting dies.

**CO6:** Identify and use standard parts.

**CO7:** Understand the difference between bending and drawing dies.

**CO8:** Understand the fundamental concept of different kinds of fixture and pressing tools and its utilization in industries.

**CO9:** Identify the appropriate materials for designing jigs and fixtures.

**CO10:** Understand the metal flow in drawing operations.

**TEXT BOOKS:**

1. Joshi, P.H. “Jigs and Fixtures”, Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2004.
2. Joshi P.H “Press tools - Design and Construction”, wheels publishing, 1996.

**REFERENCES:**

1. Venkataraman. K., “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, New Delhi,2005.
2. Donaldson, Lecain and Goold “Tool Design”, 3rd Edition, Tata McGraw Hill, 2000.
3. Kempster, “Jigs and Fixture Design”, Third Edition, Hoddes and Stoughton, 1974.
4. Hoffman “Jigs and Fixture Design”, Thomson Delmar Learning, Singapore, 2004.
5. ASTME Fundamentals of Tool Design Prentice Hall of India.
6. Design Data Hand Book, PSG College of Technology, Coimbatore.

**15DBME64 MANUFACTURE OF AUTOMOTIVE COMPONENT**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To understand the various forms of manufacturing processes used in the automobile components.
- To familiarize the students with the forging, extrusion, casting, machining process and recent trends in manufacturing of auto components.

**UNIT I MANUFACTURE OF ENGINE & ENGINE COMPONENTS 9**

Introduction - Casting of engine block - drilling of cylinder holes - water cooling passages - Preparation of casting for cylinder heads - design of cores. Forging of crankshafts and connecting rod, casting piston and drilling of oil holes - Upset forging of valves. Heat treatment of crankshafts and connecting rod. Drilling of oil holes and grinding of crank shafts. Forging and heat treatment of camshafts.

**UNIT II MANUFACTURE OF CLUTCH, GEAR BOX AND PROPELLER SHAFT 9**

Manufacturing friction plates - manufacture of composite friction lining - Composite moulding of phenol formaldehyde lining, Casting of gear box casing - Introduction to gear milling - hobbling - manufacturing and inspection of gears, Casting of propeller shaft, Extrusion of propeller shaft - extrusion dies - heat treatment and surface hardening of propeller shaft.

**UNIT III MANUFACTURE OF AXLES & SPRINGS AND BODY PANELS 9**

Forging of axles, Casting of front and rear axles - Provision of KPI. Wrap forming of coil springs. Introduction to the thermoforming and hydro-forming ,Press-forming, Welding of body panels - resistance welding and other welding processes.

**UNIT IV MANUFACTURE OF AUTOMOTIVE PLASTIC COMPONENTS 9**

Introduction - Principle of injection moulding- injection moulding of instrument panel- moulding of bumpers - tooling and tooling requirements - hand lay-up process for making composite panels - Filament winding of automotive spring and propeller shaft. Manufacture of metal/Polymer/Metal panels.

**UNIT V MANUFACTURE OF ENGINE COMPONENTS USING CERAMIC MATRIX COMPOSITES 9**

Introduction, Ceramic matrix piston rings, Chemical vapour deposition, Cryogenic grinding of powders, Sol-gel processing. Machining concepts using NC, generation of numerical control codes using Pro-E and IDEAS package, interfacing the CNC machine and manufacturing package. Introduction to rapid prototyping - rapid prototyping of using resins.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Manufacture of Automotive Components course, the student will be able to

**CO1:** Understand the various forms of manufacturing processes used in the automobile components.

**CO2:** Explain forging, extrusion, casting and other machining process used for manufacturing the auto components.

**CO3:** Understand manufacturing methods for engine and engine components

**CO4:** Identify various manufacturing methods and materials used for the clutch.

**CO5:** Identify various manufacturing methods and materials used for the gear box.

**CO6:** Identify various manufacturing methods and materials used for propeller shafts.

**CO7:** Explain the material and manufacturing process of the axels.

**CO8:** Understand material and manufacturing process of springs.

**CO9:** Understand material and manufacturing process of body panels.

**CO10:** Understand material and manufacturing process of automotive plastic components.

**TEXT BOOKS:**


1. SeropeKalpakjian, “Manufacturing Engineering and Technology”, Prentice Hall, Singapore, 5th Edition, 2006.
2. Haslehurst.S.E., “Manufacturing Technology ", ELBS, London, 1990.


**REFERENCES:**


1. Waters T F and Waters F “Fundamentals of Manufacturing for Engineers”, Taylor & Francis, First Edition, 1996.
2. Heldt.P.M., " High Speed Combustion Engines ", Oxford Publishing Co., New York, 1990.

| 15DBME65 | DESIGN OF HEAT EXCHANGERS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To learn the thermal and stress analysis on various parts of the heat exchangers
- To analyze the sizing and rating of the heat exchangers for various applications

**UNIT I DIFFERENT CLASSIFICATION OF HEAT EXCHANGERS 9**

Parallel flow, counter flow and cross flow; shell and tube and plate type; single pass and multi-pass; once through steam generators etc.

**UNIT II PROCESS DESIGN OF HEAT EXCHANGERS 9**

Heat transfer correlations, Overall heat transfer coefficient, LMTD, sizing of finned tube heat exchangers, U tube heat exchangers, fouling factors, pressure drop calculations.

**UNIT III MECHANICAL DESIGN OF SHELL AND TUBE TYPE 9**

Thickness calculation, Tubesheet design using TEMA formula, concept of equivalent plate for analysing perforated analysis, flow induced vibration risks including acousticissues and remedies, tube to tube sheet joint design, buckling of tubes, thermal stresses.

**UNIT IV COMPACT AND PLATE HEAT EXCHANGER 9**

Types – Merits and Demerits – Design of compact heat exchangers, plate heatexchangers, performance influencing parameters, limitations.

**UNIT V CONDENSORS AND COOLING TOWERS 9**

Design of surface and evaporative condensers – cooling tower –performance Characteristics

**TOTAL: 45 hours**

**COURSE OUTCOMES:**

After successful completion of the design of heat exchangers course, the student will be able to

**CO1:** Understand the basic principles of heat exchangers systems and their application.

**CO2:** Explain the different classification of heat exchangers.

**CO3:** Differentiate the Parallel flow, counter flow and cross flow for heat exchangers.

**CO4:** Understand the thermal and stress analysis on various parts of the heat exchangers.

**CO5:** Calculate the Heat transfer correlations, Overall heat transfer coefficient, LMTD, *etc.*

**CO6:** Use the TEMA formula to design Tube sheet of heat exchangers.

**CO7:** Understand and analyze the sizing, rating of the heat exchangers for various applications.

**CO8:** Calculate the performance characteristics of heat exchangers.

**CO9:** Design the compact heat exchangers.

**CO10:** Design of surface and evaporative condensers

**TEXT BOOKS:**

1. TaborekT., Hewitt G.F and AfganN., Heat Exchangers, Theory and Practice, McGraw-Hill Book Co.1980.
2. Walker, Industrial Heat Exchangers- A Basic Guide, McGraw Hill Book Co. 1980.

**REFERENCES:**


1. Nicholas Cheremistoff, Cooling Tower, Ann Arbor Science Pub, 1981.
2. Arthur, FrassP., Heat Exchanger Design, John Wiley and Sons, 1988.
3. GuptaJ.P., Fundamentals of heat exchangers and pressure vessel technology, Hemisphere Publishing Corporation, Springer-Verlag, 1986.
4. Donald Q. Kern and Alban D. Kraus, “Extended surface hear transfer”, McGrawHillBook Co., 1972
5. SandersE.A.D., Heat Exchangers, Selection Design and Construction, Layman Scientific & Technical co, John Wiley & sons, 1988.

| 15DBME71 | RAPID PROTOTYPING, TOOLING AND MANUFACTURE | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To develop the ability to understand the advanced manufacturing techniques of rapid prototyping, tooling and manufacture.

**UNIT I INTRODUCTION 9**

History – Development of RP systems – Applications in Product Development, Reverse Engineering, Rapid Tooling, Rapid Manufacturing- Principle –Fundamental – File format –Other translators – medical applications of RP – On demand manufacturing – Direct material deposition - Shape Deposition Manufacturing.

**UNIT II LIQUID BASED AND SOLID BASED RAPID PROTOTYPINGSYSTEMS 9**

Classification – Liquid based system – Stereo-lithography Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses. Solid based system -Fused Deposition Modeling, principle, process, products, advantages, applications and uses -Laminated Object Manufacturing.

**UNIT III POWDER BASED RAPID PROTOTYPING SYSTEMS 9**

Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations, applications and uses. Three Dimensional Printing – process, major applications, research and development. Direct shell production casting – key strengths, process, applications and uses, case studies, research and development. Laser Sintering System, manufacturing using Laser sintering, customized plastic parts, customized metal parts, e-manufacturing - Laser Engineered Net Shaping(LENS).

**UNIT IV MATERIALS FOR RAPID PROTOTYPING SYSTEMS 9**

Nature of material – type of material – polymers, metals, ceramics and composites liquid based materials, photo polymer development – solid based materials, powder based materials – case study.

**UNIT V REVERSE ENGINEERING AND NEW TECHNOLOGIES 9**

Introduction, measuring device- contact type and non-contact type, CAD model creation from point clouds-preprocessing, point clouds to surface model creation, medical data processing -types of medical imaging, software for making medical models, medical materials, other applications - Case study.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Rapid Prototyping, Tooling and Manufacture course, the student will be able to

**CO1:** Understand advanced manufacturing technologies

**CO2:** Get the knowledge on development of rapid prototyping system

**CO3:** Apply rapid prototyping methods for medical applications

**CO4:** Known Liquid based rapid prototyping system

**CO5:** Known Solid based rapid prototyping system

**CO6:** Known Powder based rapid prototyping system

**CO7:** Understand the basic principles of 3D Printing.

**CO8:** Identify different types of Engineering materials and its uses in Rapid prototyping systems.

**CO9:** Understand the concepts of reverse engineering

**CO10:** Understand medical models and medical image processing for rapid prototyping

**TEXT BOOKS:**


1. Rafiq I. Noorani, Rapid Prototyping – Principles and Applications, Wiley & Sons,2006.
2. Chua C.K, Leong K.F and Lim C.S, Rapid Prototyping: Principles and Applications, second edition, World Scientific, 2003.


**REFERENCE BOOKS:**


1. HopkinsonN., Hauge R.J.M,,DickensP.M, “Rapid Manufacturing – An Industrial revolution for the digitalage”, Wiley, 2006.
2. Ian Gibson, “Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototyping”, Wiley, 2006.
3. Paul F.Jacobs, Rapid Prototyping and Manufacturing, “Fundamentals of Stereolithography”, McGrawHill, 1993.
4. Pham. D.T and Dimov S.S., “Rapid Manufacturing”, Springer Verlog, 2001.

| 15DBME72 | PROCESS PLANNING AND COST ESTIMATION | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To introduce the process planning concepts to make cost estimation for various products after process planning

**UNIT I WORK STUDY AND ERGONOMICS 9**

Method study – Definition – COURSE OBJECTIVE – Motion economy – Principles – Tools and techniques – Applications – Work measurements – Purpose – Uses – Procedure – Tools and techniques – Standard time – Ergonomics – Principles – Applications.

**UNIT II PROCESS PLANNING 9**

Definition – Objective – Scope – Approaches to process planning – Process planning activities – Finished part requirements – Operating sequences – Machine selection – Material selection parameters – Se t of documents for process planning – Developing manufacturing logic and knowledge – Production time calculation – Selection of cost optimal processes.

**UNIT III INTRODUCTION TO COST ESTIMATION 9**

Objective of cost estimation – Costing – Cost accounting – Classification of cost – Elements of cost – Simple problems.

**UNIT IV COST ESTIMATION 9**

Types of estimates – Methods of estimates – Data requirements and sources – Collection of cost – Allowances in estimation.

**UNIT V PRODUCTION COST ESTIMATION 9**

Estimation of material cost, labour cost and over heads – Allocation of overheads – Estimation for different types of jobs manufactured by casting – Forging – Welding and machining.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Process Planning and Cost Estimation course, the student will be able to

**CO1:** Understand the process planning concepts to make a cost estimation for various products after process planning.

**CO2:** Understand the Drawing interpretation and material evaluation.

**CO3:** Approach various process planning activities.

**CO4:** Prepare the set of documents for process planning.

**CO5:** Select the appropriate materials.

**CO6:** Know the objectives of cost estimation.

**CO7:** Classify the cost their impact.

**CO8:** Know the various types and methods of estimation.

**CO9:** Identify the data requirements and sources.

**CO10:** Understand Production cost estimation.

**CO11:** Estimate the different types of jobs manufactured by casting, Forging, Welding and machining.

**TEXT BOOKS:**


1. Sinha, B.P., “Mechanical Estimating and Costing”, Tata McGraw-Hill, Publishing Co., 1995.
2. Ostwalal, P.F. and JairoMunez, “Manufacturing Processes and Systems”, 9th Edition, JohnWiley,1998.


**REFERENCES:**


1. Russell, R.S. and Tailor, B.W., “Operations Management”, 4th Edition, PHI, 2003.
2. Chitale, A.V. and Gupta, R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002.

| 15DBME73 | MICRO ELECTRO MECHANICAL SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To study about MEMS and parts of MEMS
- To study the design methodology of MEMS for various mechanics.
- To study about actuators in MEMS.
- To study about MEMS based circuits.
- To study about optical and RF based MEMS.

**UNIT I INTRODUCTION TO MEMS 9**

MEM Sand Micro systems, Miniaturization, Typical products, Micro Sensors, Micro actuation, MEMS with micro actuators, Micro accelerometers and Micro fluidics, MEMS materials, Micro Fabrication

**UNIT II MECHANICS FOR MEMS DESIGN 9**

Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configurations, tensional deflection, Mechanical vibration, Resonance, Thermo mechanics –actuators, force and response time, Fracture and thin film mechanics, material, physical aporde position(PVD), chemical mechanical polishing(CMP)

**UNIT III ELECTROSTATIC DESIGN 9**

Electro statics: basic theory, electrostatic in stability, Surface tension, gap and finger pull up, Electro static actuators, Comb generators, gap closers, rotary motors, inchworms, Electromagnetic actuators, bi-stable actuators.

**UNIT IV CIRCUIT AND SYSTEM ISSUES 9**

Electronic interfaces, Feedback systems, Noise, Circuit and system issues, Case studies – Capacitive accelerometer, Peizo electric pressure sensor, Thermal sensors, radiation sensors, mechanical sensors, bio-chemical sensors Modeling of MEMS systems, CAD for MEMS.

**UNIT V INTRODUCTION TO OPTICAL AND RF-MEMS 9**

Optical MEMS, system design basics – Gaussian optics, matrix operations, Resolution, Case studies, MEMS scanners and retinal scanning, display, Digital Micro mirror devices, RF Memes– design basics, case study–Capacitive RFMEMS switch, Performance issue.

**TOTAL:45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Micro Electro Mechanical Systems course, the student will be able to

**CO1:** Understand the operational theory of common MEMS sensors and MEMS actuators.

**CO2:** Identify situations where MEMS sensors and actuators would be ideal for applications to various products.

**CO3:** Apply the scaling laws to determine that MEMS devices would perform better than existing Non micro scale devices.

**CO4:** Analyze the engineering, science and physics of MEMS devices at the micro scale level including electrostatics, thermodynamics, piezoresistive, piezoelectric, magnetism, micro fluidics and optics.

**CO5:** Understand the fabrication methods used to build/construct MEMS.

**CO6:** Understand and develop new ideas and applications for MEMS devices and electrostatic design.

**CO7:** Understand the basics of micro fabrication developed models and Simulate electrostatic and electromagnetic sensors and actuators.

**CO8:** Understand material properties important for MEMS system performance.

**CO9:** Understand the circuit and system related issues.

**CO10:** Understand the design process and validation for MEMS devices and systems, and learn the state of the art in optical Microsystems.

**TEXTBOOK:**

1. Stephen Santeria,“Micro systems Design“, Kluwer publishers, 2000.

| 15DBME74 | DESIGN AND ANALYSIS OF COMPOSITES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To understand the fundamentals of composite material strength and its mechanical behavior.
- Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.
- Thermo-mechanical behavior and study of residual stresses in Laminates during processing. Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.

**UNIT I COMPOSITE MATERIALS AND THEIR APPLICATIONS 9**

Composite materials, Introduction Fibers Matrix materials Material forms and various stages, Fibers Matrix materials Material fabrication methods Current applications.

**UNIT II CONCEPTS OF SOLID MECHANICS 9**

Tensors Stress and strain Plane stress and plane strain energy density Generalized Hooke's Law Material symmetry Engineering constants 3 Coordinate transformations Thermal effects, Moisture effects Chemical aging, flammability.

**UNIT III CONCEPTS OF MICROMECHANICS 9**

Effective properties Survey and model comparison from strength of materials approximations, continuum mechanics approaches.

**UNIT IV STRESS-STRAIN FOR AN ORTHOTROPIC LAMINA AND AMINATE ANALYSIS 9**

Orthotropic properties in plane stress, Deformation due to extension/shear and bending/torsion A, B, D matrices hydrothermal behavior Special laminates Average stress-strain properties.

**UNIT V CONCEPTS OF FAILURE OF LAMINATES AND SHAFTS 9**

Tensile failure of fiber composites Compressive failure of fiber composites Effect of multi axial stresses (failure criteria by Tsai-Wu, Hashin, etc.) Edge effects, Effective stiffness of beams Effective stiffness of shafts

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Design and Analysis of Composites course, the student will be able to

**CO1:** Understand the fundamentals of composite material strength and its mechanical behavior.

**CO2:** Understand the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.

**CO3:** Understand Thermo-mechanical behavior and study of residual stresses in Laminates during processing.

**CO4:** Implement Classical Laminate Theory (CLT) to study and analysis of residual stresses in an isotropic layered structure such as electronic chips.

**CO5:** Study the concepts of polymer, Graphite, ceramic and metal matrices

**CO6:** Study the concepts of lamina strength analysis and prediction of laminate failure

**CO7:** Make properties survey and model comparison.

**CO8:** Identify the equilibrium equations of motion and energy formulations.

**CO9:** Study the tensile failure of fiber composites.

**CO10:** Study the bending and pickling analysis of laminated flat plates.

**TEXT BOOKS:**


1. Carl T. Herakovich, Mechanics of Fibrous Composites, 1997,
2. Stephen R. Swanson, Introduction to Design and Analysis with Advanced Composite Materials, Prentice-Hall, 1997.


**REFERENCES:**


1. HyerM. W., Stress Analysis of Fiber-Reinforced Composite Materials, McGraw-Hill, 1997
2. GibsonR. F., Principles of Composite Material Mechanics, 2nd edition, CRC Press.

| 15DBME75 | ADDITIVE MANUFACTURING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies.
- To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.

**UNIT I INTRODUCTION 9**

Overview – History - Need-Classification -Additive Manufacturing Technology in product development-Materials for Additive Manufacturing Technology – Tooling - Applications.

**UNIT II CAD & REVERSE ENGINEERING 9**

Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS.

**UNIT III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS 9**

Classification – Liquid based system – Stereolithography Apparatus (SLA)- Principle, process, advantages and applications - Solid based system –Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing.

**UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS 9**

Selective Laser Sintering – Principles of SLS process - Process, advantages and applications, Three Dimensional Printing - Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting.

**UNIT V MEDICAL AND BIO-ADDITIVE MANUFACTURING 9**

Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies.

**TOTAL : 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Additive Manufacturing course, the student will be able to

**CO1:** Understand why the Advanced/Additive manufacturing (AM) has become one of the most important technology trends in decades of product development and innovation.

**CO2:** Understand the comprehensive knowledge of the broad range of AM processes, devices, Capabilities and materials available.

**CO3:** Understand the various software tools and reverse engineering techniques.

**CO4:** Know how to create liquid based and solid based additive manufacturing system and additive manufacturing devices and processes.

**CO5:** Understand the powder based additive manufacturing system.

**CO6:** Get an opportunity to design and fabricate an actual multi-component object using Advanced/additive manufacturing devices and processes.

**CO7:** Understand the latest trends and business opportunities in the AM, distributed manufacturing and mass customization.

**CO8:** Understand the laser engineering net shaping (LENS) and Electron beam melting.

**CO9:** Understand the customized bio additive manufacturing.

**CO10:** Understand the medical and bio-additive manufacturing.

**TEXT BOOKS:**

1. Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third Edition, World Scientific Publishers, 2010.
2. Gebhardt A., “Rapid prototyping”, Hanser Gardener Publications, 2003.

**REFERENCES:**

1. Liou L.W. and Liou F.W., “Rapid Prototyping and Engineering applications : A tool box for prototype development”, CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.
3. Hilton P.D. and Jacobs P.F., “Rapid Tooling: Technologies and Industrial Applications”, CRC press, 2000.

| 15DBME81 | NON DESTRUCTIVE TESTING AND MATERIALS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To stress the importance of NDT in engineering.
- To introduce all types of NNDT and their applications in Engineering.

**UNIT I OVERVIEW OF NDT 9**

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

**UNIT II SURFACE NDE METHODS 9**

Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretatioand evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

**UNIT III THERMOGRAPHY AND EDDY CURRENT TESTING (ET) 9**

Thermography- Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation - infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

**UNIT IV ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE) 9**

Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique –Principle, AE parameters, Applications

**UNIT V RADIOGRAPHY (RT) 9**

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use offilters and screens, geometric factors, Inverse square, law, characteristics of films - graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radio graphic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography.

**TOTAL : 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Non Destructive Testing and Materials course, the student will be able to

**CO1:** Understand the NDT versus mechanical testing.

**CO2:** Understand the characteristics of materials and their application in NDT.

**CO3:** Understand the various surface testing methods and NDT visual inspection.

**CO4:** Speculate how sonar works for locating the submerged submarines based on the knowledge gained in NDT.

**CO5:** Understand thermography and eddy current testing (contact and non contact inspection Method)

**CO6:** Understand the ultrasonic testing and acoustic emission

**CO7:** Understand various magnetizing methods used practically in any steel part in the testing sample.

**CO8:** Know the Particle method on the basis of classifying them into residual and continuous methods.

**CO9:** Understand the principle of radiography and film techniques.

**CO10:** Understand the ultrasonic method rather than sonic method.

**CO11:** Understand what ate the advantages and disadvantages of ultrasonic inspection as compared to other Methods for nondestructive inspection of metal parts, and to draw a block diagram of an analog A-scan pulse-echo ultrasonic inspection setup.

**TEXT BOOKS:**


**1.** Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.

**2.** Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010


**REFERENCES:**


1. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005
3. Charles, J. Hellier," Handbook of Nondestructive evaluation", McGraw Hill, New York 2001.
4. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Hand book,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol.7, Ultrasonic Test.

| 15DBME82 | ADVANCED I.C. ENGINES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To understand the underlying principles of operation of different IC Engines and components.
- To provide knowledge on pollutant formation, control, alternate fuel etc.

**UNIT I SPARK IGNITION ENGINES 9**

Mixture requirements – Fuel injection systems – Mono point, Multipoint & Direct injection - Stages of combustion – Normal and Abnormal combustion – Knock - Factors affecting knock – Combustion chambers.

**UNIT II COMPRESSION IGNITION ENGINES 9**

Diesel Fuel Injection Systems - Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behavior – Spray structure and spray penetration – Air motion - Introduction to Turbocharging.

**UNIT III POLLUTANT FORMATION AND CONTROL 9**

Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement – Emission norms and Driving cycles.

**UNIT IV ALTERNATIVE FUELS 9**

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits - Engine Modifications.

**UNIT V RECENT TRENDS 9**

Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems - Hybrid Electric Vehicles – NOx Adsorbers - Onboard Diagnostics.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

**After successful completion of the Advanced I.C Engine course, the student will be able to**

**CO1:** Understand the different internal combustion engine designs.

**CO2:** Recognize and understand the reasons for differences among operating characteristics of different engine types and designs.

**CO3:** Understand the engine design specification, predict performance and fuel economy trends with good accuracy.

**CO4:** Predict the concentration of Primary exhaust pollutants based on an in-depth analysis of the combustion process.

**CO5:** Get the exposure of engineering systems needed to set-up and run engines in controlled Laboratory environments.

**CO6:** Understand the skills to run engine dynamometer experiments and alternative fuels

**CO7:** Compare and contrast experimental results with theoretical trends.

**CO8:** Understand the real world engine design issues and pollutant formation control.

**CO9:** Develop the ability to optimize future engine designs for specific sets of constraints fuel economy, performance and emissions.

**CO10:** Understand the recent trends in hybrid vehicles.

**TEXT BOOKS:**


1. Ramalingam. K.K., "Internal Combustion Engine Fundamentals", Scitech Publications, 2002.
2. Ganesan, "Internal Combustion Engines", II Edition, TMH, 2002.


**REFERENCES:**


1. Mathur. R.B. and R.P. Sharma, "Internal Combustion Engines".,DhanpatRai& Sons 2007.
2. Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company, Inc., 1987.
3. Eric Chowenitz, "Automobile Electronics", SAE Publications, 1995.

**15DBME83 WASTE HEAT RECOVERY AND CO-GENERATION**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To learn the basic thermal analysis on various parts of the heat exchangers and learn the waste heat recovery.
- To analyze the sizing and rating of the heat exchangers for various applications with co-generation.

**UNIT I INTRODUCTION 9**

Source and utilization of waste heat, thermodynamic analysis - Second law and waste heat, Recovery of waste heat engines and other power plants -Heat pump for waste heat recovery.

**UNIT II DESIGN OF WASTE HEAT RECOVERY SYSTEMS 9**

Design of waste heat recovery system - Heat exchanger - Theory and design, Organic fluid systems – Analysis and design.

**UNIT III COGENERATION PRINCIPLES 9**

Cogeneration principles and thermodynamics power cycle analysis, combined for power generation and process heat.

**UNIT IV APPLICATIONS OF COGENERATION 9**

Applications in sugar mills rice mills, textile factories, and other process and engineering industries.

**UNIT V COST ANALYSIS OF COGENERATION SYSTEMS 9**

Financial considerations, operating and maintenance cost, investment costs of waste heat recovery and Cogeneration system, environmental and air quality consideration.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the waste heat recovery and co-generation course, the student will be able to

**CO1:** Understand the concepts of waste heat recovery systems.

**CO2:** Understand basic thermal analysis on various parts of the heat exchangers and learn the waste heat recovery.

**CO3:** Analyze the heat exchangers for various applications.

**CO4:** Discuss the theory and design of organic fluid systems.

**CO5:** Sizing and rating the heat exchangers for various applications with co-generation.

**CO6:** Design of waste heat recovery system.

**CO7:** Know the heat exchangers applications in sugar mills, rice mills, textile factories, and engineering industries.

**CO8:** Understand the investment costs of waste heat recovery and cogeneration system.

**CO9:** Understand the operating and maintenance cost.

**CO10:** Understand the Applications of cogeneration in sugar mills rice mills, textile factories, and other process of engineering industries.

**TEXT BOOKS:**


1. Charles H.Butler, “Cogeneration ", McGraw Hill Book Co., 1984.
2. Goldstick R., et.al, “Principles of Waste Heat Recovery ", The Fairment Press, Inc., Georgia, 1986.


**REFERENCES:**


1. Kiang Y.H., “Waste Utilization Technology ", Maecel Dekker Inc., 1981.
2. David Hu and Gerald Hrd, “Waste recycling for Energy Conservation ", John Wiley and Sons, New York, 1981.
3. Sydney Reiter, " Industrial and Commercial Heat Recovery Systems ", Van Nostrand Reinhold, 1985.
4. Spiewak Scott A, “Cogeneration and Small Power Production Manual ",The Fairment Press,1987.
5. Nelson E, Hay, “Guide to Natural Gas Cogeneration", The Fairment Press Inc., 1980.

| 15DBME84 | FUNDAMENTAL OF NANOSCIENCE | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To understand the different types of stresses and their effects in pressure vessel.
- To understand the piping layout and the stresses acting on it.

**UNIT I INTRODUCTION 9**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering classifications of nanostructured materials- nano particles- quantum dots, nano wires-ultra-thin films ultilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, ptical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

**UNIT II PREPARATION METHODS 9**

Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Selfassembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

**UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES 9**

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wetetching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

**UNIT IV PREPARATION ENVIRONMENTS 9**

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 on tamination, Safety issues, flammable and toxichazards, biohazards.

**UNIT V CHARACTERIZATION TECHNIQUES 9**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM,STM, SNOM, ESCA, SIMS-Nano indentation

**TOTAL : 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Fundamentals of Nano science course, the student will be able to

**CO1:** Gain the working knowledge of nanotechnology principles and industrial applications.

**CO2:** Understand the Nano-scale paradigm in terms of properties at the Nano-scale dimensions.

**CO3:** Understand the concepts in materials science, chemistry, physics, biology and engineering.

**CO4:** Gain the knowledge in the field of nanotechnology.

**CO5:** Understand the current nanotechnology solutions in design, engineering and Manufacturing.

**CO6:** Understand patterning and lithography for Nano-scale devices.

**CO7:** Understand UV electron beam and x-ray lithography system process

**CO8:** Understand the technology issues that may impede the adoption of nanotechnology.

**CO9:** Identify career paths and requisite knowledge and skills for career changes towards Nanotechnology.

**CO10:** Understand the latest characterization techniques.

**CO11:** Understand the surface analysis techniques such as AFM, SPM, STM, SNOM, ESCA, SIMS.

**TEXT BOOKS:**


1. A.S. Edelstein and R.C. Cammearata, eds., Nano materials: Synthesis, Properties and Applications, (Institute of Physics Publishing, Bristol and Philadelphia, 1996)
2. N John Dinardo, Nanoscalecharecterisation of surfaces & Interfaces, Second edition, Weinheim Cambridge, Wiley-VCH, 2000


**REFERENCES:**


1. G Timp (Editor), Nanotechnology, AIP press/Springer, 1999
2. AkhleshLakhtakia (Editor) The Hand Book of Nano Technology, “NanometerStructure”, Theory, Modeling and Simulations. Prentice-Hall of India (P) Ltd, NewDelhi, 2007.

**15DBME85 PRODUCT DEVELOPMENT AND MANUFACTURE**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To introduce the various concepts of product design tools and techniques while designing a product.

**UNIT I INTRODUCTION 9**

Product Development process – Product development organizations, Gather raw data –Interpret raw data- organize the needs into a hierarchy – Relative importance of the needs. Product life cycle management - concepts, benefits, value addition to customer. Lifecycle Models- creation of projects and roles, users and project management, system administration, Access control and its use in life cycle.

**UNIT II PRODUCT SPECIFICATIONS 9**

Establishing the product specifications– Target specifications – Refining specifications, concept, Generation-Clarify the problem – Search internally – Search externally – Explore systematically.

**UNIT III PRODUCT ARCHITECTURE 9**

Concept selection- Screening – scoring, Product architecture – Implication of architecture – Establishing the architecture – Related system level design issues.

**UNIT IV INDUSTRIAL DESIGN 9**

Need for industrial design – Impact of industrial design – Industrial design process –Management of industrial design process – Assessing the quality of industrial design, design for Manufacturing- cost considerations, Impact of DFM decisions on other factors.

**UNIT V PRINCIPLES OF PROTOTYPING AND ECONOMIC ANALYSIS 9**

Principles of prototyping – Planning for prototypes, economics of product development projects, Elements of economic analysis – Base – Case financial model – Sensitivity analysis – Influence of the quantitative factors.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Product Development and Manufacture course, the student will be able to

**CO1:** Understand the new product management through the manufacturing area.

**CO2:** Introduce the various concepts of product design tools.

**CO3:** Identification of design criteria which are used in designing a product.

**CO4:** Gathering and interpreting and organizing of raw data.

**CO5:** Understand Product lifecycle management (PLM) and Product Data Management (PDM).

**CO6:** Applying product development strategy.

**CO7:** Applying the concept of Feasibility analysis.

**CO8:** Involves creating a rapid prototype for product concept.

**CO9:** Explain the product technical design.

**CO10:** Establishing product specification.

**CO11:** Understand Establish the product architecture.

**CO12:** Understand Need for industrial design.

**TEXT BOOKS:**

1. Karal, T.Ulrich Steven D.Eppinger, Product Design and Development, McGraw Hill, International Editions, 2003.
2. Stephan C. Wheelwright, Kim B. Clark, Managing New Product and Process Development: Text and Cases, Free Press, 1992.

**REFERENCES:**

1. RosenthalS., Effective Product Design and Development, Irwin, 1992.
2. Charles Gevirtz Developing New products with TQM, McGraw Hill InternationalEditions, 1994.

# SYLLABUS
# GENERIC ELECTIVE COURSES

| 15GBME31 | ELECTRICAL DRIVES AND CONTROL | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE**

- To understand the basic concepts of different types of electrical machines and their performance.
- To study the different methods of starting D.C motors and induction motors.
- To study the conventional and solid-state drives

**UNIT I INTRODUCTION 9**

Fundamentals of electric drives – advances of electric drive-characteristics of loads – different types of mechanical loads – choice of an electric drive – control circuit components: Fuses, switches, circuit breakers, contactors, Relay – control transformers.

**UNIT II SPEED CONTROL OF DC MACHINES 9**

DC shunt motors – Speed Torque characteristics - Ward Leonard method, DC series motor – series parallel control – solid state DC drives – Thyristor bridge rectifier circuits- chopper circuits.

**UNIT III SPEED CONTROL OF AC MACHINES 9**

Induction motor – Speed torque Characteristics – pole changing, stator frequency variation - slip-ring induction motor – stator voltage variation - Rotor resistance variation, slip power recovery – basic inverter circuits- variable voltage frequency control.

**UNIT IV MOTOR STARTERS AND CONTROLLERS 9**

DC motor starters: using voltage sensing relays, current sensing relays and time delay relays - wound rotor induction motor starters – starters using frequency sensing relays - DOI –starter and auto transformers starter.

**UNIT V HEATING AND POWER RATING OF DRIVE MOTORS 9**

Load diagram, over load capacity, insulating materials, heating and cooling of motors, service condition of electric drive – continuous, intermittent and short time – industrial application.

**TOTAL 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Electrical Drives and Control course, the student will be able to

**CO1:** Identify the need and choice of various electrical drives and their controls.

**CO2:** Understand to different speed control methods in D.C and A.C motors.

**CO3:** Get exposed to use Microprocessors.

**CO4:** Articulate power electronics applications in control of speed, torque and other components.

**CO5:** Understand the DC motor by Single phase converters.

**CO6:** Understand the AC machines and their speed controls.

**CO7:** Discuss the four quadrant operation of DC drives.

**CO8:** Control the DC motors with the help of choppers.

**CO9:** Explain the control of induction motor; through station voltage.

**CO10:** Understand the motor starters, controllers, heating and power rating of the drive motors.

**TEXT BOOKS:**

1. N.K De and P.K Sen ‘Electric Drives’ Prentice Hall of India Private Ltd, 2002.
2. Vedam Subramaniam ‘Electric Drives’ Tata McGraw Hill, New Delhi, 2007.
3. V.K Mehta and Rohit Mehta ‘Principle of Electrical Engineering’, S Chand & Company, 2008.

**REFERENCES:**

1. S.K Bhattacharya Brinjinder Singh ‘Control of Electrical Machines’ New Age International Publishers, 2002.
2. John Bird ‘Electrical Circuit theory and technology’ Elsevier, First Indian Edition, 2006.

| 15DBME41 | ENTREPRENEURSHIP DEVELOPMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

**UNIT I ENTREPRENEURSHIP 9**

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intra preneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

**UNIT II MOTIVATION 9**

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, objective.

**UNIT III BUSINESS 9**

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

**UNIT IV FINANCING AND ACCOUNTING 9**

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

**UNIT V SUPPORT TO ENTREPRENEURS 9**

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures- Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

**TOTAL : 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Entrepreneurship Development course, the student will be able to

**CO1:** Understand the basic concepts of entrepreneurship and its application in the recognition of product/ service/ process opportunities.

**CO2:** Explain the concepts of underpinning innovation associated with developing and sustaining the organizations.

**CO3:** Understanding the strategies for pursuing, exploiting and further developing new opportunities.

**CO4:** Analyze the issues associated with securing and managing financial resources in new and established organizations.

**CO5:** Ability to discern distinct entrepreneurial, assess opportunities and constraints for new business ideas.

**CO6:** Understand the systematic process to select for successful implementation of design ideas.

**CO7:** Advanced knowledge in regard to the process of bringing new technology to the market.

**CO8:** Understanding of new knowledge or new technology with her/his insights for the business.

**CO9:** Gained up to date in the field in regard to process and assessing the commercial potential of new technology on markets.

**CO10:** Identifying opportunities and challenges affiliated with the organization and financing of new initiatives such as new business ventures.

**TEXT BOOKS :**


1. Khanka. S.S., “Entrepreneurial Development” S.Chand & Co. Ltd., Ram Nagar, New Delhi,2013.
2. Donald F Kuratko, “Entreprenuership – Theory, Process and Practice”, 9th Edition, Cengage Learning, 2014.


**REFERENCES :**


1. Hisrich R D, Peters M P, “Entrepreneurship” 8th Edition, Tata McGraw-Hill, 2013.
2. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis” 2nd Edition Dream tech, 2005.
3. Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011.
4. EDII “Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development”, Institute of India, Ahmadabad, 1986.

| 15GBME51 | PRINCIPLES OF MANAGEMENT & PROFESSIONAL ETHICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization.
- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

**UNIT I OVERVIEW OF MANAGEMENT 9**

Definition - Management - Role of managers - Evolution of Management thought – Organization and the environmental factors – Trends and Challenges of Management in Global Scenario.

**UNIT II PLANNING & ORGANIZING 9**

Nature and purpose of planning and Organizing - Planning process - Types of plans – Managing by objective (MBO) Strategies - Types of strategies - Policies - Decision Making - Types of decision - Decision Making Process - Rational Decision Making Process - Decision Making under different conditions. - Organization structure - Formal and informal groups I organization - Line and Staff authority - Departmentation - Span of control - Centralization and Decentralization - Delegation of authority - Staffing - Selection and Recruitment - Orientation - Career Development - Career stages – Training - Performance Appraisal.

**UNIT III DIRECTING & CONTROLLING 9**

Creativity and Innovation - Motivation and Satisfaction - Motivation Theories - Leadership Styles - Leadership theories - Communication - Barriers to effective communication – Organization Culture - Elements and types of culture - Managing cultural diversity. Process of controlling - Types of control - Budgetary and non-budgetary control techniques - Managing Productivity - Cost Control - Purchase Control - Maintenance Control - Quality Control - Planning operations.

**UNIT IV ENGINEERING ETHICS & HUMAN VALUES 9**

Definition - Societies for engineers – Code of Ethics – Ethical Issues involved in cross border research - Ethical and Unethical practices – case studies – situational decision making - Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

**UNIT V SAFETY RESPONSIBILITIES AND RIGHTS 9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination – Global issues - Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Principles of Management and Professional Ethics course, the student will be able to

**CO1:** Understand the management roles and skills and evolution of the management.

**CO2:** Understand the functions and applications of the principles organization.

**CO3:** Understand the planning and organizing system of the management.

**CO4:** Understand the directing and controlling system of the management.

**CO5:** Identify and analyze the ethical issue in the subject matter under investigation.

**CO6:** Identify the multiple ethical interests at stake in a real-world situation or in practice.

**CO7:** Understand the own ethical values and the social context problems.

**CO8:** Identify the ethical concerns in research and intellectual contexts, including academic integrity.

**CO9:** Demonstrate knowledge and ethical values of non-classroom activities, such as service.

**CO10:** Understand the internships, field work nature and safety responsibilities with rights.

**TEXT BOOKS:**


1. Stephen P. Robbins and Mary Coulter, 'Management', Prentice Hall of India, 8th edition.
2. Charles W L Hill, Steven L McShane, 'Principles of Management', Mcgraw Hill Education, Special Indian Edition, 2007.
3. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.


**REFERENCES:**


1. Hellriegel, Slocum & Jackson, ' Management - A Competency Based Approach', Thomson South Western, 10th edition, 2007.
2. Harold Koontz, Heinz Weihrich and Mark V Cannice, 'Management - A global & Entrepreneurial Perspective', Tata Mcgraw Hill, 12th edition, 2007.
3. Andrew J. Dubrin, 'Essentials of Management', Thomson Southwestern, 7th edition, 2007.
4. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
5. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.

| 15GBME52 | OPERATIONS RESEARCH | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.

**UNIT I LINEAR MODELS 9**

The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.

**UNIT II TRANSPORTATION MODELS AND NETWORK MODELS 9**

Transportation Assignment Models –Traveling Salesman problem-Networks models – Shortest route– Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks –Critical path scheduling – Sequencing models.

**UNIT III INVENTORY MODELS 9**

Inventory models – Economic order quantity models – Quantity discount models – Stochasticin ventory models – Multi product models – Inventory control models in practice.

**UNIT IV QUEUEING MODELS 9**

Queueing models - Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.

**UNIT V DECISION MODELS 9**

Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life– Single / Multi variable search technique – Dynamic Programming – Simple Problem.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Operations Research course, the student will be able to

**CO1:** Develop the operational research models for the verbal description of the real system of linear models.

**CO2:** Understand the mathematical optimization tools to solve optimization problems.

**CO3:** Use mathematical and simulation software to solve the proposed models.

**CO4:** Understand the transportation & network models and various techniques of operations research.

**CO5:** Understand the techniques used in operations research to solve the real life problem in minimizing the industrial problems suggest an optimum solution.

**CO6:** Understand the significant role of operational research to solve transportation problems.

**CO7:** Understand the inventory models, economic order quantity models and quantity discount models.

**CO8:** Understand the critical path analysis, programming evaluation, production and review techniques.

**CO9:** Understand the decision models and game theory.

**CO10:** Understand the dynamic programming and minimizing projects execution and completion.

**TEXT BOOK:**

1. Taha H.A., “Operations Research”, Sixth Edition, Prentice Hall of India, 2003.

**REFERENCES:**

1. Shennoy G.V. and Srivastava U.K., “Operation Research for Management”, Wiley Eastern,1994.

2. Bazara M.J., Jarvis and Sherali H., “Linear Programming and Network Flows”, John Wiley,1990.

3. Philip D.T. and Ravindran A., “Operations Research”, John Wiley, 1992.

4. Hillier and Libeberman, “Operations Research”, Holden Day, 1986

5. Budnick F.S., “Principles of Operations Research for Management”, Richard D Irwin, 1990.

6. Tulsian and Pasdey V., “Quantitative Techniques”, Pearson Asia, 2002.

| 15GBME61 | QUALITY CONTROL AND RELIABILITY ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To make the students to understand the various quality control techniques and to construct the various quality control charts for variables and attributes and also the design concepts for reliable system and maintenance aspects in industries.

**UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES 9**

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process causes of variation –Theory of control chart- uses of control chart – Control chart for chart -process capability – process capability studies$\sigma$variables – X chart, R chart and simple problems, Six sigma concepts.

**UNIT II PROCESS CONTROL FOR ATTRIBUTES 9**

Control chart for attributes –control chart for non conforming – p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

**UNIT III ACCEPTANCE SAMPLING 9**

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

**UNIT IV LIFE TESTING – RELIABILITY 9**

Life testing – Objective – failure data analysis, Mean failure rate, means time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability –simple problems, Acceptance sampling based on reliability test – O.C Curves.

**UNIT V QUALITY AND RELIABLITY 9**

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.

**Note:** *Use of approved statistical table permitted in the examination.*

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Quality Control and Reliability Engineering course, the student will be able to

**CO1:** Understand the concepts of Quality Control and Statistical Process Control variables (SPC).

**CO2:** Understand the Control Charts for Variables and Central Limit Theorem.

**CO3:** Understand the Natural and assignable causes of variation and process control for attributes

**CO4:** Draw and explain the Mean Chart Limits (x-Charts) and Setting the Range Chart Limits (R-Charts)

**CO5:** Understand the Mean and Range Charts and acceptance sampling.

**CO6:** Control Charts for Attributes (p-charts and C-charts) and life testing reliability.

**CO7:** Managerial Issues and Control Charts Process Capability

**CO8:** Understand the Producer's and consumer's risk of the acceptance Sampling

**CO9:** Understand the reliability and Operating characteristic (OC) Curves

**CO10:** Understand and solve the average Outgoing Quality problems; Service quality problems.

**TEXT BOOKS:**


1. Douglas.C.Montgomery, "Introduction to Statistical quality control", John wiley, 4th edition2001.
2. SrinathL.S., "Reliability Engineering", Affiliated East west press, 1991.


**REFERENCES:**


1. John.S.Oakland. Statistical process control", Elsevier, 5th edition, 2005
2. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 1996.
3. MonoharMahajan, "Statistical Quality Control", DhanpatRai& Sons, 2001.
4. GuptaR.C., "Statistical Quality control", Khanna Publishers, 1997.
5. Besterfield D.H., "Quality Control", Prentice Hall, 1993.

**15GBME62 VALUE ANALYSIS AND VALUE ENGINEERING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To provide the basic concepts and features of value analysis and value engineering.

**UNIT I CONCEPTS** **9**

Introduction – status of VE in India and origin country – impact of VE application – types of values – types of function – function identification on product – function matrix – function analysis – elements of costs – calculation of costs – cost allocation to function – evaluation of worth in VE methodology.

**UNIT II TECHNIQUES** **9**

General techniques: brain storming – godson feasibility ranking – morphological analysis – ABC analysis – probability approach – make or buy.

**UNIT III ANALYSIS** **9**

Function – cost-worth analysis – function analysis – system techniques – function analysis matrix – customer oriented FAST diagram – fire alarm – Langrange plan – evaluation methods – matrix in evaluation – break even analysis.

**UNIT IV VALUE ENGINEERING IN JOB PLAN** **9**

Orientation phase – information phase – functional analysis – creative phase – evaluation phase – recommendation phase – implementation phase – audit phase.

**UNIT V CASE STUDIES** **9**

Water treatment plant – engineering management, pump component, motor component, wet grinder, automobile, hospital.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Value Analysis and Value Engineering course, the student will be able to

**CO1:** Solve complex engineering tasks based on technical-economic disciplines.

**CO2:** Calculation of costs and evaluation of worth in Value Engineering Methodology.

**CO3:** Understand the general techniques of brainstorming and ABC analysis.

**CO4:** Understand functionality important for the customer will improve the worth of the Product and eliminate the unwanted functionality to reducing the overall cost.

**CO5:** Apply Value Engineering and Value Analysis in the manufacturing products.

**CO6:** Scientifically compare, analyze the alternatives and Integrate Value Engineering in the design process.

**CO7:** Develop a systematic approach to avoid unnecessary cost for the effective team outcome.

**CO8:** Integrate Value Engineering with TQM, Enhance the relationship between employees and customers.

**CO9:** Understand the value engineering in job planning and scheduling.

**CO10:** Understand difference between the Value Engineering, Design Reviews and Cost reduction.

**TEXT BOOKS:**


1. Mukhophadhyaya A K, “Value Engineering”, Sage Publications Pvt. Ltd., New Delhi, 2003.
2. Richard J Park, “Value Engineering – A Plan for Inventions”, St.Lucie Press, London, 1998.


**REFERENCES:**


1. Larry W Zimmesman. P E , “VE –A Practical Approach for Owners Designers and Contractors”, CBS Publishers, New Delhi, 1992.
2. Arthus E Mudge, “Value Engineering”, McGraw Hill Inc., New York, 1971.
3. Army Materiel Command U S, “Value Engineering (Engineering Design Handbook)”, University Press of the Pacific, 2006.

| 15GBME71 | TOTAL QUALITY MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

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

**UNIT I INTRODUCTION 9**

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**

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**

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**

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

**UNIT V QUALITY SYSTEMS 9**

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 Hours**

**COURSE OUTCOMES:**

After successful completion of the Total Quality Management course, the student will be able to

**CO1:** Evaluate the principles of quality management and to explain; how these principles can be applied within quality management systems.

**CO2:** Understand the key aspects of the quality improvement cycle and to select and use the appropriate tools and techniques for controlling, improving and measuring quality.

**CO3:** Understand the strategic quality planning and quality statement.

**CO4:** Understand the communication and teamwork requirements for effective quality management.

**CO5:** Critically analyze the strategic issues in quality management, including current issues and developments.

**CO6:** Evaluate the quality implementation of the firm and understand the various total quality management techniques.

**CO7:** Know prerequisites of evolution of total quality management and significance with the quality of modern quality requirement of the organization.

**CO8:** Explain the Quality impact of TQM and the cost of poor quality.

**CO9:** Understand the methodologies to enhance the management processes, such as Benchmarking and business process reengineering.

**CO10:** Understand the quality system ISO 9000-2000.

**TEXT BOOK:**

1. Dale H.Besterfiled, etc at “Total Quality Management”, Pearson Education Asia, Third Edition, 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, 3rd 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.
5. R. Pugazhenthi, A. Baradeswaran, K. Balachandran, and P. Balamurali, “Total Quality Management”, sams publications, 2015.

**15GBME72 ENERGY AUDIT AND ENERGY CONSERVATION METHODS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- This course provides the knowledge about energy audit and energy conservation methods in I.C. Engines.

**UNIT I ENERGY AND ENVIRONMENT 9**

Introduction - fossil fuels reserves - world energy consumption - green house effect, global warming - Renewable energy sources - environmental aspects utilization - energy prizes - energy policies.

**UNIT II ENERGY CONSERVATION 9**

Energy conservation schemes - industrial energy use - energy surveying and auditing - energy index –Energy cost - cost index - energy conservation in engineering and process industry, in thermal Systems, in buildings and non-conventional energy resources scheme

**UNIT III ENERGY TECHNOLOGIES 9**

Fuels and consumption - boilers - furnaces - waste heat recovery systems - heat pumps and Refrigerators - storage systems - insulated pipe work systems - heat exchangers.

**UNIT IV ENERGY MANAGEMENT 9**

Energy management principles - energy resource management - energy management information Systems - instrumentation and measurement - computerized energy management - energy Auditing.

**UNIT V ECONOMICS AND FINANCE 9**

Costing techniques - cost optimization - optimal target investment schedule - financial appraisal and Profitability - project management.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Energy Audit and Energy Conservation Methods course, the student will be able to

**CO1:** Understanding the basics of demand side management and mechanisms (technical, legal or financial) that influences energy consumption. Recognizing opportunities for increasing rational use of energy.

**CO2:** Understanding the basics of energy auditing with application on different sectors.

**CO3:** Understood and acquired fundamental knowledge on the science of energy and on both the conventional and non-conventional energy technologies

**CO4:** Acquired the skills needed for the energy monitoring, auditing and management.

**CO5:** Capable of design and analysis of energy conversion systems.

**CO6:** Understand the energy conservation and energy technology in Planning and implementation of energy projects.

**CO7:** Identify the demand supply gap of energy in Indian scenario.

**CO8:** Understand the energy flow diagram of an industry and identify the energy wasted or a waste stream.

**CO9:** Understand the appropriate energy conservation method to reduce the wastage of energy.

**CO10:** Evaluate the techno economic feasibility of the energy conservation techniques in project management.

**TEXT BOOKS:**


1. MurphyW.R. and McKAYG.,“Energy Management, Butterworths, London, 1982.
2. TrivediP.R.,JulkaB.R., “Energy Management”,Common wealth publishers, 1997.


**REFERENCES:**


1. David Merick, Richard Marshal, “Energy, present and future options”, Vol. I and II, John Wiley and Sons, 1981.
2. Chaigier N.A. “Energy Consumption and Environment ", McGraw-Hill, 1981.
3. Ikken P.A. Swart R.J and Zwerves.S, “Climate and Energy ", 1989.
4. Ray D.A. “Industrial Energy Conservation ", Pergamaon Press, 1980.

| 15GBME81 | SUPPLY CHAIN MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To make the students familiar with the various concepts and functions of supply chain management, so that the students will be in a position to manage the supply chain management.

**UNIT I INTRODUCTION 9**

Definition of Logistics and SCM: Evolution, Scope, Importance& Decision Phases – Drivers of SC Performance and Obstacles.

**UNIT II LOGISTICS MANAGEMENT 9**

Factors – Modes of Transportation - Design options for Transportation Networks-Routing and Scheduling – Inbound and outbound logistics- Reverse Logistics – 3PL- Integrated Logistics Concepts- Integrated Logistics Model – Activities - Measuring logistics cost and performance – Warehouse Management - Case Analysis.

**UNIT III SUPPLY CHAIN NETWORK DESIGN 9**

Distribution in Supply Chain – Factors in Distribution network design –Design options-Network Design in Supply Chain – Framework for network Decisions - Managing cycle inventory and safety.

**UNIT IV SOURCING, AND PRICING IN SUPPLY CHAIN 9**

Supplier selection and Contracts - Design collaboration - Procurement process. Revenue management in supply chain.

**UNIT V COORDINATION AND TECHNOLOGY IN SUPPLY CHAIN 9**

Supply chain coordination - Bullwhip effect – Effect of lack of co-ordination and obstacles – IT and SCM - supply chain IT frame work, E Business & SCM, Metrics for SC performance – Case Analysis

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Supply Chain Management course, the student will be able to

**CO1:** Understand and apply the metrics in supply chains and logistics.

**CO2:** Define the principles of scheduling and planning in supply chain management and design option for transportation networks.

**CO3:** Apply the principles of Strategic/Master planning of resource in supply chains, warehouse management and case analysis

**CO4:** Identify the principles of customer and supplier relationship management.

**CO5:** Explain the principles of quality and lean system.

**CO6:** Understand the supply chain network design, inventory and safety constraints.

**CO7:** Understand the procurement process and revenue management in supply.

**CO8:** Understand the supply chain coordination and bullwhip effect.

**CO9:** Understand the various techniques in supply chain management.

**CO10:** Understand the E-business.

**TEXT BOOKS:**

1. Supply Chain Management, Strategy, Planning, and operation – Sunil Chopra and Peter Meindl- PHI, Second edition, 2007.
2. Logistics, David J.Bloomberg, Stephen Lemay and Joe B.Hanna, PHI, 2002.

**REFERENCES:**

1. Logistics and Supply Chain Management –Strategies for Reducing Cost and Improving Service. Martin Christopher, Pearson Education Asia, Second Edition.
2. Modeling the supply chain, Jeremy F.Shapiro, Thomson Duxbury, 2002.
3. Handbook of Supply chain management, James B.Ayers, St.Lucle Press, 2000.

**15GBME82 INDUSTRIAL MARKETING AND MARKET RESEARCH**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To enable students to deal with newer concepts of marketing concepts like strategic marketing segmentation, pricing, advertisement and strategic formulation. The course will enable a student to take up marketing as a professional career.

**UNIT I INDUSTRIAL MARKETING 9**

Nature of Industrial Marketing: Industrial Marketing Vs Consumer Marketing Relational approach to Industrial Marketing- The Nature of Industrial Demand &Industrial Customer. Types of Industrial Products: Major Equipment; Accessory Equipment; Raw and Processed Materials; Component Parts and Sub- Assemblies; Operating Supplies; Standardized and Non-standardized parts, Industrial services.

**UNIT II PRICING 9**

Pricing for Industrial Products – Pricing COURSE OBJECTIVE - Price Decision Analysis –Breakeven analysis – net pricing – discount pricing – trade discounts – geographic pricing – factory pricing – freight allowance pricing – Terms of Sale – Outright purchase – Hire-purchase – Leasing.

**UNIT III MARKET RESEARCH 9**

Introduction to Market Research, Types of Research – Basic & Applied, Nature, Scope, objective, Importance & Limitations of Market Research. Sources and collection of Marketing Data. Secondary data – Advantages &Limitations, Sources – Govt. & Non Govt. Primary Data – Advantages &Limitations, Sources, Methods of Collection Primary Data – Observation, Mail, Personal Interview, Telephonic Interview, Internet Interviewing.

**UNIT IV TECHNIQUES 9**

Market Research Techniques. National readership survey, Retail Store Audit, Consumer Panels, Test Marketing, Research in Advertising Decisions, Marketing Audit, Data Base Marketing, Focus Group Interviews. Sampling, Questionnaire & Scaling Techniques. Probability and Non Probability Sampling, Sampling methods, Sample Design, Questionnaire design and drafting. Scaling techniques like Nominal, Ordinal, Interval, Ratio, Perceptual Map, Semantic Differential, Likert, Rating& Ranking Scales.

**UNIT V Implementation 9**

Setting up & Implementation of Marketing Research Project, Steps in formulating Market Research Projects, One project for consumer durables andone for non durables to be discussed.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Industrial Marketing and Market Research course, the student will be able to

**CO1:** Integrate the marketing mixed elements in the industry and apply strategies of relations between the industrial partners.

**CO2:** Comprehend the purchasing behavior of industrial customers and evaluate the industrial Purchasing decisions.

**CO3:** Explain the multilevel segmentation process within the Business-to-Business (B2B) markets.

**CO4:** Gain insight and work with the management of product portfolio, pricing and promotion.

**CO5:** Implement the marketing strategies in the B2B market for industries.

**CO6:** Develop a fundamental understanding of business marketing, Develop critical analysis and Problem-solving abilities with respect to business marketing.

**CO7:** Compare the differences of similarities in the consumer markets.

**CO8:** Recognize the challenges posed to participants in B2B markets, from a derived demand to networks of interactions and relationships.

**CO9:** Comprehend and interpret the prevailing decision-making mechanisms and their significance for business marketing practice.

**CO10:** Demonstrate an integrative understanding of various mechanisms for the elaboration of Segmentation, targeting and positioning strategies in global business markets.

**CO11:** Apply relevant marketing theory, inquiry and analysis skills to contemporary case studies and communicate outcomes employing professional discourse and formats.

**TEXT BOOKS:**


1. Ralph S. Alexander, James S. Cross, Richard M. Hill, “Industrial Marketing”, Homewood, 1967.
2. Rajendra Nargundkar, “Marketing Research”, Tata McGraw Hill, 2008.


**REFERENCES:**


1. Robert R. Reeder; Edward G. Brierty; Betty H. Reeder**,** “Industrial Marketing – Analysis, Planning and Control”, Prentice Hall, 1991**.**
2. GhoshPK, “Industrial Marketing”, Oxford University Press, India.
3. RamanujMajumdar,“Marketing Research-Text, Applications and Case Studies”.
4. Donald R.Cooper, “Business research Methods”, McGraw-Hill, 2005.

# SYLLABUS
# SKILL ENHANCEMENT ELECTIVE COURSES

| 15SUPD31 | PERSONALITY DEVELOPMENT I | L | T | P | C |
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**COURSE OBJECTIVE:**

- To improve the interpersonal skills, soft skills, effective team player and analyze strength and weakness to meet their professional career.

**UNIT I SOFT SKILLS I** **6**

Introduction to Personality Development – Meaning-Features of personality=Dimensions of Personality=Determinants of Personality-Features and Traits- Components of self concept-Barriers-Self analysis

**UNIT II SOFT SKILLS II** **6**

Importance of Soft Skills – First impression-Work Place requirements-Discipline-Cleanliness-Hygiene-general Appearance--Building Confidence—Concept of Thinking and Usage-Value of Time-Focus & Commitment.

**UNIT III SOFT SKILLS IN ACTION** **6**

Grooming – Attire – Understanding others- – Stability & Maturity Development – Strengths – Weakness –Opportunities-threats -Merits of SWOT Analysis-Components-how to convert weakness into strengths-Goal settings

**UNIT IV SELF AWARENESS AND SELF ESTEEM** **6**

Definitions-Components of self awareness-Developing Self awareness-Self esteem-meaning-Steps to improve self esteem

**UNIT V SELF MOTIVATION** **6**

Motivation –Meaning-Techniques of self motivation-Motivation & goal setting – Motivation and emotion – Motivation at work.

**Total: 30 Hours**

**REFERENCES:**


1. Personality Development And Soft Skills---Barun K Mitra, Oxford Publication
2. Seven habits of Higly Effective people – Stephen R. covey
3. Emotion, motivation and Self regulation - Nathan C. Hall , McGill University, Canada, Thomas Goetz, University of Konstanz, Germany
4. http://www.emeraldgrouppublishing.com/
5. Psychology of Selfesteem – Nathaniel Branden, Nash (1st edition), Jossey-Bass (32nd anniversary edition

| 15SUPD41 | PERSONALITY DEVELOPMENT II | L | T | P | C |
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**COURSE OBJECTIVE:**

- To improve the leadership quality, team management, quantitative analyzing knowledge, ordering, sequencing and logical thinking knowledge to meet their professional career.

**UNIT I SOFT SKILLS III** **6**

Basic Etiquette – Email etiquette – Business etiquette – Telephone etiquette – Meeting etiquette – Adjustment of Role & Leadership – Team Management & Development

**UNIT II QUANTITATIVE APTITUDE I** **6**

Percentage – Profit Loss -Discount – Ratio Proportion – Time & Work – Time, Speed & Distancel. Problems relating to ages- Permutation &Combination-Probability

**UNIT III QUANTITATIVE APTITUDE II** **6**

Mensuration Clocks and Calendars- Boats-Simple Interest –Compound Interest- Fractions and Decimals – Square roots – Functions.

**UNIT IV ANALYTICAL PROBLEMS** **6**

Introduction – Linear Sequencing – Seating Arrangements – Distribution/Double Line Up – Selection – Ordering and Sequencing – Binary Logic – Venn Diagrams –Directions.

**UNIT V LOGICAL PROBLEMS** **6**

Introduction to Logical problems – Cause and Effect – Course of Action – Statement and Assumption – Letter and Symbol series – Analogies.

**TOTAL: 30 Hours**

**REFERENCES:**


1. Personality Enrichment--K R Dhanalakshmi And N S Raghunathan, Margham Publications
2. Personality Development --Dr V M Selvaraj Bhavani Publications
3. Quantitative Aptitude – R. S Aggarwal
4. Logical and Analytical Reasoning (English) 30th Edition – A.K Gupta

| 15SUPD51 | PERSONALITY DEVELOPMENT III | L | T | P | C |
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**COURSE OBJECTIVE:**

- To improve the verbal aptitude, Speech Mechanism, Sentence Stress knowledge, Personality factors, time management and team building to meet their professional career.

**UNIT I VERBAL APPTITUDE I 6**

Phonetics/Neutral Accent/Pronunciation – Speech Mechanism/Mouth & Face Exercise – Vowels & Consonants – Sounds – Syllable and Syllable Stress/ Word Stress – Sentence Stress & Intonation – Articulation Exercise – Rate of Speech / Flow of Speech / Idiomatic Phrases.

**UNIT II VERBAL APTITUDE II 6**

Singular/plural-present tense/past tense—genders - Prepositions-conjunctions-Choice of words—simple sentences—compound sentences- summarising phrases—Synonyms—Antonyms—Analogies—Similar Words

**UNIT III SOFT SKILLS IV 6**

Attitude—Meaning- Features of attitude-Formation-Personality Factors-Types of attitude-change in attitude-Developing Positive attitude.

**UNIT IV TIME MANAGEMENT 6**

Definition –Meaning-Importance, Value of time as an important resource- comparison of Time and Money-Circle of influence and circle of control—Definition of URGENT and IMPORTANT—Time Wasters and how to reduce—Procrastination—meaning and impact- 4 Quadrants.

**UNIT V TEAM BUILDING 6**

Meaning—Aspects of team building—Process of team building—Types of Teams-Team ethics and Understanding-Team trust and commitment

**TOTAL: 30 Hours**

**REFERENCES:**


1. Managing Soft Skills And Personality - B N Ghosh, Mcgraw Hill Publications.
2. Principles and Practices of Management - Shejwalkar and Ghanekar McGraw Hill Latest.
3. Time management for Busy people – Roberta roesch, Tata Mcgraw-Hill Edition.
4. Personality Development -Dr V M Selvaraj, Bhavani Publications.

| 15SUPD61 | PERSONALITY DEVELOPMENT IV | L | T | P | C |
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**COURSE OBJECTIVE:**

- To improve the communication by understanding the elements of communication, presentation skills, understanding the audience, Personality factors, improve the skill in seminars and conferences presentation.

**UNIT I SOFT SKILLS V** **6**

Assertiveness—Meaning—Importance of assertiveness- Characteristics of assertive communication-Merits –forms of assertion—Causes of misunderstanding

**UNIT II COMMUNICATION SKILLS** **6**

Meaning—Elements of communication—Functions of communication—Principles of communication—Formal and Informal communication—Barriers in Communication—Characteristics of good communication—Feedback—communication systems.

**UNIT III PRESENTATION SKILLS I** **6**

Meaning—Importance of Presentation—Concept of 5 w's and one H —understanding the audience—Types of presentations—How to make effective presentation

**UNIT IV PRESENTATION SKILLS II** **6**

Use of slide, PPT's. and visuals—Rules for slide presentation—precautions-seminars and conferences-Steps to eliminate Stage fear.

**UNIT V CHANGE MANAGEMENT** **6**

Definition – Necessity - Resistance towards Change – 10 Principles of Change Management – Leaders approach – Effective Change management.

**TOTAL: 30 Hours**

**REFERENCES**


1. Helping employees embrace change - LaClair, J. and Rao, R. Helping Employees Embrace Change, McKinsey Quarterly, 2002, Number 4.
2. Who Moved My Cheese by Spencer Johnson published by Vermilion first edition
3. Effective Communication. Adair, John. London: Pan Macmillan Ltd., 2003.
4. Business Communication Today: Bovee, Courtland L, John V. Thill & Barbara E. Schatzman.Tenth Edition. New Jersey: Prentice Hall, 2010.

| 15NSS255 | NSS – I | L | T | P | C |
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**UNIT I INTRODUCTION AND BASIC CONCEPTS OF NSS 6**

NSS: History, philosophy, aims, objectives –Emblem: flag, motto, song, badge- NSS functionaries: Organizational structure, roles and responsibilities.

**UNIT II NSS PROGRAMS AND ACTIVITIES 6**

Concept of regular activities- special camping-day camps-Basis of adoption of village/slums, Methodology of conducting survey-Financial pattern of the scheme- other youth program/schemes of GOI- Coordination with different agencies- Maintenance of the dairy

**UNIT III UNDERSTANDING YOUTH 6**

Youth: Definition, profile of youth, categories – youth: Issues, challenges and opportunities - Youth as an agent of social change.

**UNIT IV COMMUNITY MOBILIZATION 6**

Mapping of community stakeholders-Designing the message in the context of the problem and the culture of the community-Identifying methods of mobilization-Youth adult partnership

**UNIT V VOLUNTEERISM AND SHRAMDAN 6**

Indian Tradition of volunteerism-Needs& Importance of volunteerism- Motivation and constraints of volunteerism-Shramdan as a part of volunteerism.

**TOTAL: 30 Hours**

| 15NSS 256 | NSS – II | L | T | P | C |
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**UNIT I IMPORTANCE AND ROLE OF YOUTH LEADERSHIP 7**

Meaning and types of leadership-Qualities of good leaders; traits of leadership- Importance and role of youth leadership

**UNIT II LIFE COMPETENCIES 7**

Definition and importance of life competencies-Communication- Inter personal- Problem solving and decision-making

**UNIT III SOCIAL HARMONY AND NATIONAL INTEGRATION 8**

Indian history and culture-Role of youth in peace-building and conflict resolution- Role of youth in Nation building

**UNIT IV YOUTH DEVELOPMENT PROGRAMMES IN INDIA 8**

National youth policy-Youth development programmes at the National level, state level and voluntary sector-Youth focused and youth-led organization

Conducting surveys on special theme and preparing a report thereof.

**TOTAL: 30 Hours**

| 15NSS257 | NSS – III | L | T | P | C |
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**UNIT I CITIZENSHIP 6**

Basic features of constitution of India-Fundamental Rights and duties- Human rights- Consumer awareness and the legal rights of consumer- RTI

**UNIT II FAMILY AND SOCIETY 6**

Concept of family-community(PRIs and community-based organization) and society-Growing up in the family-dynamics and impact-Human values-Gender justice

**UNIT III HEALTH, HYGIENE & SANITATION 6**

Health Education Definition, needs and scope-Food and nutrition- Safe drinking water- water born diseases and sanitation(Swachh Bharath Abhiyan)-National Health Programme- Reproductive health

**UNIT IV YOUTH HEALTH 6**

Healthy Lifestyles-HIV AIDS, Drugs and substance abuse- Home nursing- First aid.

**UNIT V YOUTH AND YOGA 6**

Yoga: History, philosophy and concept-Myths and misconceptions about yoga- Different yoga traditions and their impact-Yoga as a preventive, promotive and curative method- Yoga as a tool for healthy lifestyle

Preparation of research project report.

**TOTAL: 30 Hours**

| 15NSS258 | NSS – IV | L | T | P | C |
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**UNIT I ENVIRONMENT ISSUES 7**

Environment: conservation, enrichment and sustainability-Climate change- Waste management-Natural resource management (Rainwater harvesting, energy conservation, wasteland development, soil conservations and afforestation)

**UNIT II DISASTER MANAGEMENT 7**

Introduction to Disaster management-classification of disasters-Role of youth in disaster management

**UNIT III PROJECT CYCLE MANAGEMENT 8**

Project planning-Project implementation- Project monitoring- Project evaluation-Impact Assessment

**UNIT IV DOCUMENTATION AND REPORTING 8**

Collection and analysis of data- Preparation of Documentation/Reports- Dissemination of documents/Reports Workshops/seminars on personality development and improvement of communication skills.

**TOTAL: 30 Hours**

| 15NSS259 | NSS – V | L | T | P | C |
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**UNIT I VOCATIONAL SKILL DEVELOPMENT 15**

This unit will aim to enhance the employment potential of the NSS volunteers- alternately to help them to set up small business enterprises. For this purpose, a list of 12-15 vocational skills will be drawn up, based on local conditions and opportunities - Each volunteer will have the option to select two skill-areas out of this list-one such skill in each semester-The education institution (or the university)will make arrangements for developing these skills in collaboration with established agencies that possess the necessary expertise in the related vocational skills.

**UNIT II ENTREPRENEURSHIP DEVELOPMENT 8**

Definitions & meaning- Qualities of good Entrepreneur- Steps/ways in opening an enterprise- Role of financial and support service Institutions.

**UNIT III YOUTH AND CRIME 7**

Sociological and Psychological Factors influencing youth crime- Peer monitoring in preventing crimes Awareness about Anti-Ragging -Cyber Crime and its prevention- Juvenile justice

**TOTAL: 30 Hours**

| 15NSS260 | NSS – VI | L | T | P | C |
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**UNIT II CIVIL/SELF DEFENSE 5**

Civil defense services-aims and objectives of civil defense - Needs for Self defense training

**UNIT III RESOURCE MOBILISATION 3**

Writing a project proposal- Establishment of SFUs

**UNIT IV ADDITIONAL LIFE SKILLS 7**

Positive thinking- Self confidence and self esteem- Setting life goals and working to achieve them-Management of stress including time management

**TOTAL: 30 Hours**