# NATIONAL ENGINEERING COLLEGE

*(An Autonomous Institution – Affiliated to Anna University Chennai)*

**K.R.NAGAR, KOVILPATTI – 628 503**

www.nec.edu.in

# REGULATIONS – 2011


**DEPARTMENT OF**

**MECHANICAL ENGINEERING**

**CURRICULUM AND SYLLABI OF**

**B.E. - MECHANICAL ENGINEERING**

**REGULATIONS – 2011**

**CURRICULUM AND SYLLABI FOR FULL TIME**

# B.E. MECHANICAL ENGINEERING

## SEMESTER – I

(Common to all B.E. / B.Tech. Degree Programmes)

| S.No | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|
| ***THEORY*** | | | | | | |
| 1. | BEG101 | Technical English – I | 3 | 1 | 0 | 4 |
| 2. | BMA101 | Mathematics – I | 3 | 1 | 0 | 4 |
| 3. | BPH101 | Engineering Physics – I | 3 | 0 | 0 | 3 |
| 4. | BCY101 | Engineering Chemistry – I | 3 | 0 | 0 | 3 |
| 5. | BCS101 | Fundamentals of Computing and Programming | 3 | 0 | 0 | 3 |
| 6. | BME101 | Engineering Graphics | 2 | 3 | 0 | 4 |
| ***PRACTICAL*** | | | | | | |
| 7. | BCS131 | Computer Practice Laboratory – I | 0 | 0 | 3 | 2 |
| 8. | BPC131 | Physics and Chemistry Laboratory –I | 0 | 0 | 3 | 2 |
| 9. | BME131 | Engineering Practices Laboratory | 0 | 0 | 3 | 2 |
| | | **Total Number of Credits :** | | | | **27** |

## SEMESTER – II

| S.No | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1. | BEG201 | Technical English – II* | 3 | 0 | 0 | 3 |
| 2. | BMA201 | Mathematics – II* | 3 | 1 | 0 | 4 |
| 3. | BPH201 | Engineering Physics – II * | 3 | 0 | 0 | 3 |
| 4. | BCY201 | Engineering Chemistry – II * | 3 | 0 | 0 | 3 |
| 5. a. | BME201 | Engineering Mechanics (For Mechanical & Civil branches) | 3 | 1 | 0 | 4 |
| b. | BEE201 | Circuit Theory (For EEE & EIE branches) | 3 | 1 | 0 | 4 |
| c. | BEC201 | Electric Circuits and Electron Devices (For CSE, IT & ECE branches) | 3 | 1 | 0 | 4 |
| 6. a. | BEE202 | Basic Electrical & Electronics Engineering (For Mechanical & Civil branches) | 4 | 0 | 0 | 4 |
| b. | BME202 | Basic Civil & Mechanical Engineering (For CSE, IT, EEE, EIE & ECE branches) | 4 | 0 | 0 | 4 |
| **PRACTICAL** | | | | | | |
| 7. | BCS231 | Computer Practice Laboratory – II* | 0 | 1 | 2 | 2 |
| 8. | BPC231 | Physics & Chemistry Laboratory – II* | 0 | 0 | 3 | 2 |
| 9. a. | BME231 | Computer Aided Drafting and Modeling Laboratory (For Mechanical & Civil branches) | 0 | 1 | 2 | 2 |
| b. | BEE231 | Electrical Circuits Laboratory (For EEE & EIE branches) | 0 | 0 | 3 | 2 |
| c. | BEC231 | Circuits and Devices Laboratory (For ECE, CSE & IT branches) | 0 | 0 | 3 | 2 |
| 10. | BEG231 | English Language Skill Laboratory* (Skill of Listening) | 0 | 0 | 3 | 2 |
| | | **Total Number of Credits :** | | | | **29** |

- *** Common to all B.E. / B.Tech. Programmes**

## SEMESTER – III

| S.No | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1 | BMA301 | Transforms and Partial Differential Equations | 3 | 1 | 0 | 4 |
| 2 | BME301 | Manufacturing Technology - I | 3 | 0 | 0 | 3 |
| 3 | BME302 | Engineering Thermodynamics | 3 | 1 | 0 | 4 |
| 4 | BME303 | Fluid Mechanics and Machinery | 3 | 1 | 0 | 4 |
| 5 | BME304 | Kinematics of Machinery | 3 | 1 | 0 | 4 |
| 6 | BEE304 | Electrical Drives and Controls | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | |
| 7 | BME331 | Manufacturing Technology Laboratory - I | 0 | 0 | 3 | 2 |
| 8 | BME332 | Fluid Mechanics and Machinery Laboratory | 0 | 0 | 3 | 2 |
| 9 | BEE333 | Electrical Engineering Laboratory | 0 | 0 | 3 | 2 |
| 10 | BEG331 | Communication Skills and Technical Seminar - I | 0 | 0 | 3 | 2 |
| | | **Total Number of Credits :** | | | | **30** |

## SEMESTER – IV

| S.No | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1 | BMA401 | Statistics and Numerical Methods | 3 | 1 | 0 | 4 |
| 2 | BME401 | Heat and Mass Transfer | 3 | 1 | 0 | 4 |
| 3 | BME402 | Manufacturing Technology – II | 3 | 0 | 0 | 3 |
| 4 | BME403 | Engineering Materials and Metallurgy | 3 | 0 | 0 | 3 |
| 5 | BME406 | Strength of Materials | 3 | 1 | 0 | 4 |
| 6 | BEC406 | Electronics and Microprocessor | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | |
| 7 | BME434 | Materials Testing Laboratory | 0 | 0 | 3 | 2 |
| 8 | BME431 | Computer Aided Machine Drawing Laboratory | 1 | 0 | 3 | 2 |
| 9 | BME432 | Manufacturing Technology Laboratory - II | 0 | 0 | 3 | 2 |
| 10 | BEG431 | Communication Skills and Technical Seminar - II | 0 | 0 | 3 | 2 |
| | | **Total Number of Credits :** | | | | **29** |

## V SEMESTER

| S.No | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1. | BCE301 | Environmental Science And Engineering | 3 | 0 | 0 | 3 |
| 2. | BME501 | Thermal Engineering | 3 | 1 | 0 | 4 |
| 3. | BME502 | Dynamics Of Machinery | 3 | 1 | 0 | 4 |
| 4. | BME503 | Design Of Machine Elements | 3 | 1 | 0 | 4 |
| 5. | BME504 | Engineering Metrology And Measurements | 3 | 0 | 0 | 3 |
| 6. | BME505 | Applied Hydraulics And Pneumatics | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | |
| 7. | BME531 | Thermal Engineering Laboratory | 0 | 0 | 3 | 2 |
| 8. | BME532 | Computer Aided Design And Computer Aided Manufacturing Laboratory | 0 | 0 | 3 | 2 |
| | | **Total Number of Credits:** | | | | **25** |

## VI SEMESTER

| S.No | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1. | BME601 | Automobile Engineering | 3 | 0 | 0 | 3 |
| 2. | BME602 | Design Of Transmission Systems | 3 | 1 | 0 | 4 |
| 3. | BME603 | Finite Element Analysis | 3 | 1 | 0 | 4 |
| 4. | BME604 | Gas Dynamics And Jet Propulsion | 3 | 1 | 0 | 4 |
| 5. | BGE004 | Professional Ethics In Engineering | 3 | 0 | 0 | 3 |
| 6. | | Elective -1 | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | |
| 7. | BME631 | Heat Transfer Laboratory | 0 | 0 | 3 | 2 |
| 8. | BME632 | Metrology, Measurements And Dynamics Laboratory | 0 | 0 | 3 | 2 |
| | | **Total Number of Credits:** | | | | **25** |

**VII SEMESTER**

| S. No. | CODE NO. | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1. | BMG701 | Total Quality Management | 3 | 0 | 0 | 3 |
| 2. | BMG702 | Operations Research | 3 | 1 | 0 | 4 |
| 3. | BME701 | Computer Integrated Manufacturing | 3 | 0 | 0 | 3 |
| 4. | BME702 | Mechatronics and Modern Control | 3 | 0 | 0 | 3 |
| 5. | | Elective -2 | 3 | 0 | 0 | 3 |
| 6. | | Elective -3 | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | |
| 7. | BME731 | Computer Aided Simulation And Analysis Laboratory | 0 | 0 | 3 | 2 |
| 8. | BME732 | Mechatronics Laboratory | 0 | 0 | 3 | 2 |
| 9. | BME733 | Comprehension | 0 | 0 | 3 | 1 |
| | | **Total Number of Credits:** | | | | **24** |

**VIII SEMESTER**

| S.No. | CODE NO. | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| **THEORY** | | | | | | |
| 1. | BMG601 | Principles Of Management | 3 | 0 | 0 | 3 |
| 2. | BME801 | Power Plant Engineering | 3 | 0 | 0 | 3 |
| 3. | BGE801 | Engineering Economics And Cost Analysis | 3 | 0 | 0 | 3 |
| | | Elective – 4 | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | |
| 4. | BME831 | Project Work | 0 | 0 | 18 | 9 |
| | | **Total Number of Credits:** | | | | **21** |

## LIST OF ELECTIVES FOR B.E. MECHANICAL ENGINEERING

| S.No | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|
| 1. | BME001 | Quality Control And Reliability Engineering | 3 | 0 | 0 | 3 |
| 2. | BME002 | Refrigeration And Air Conditioning | 3 | 0 | 0 | 3 |
| 3. | BME003 | Renewable Sources Of Energy | 3 | 0 | 0 | 3 |
| 4. | BME004 | Industrial Tribology | 3 | 0 | 0 | 3 |
| 5. | BME005 | Vibration And Noise Control | 3 | 0 | 0 | 3 |
| 6. | BME006 | Unconventional Machining Processes | 3 | 0 | 0 | 3 |
| 7. | BME007 | Process Planning And Cost Estimation | 3 | 0 | 0 | 3 |
| 8. | BME008 | Design Of Jigs, Fixtures And Press Tools | 3 | 0 | 0 | 3 |
| 9. | BME009 | Composite Materials | 3 | 0 | 0 | 3 |
| 10. | BME010 | Thermal Turbo Machines | 3 | 0 | 0 | 3 |
| 11. | BME011 | Applied Computational Fluid Dynamics and Finite Element Analysis | 3 | 0 | 0 | 3 |
| 12. | BME012 | Utilization Of Solar Energy | 3 | 0 | 0 | 3 |
| 13. | BME013 | Nuclear Engineering | 3 | 0 | 0 | 3 |
| 14. | BME014 | Fundamentals Of Nano Technology | 3 | 0 | 0 | 3 |
| 15. | BME015 | Production Planning And Control | 3 | 0 | 0 | 3 |
| 16. | BME016 | Maintenance Engineering | 3 | 0 | 0 | 3 |
| 17. | BME017 | Product Design And Costing | 3 | 0 | 0 | 3 |
| 18. | BME018 | Pressure Vessel And Piping Design | 3 | 0 | 0 | 3 |
| 19. | BME019 | Advanced Internal Combustion Engines | 3 | 0 | 0 | 3 |
| 20. | BME020 | Heat Exchanger Design | 3 | 0 | 0 | 3 |
| 21. | BME021 | Robotics | 3 | 0 | 0 | 3 |
| 22. | BME022 | Solar Photovoltaic Fundamentals and Applications | 3 | 0 | 0 | 3 |
| 23. | BME023 | Piping Design Engineering | 3 | 0 | 0 | 3 |
| 24. | BME024 | Advanced Modeling Techniques | 2 | 0 | 2 | 3 |
| 25. | BME025 | Quality Control of Welded Structures | 2 | 0 | 2 | 3 |
| 26. | BME026 | Quality Assurance for Welded Structures | 2 | 0 | 2 | 3 |
| 27. | BME027 | Creativity, Innovation and Product Development | 3 | 0 | 0 | 3 |
| 28. | BME028 | Advanced Computer Aided Manufacturing | 2 | 0 | 2 | 3 |
| 29. | BME029 | Design of Heat Exchanger and Pressure Vessel | 3 | 0 | 0 | 3 |
| 30. | BME030 | Aircraft Engineering | 3 | 0 | 0 | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 31. | BME031 | Non Destructive Testing for Welded Structures | 3 | 0 | 0 | 3 |
| 32. | BMG001 | Marketing Management | 3 | 0 | 0 | 3 |
| 33. | BMG002 | Entrepreneurship Development | 3 | 0 | 0 | 3 |
| 34. | BMG003 | Operations Management | 3 | 0 | 0 | 3 |
| 35. | BGE002 | Industrial Safety Engineering | 3 | 0 | 0 | 3 |

**BEG101 TECHNICAL ENGLISH – I L T P C**
**3 1 0 4**

**UNIT I 12**

General Vocabulary – Changing words from one form to another – Adjectives, Comparative adjectives – Active and Passive voice – Tenses – simple present, present continuous – Nouns – compound nouns – Skimming and scanning – Listening and transfer of information – bar chart, flowchart – Paragraph writing, description – Discussing as a group and making an oral report on the points discussed, Conversation techniques – convincing others.

**Suggested activities:**

1. Matching words & meanings - Using words in context – Making sentences.
2. Changing sentences from active to passive voice & vice versa.
3. Skimming, cloze exercises, exercises transferring information from text to graphic form – bar charts, flow charts.
4. Writing descriptions using descriptive words & phrases, and technical vocabulary.
5. Role play, conversation exercises, discussions, oral reporting exercises.

Any other related relevant classroom activity.

**UNIT II 12**

Vocabulary – prefixes & suffixes – simple past tense – Spelling and punctuation – 'wh' Question forms – Scanning, inference – Listening & note-taking – Paragraph writing – Comparison and contrast – Creative thinking and speaking.

**Suggested Activities:**

1. a. Vocabulary activities using prefixes and suffixes.
   b. Exercises using questions – asking & answering questions.
2. Scanning the text for specific information.
3. Listening and note-taking – Writing paragraphs using notes, giving suitable headings and subheadings for paragraphs. Using expressions of comparison and contrast.
4. Discussion activities and exploring creative ideas.

Any other related relevant classroom activity.

**UNIT III 12**

Tenses – simple past, simple future and past perfect – Reading in Context – Reading & note-making – single line – Definitions – sequencing of sentences – instruction writing – Persuasive speaking.

**Suggested activities:**

1. Providing appropriate context for the use of tenses
2. Listening and note-taking
3. (a) Writing sentence definitions and instructions
   (b) Identifying the discourse links and sequencing jumbled sentences.
4. Speaking exercises, discussions, role play exercises using explaining, convincing and persuasive Strategies.

Any other related relevant classroom activity.

**UNIT IV 12**

Modal verbs and Probability – Concord subject verb agreement (Correction of errors) – Cause and effect expressions – Extended Definition – Speaking about the future plans.

**Suggested activities:**

1. a. Making sentences using modal verbs to express probability
   b. Gap filling using relevant grammatical form of words.
2. Writing extended definitions
3. Speaking – role play activities, discussions, extempore speaking exercises speculating about the future.
   Any other related relevant classroom activity

**UNIT V** **12**

'If' conditionals – Gerunds – Intensive reading – Speaking – Presentation of problems & solutions – Itinerary – planning for an industrial visit – Formal Letter writing – Letter to the editor, invitation letter, accepting, declining letter and permission letter.

**Suggested activities:**

1. a) Sentence completion exercises using 'If' conditionals.
   b) Gap filling exercises using gerunds and present participle forms
2. Reading comprehension exercises.
3. Role play, discussion, debating and speaking activities for stating, discussing problems and suggesting solutions.
4. Writing letters to officials and to the editor in formal/official contexts.
   Any other related relevant classroom activity.

**TOTAL: 60 PERIODS**

**AREAS TO BE COVERED UNDER DIFFERENT HEADINGS:**

**A) Language focus**

1. Suffixes and Prefixes
2. Transformation of words from one form to another (Derivatives from root words)
3. Matching words & meanings (synonyms)
4. Compound nouns
5. Degrees of comparison
6. Active and passive voice-impersonal passive
7. Tenses: simple present, simple past, simple future, present continuous, past continuous, Present Perfect.
8. Modal verbs
9. 'Wh' Question forms
10. Conditional clause
11. Gerunds and infinitives
12. Expressing Cause and effect
13. Concord
14. Punctuation
15. Writing definitions

**B) Reading**

1. Reading in context
2. Skimming and scanning
3. Scanning the text for specific information
4. Reading and note-making
5. Intensive reading for making inferences
6. Reading comprehension

**C) Listening:**

1. Listening and transfer of information
2. Listening & note taking

**D) Writing**:

1. Transformation of information from graphical data to written form and from written form to graphical Form.
2. Paragraph writing – Description
3. Paragraph Writing – comparison and contrast.
4. Note-making
5. Writing Instructions
6. Jumbled sentences
7. Letter writing – Formal letters (Invitation, Accepting, Declining, Permission Letters) Letters to the editor

**E) Speaking:**

1. Discussing as a group and making oral reports,
2. Role play-Conversation techniques – convincing others
3. Creative thinking and speaking, Exploring creative ideas
4. Persuasive strategies
5. Speaking about the future plans
6. Extempore speech – Speaking exercises speculating about the future
7. Presentation of problems and solutions
8. Debates

**TEXT BOOK:**

1. Department of Humanities & Social Sciences, Anna University, 'English for Engineers and Technologists' Combined Edition (Volumes 1 & 2), Chennai: Orient Longman Pvt. Ltd., 2006. Themes 1– 4 (Resources, Energy, Computer, Transport)

**REFERENCES:**

1. Meenakshi Raman and Sangeeta Sharma, 'Technical Communication English skills for Engineers', Oxford University Press, 2008.
2. Andrea, J. Rutherford, 'Basic Communication Skills for Technology', 2nd Edition, Pearson Education, 2007.

***Extensive Reading*:**

A.P.J.Abdul Kalam with Arun Tiwari, 'Wings of Fire' An Autobiography, University Press (India) Pvt. Ltd.,1999, 30th Impression 2007.

**BMA101 MATHEMATICS – I L T P C**
**3 1 0 4**

**UNIT I MATRICES 12**

Characteristic equation – Eigen values and eigen vectors 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 Lagrangian 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 integration in Cartesian co-ordinates – Area as double integral – Volume as triple integral.

**TOTAL: 60 PERIODS**

**TEXT BOOK:**

1. Bali N. P and Manish Goyal, "Text book of Engineering Mathematics", 3rd Edition, Laxmi Publications (P) Ltd., (2008)

**REFERENCES:**

1. Grewal. B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, Delhi, (2007).
2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2007).
3. Glyn James, "Advanced Engineering Mathematics", 7th Edition, Wiley India, (2007).
4. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House Pvt. Ltd., (2007).

**BPH101 ENGINEERING PHYSICS – I L T P C**
**3 0 0 3**

**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 – SONAR – Non Destructive Testing – pulse echo system through transmission and reflection modes – A,B and C – scan displays, Medical applications – Sonograms.

**UNIT II LASERS 9**

Introduction – Principle of Spontaneous emission and stimulated emission, Population inversion, pumping, Einsteins A and B coeffcients – derivation. Types of lasers – He-Ne, $CO_2$, Nd-YAG, Semiconductor lasers (homojunction & heterojunction) Qualitative Industrial Applications - Lasers in welding, heat treatment, cutting – Medical applications – Holography (construction & reconstruction).

**UNIT III FIBER OPTICS & APPLICATIONS 9**

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

**UNIT IV QUANTUM PHYSICS 9**

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jean's 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 PERIODS**

**TEXT BOOKS:**

1. R. K. Gaur and S.C. Gupta, 'Engineering Physics' Dhanpat Rai Publications, New Delhi (2003)
2. M.N.Avadhanulu and PG Kshirsagar, 'A Text book of Engineering Physics' S.Chand and company, Ltd., New Delhi, 2005.

**REFERENCES:**

1. Serway and Jewett, 'Physics for Scientists and Engineers with Modern Physics', 6th Edition, Thomson Brooks/Cole, Indian reprint (2007)
2. Rajendran, V and Marikani A, 'Engineering Physics' Tata Mc Graw Hill Publications Ltd, III Edition, New Delhi (2004).
3. Palanisamy, P.K., 'Engineering Physics' Scitech publications, Chennai (2007).
4. Jayakumar. S, 'Engineering Physics', R.K. Publishers, Coimbatore (2003).
5. Chitra Shadrach and Sivakumar Vadivelu, 'Engineering Physics', Pearson Education, New Delhi (2007).

**BCY101 ENGINEERING CHEMISTRY – I L T P C**
**3 0 0 3**

**UNIT I WATER TECHNOLOGY 9**

Characteristics – alkalinity – types of alkalinity and determination – hardness – types and estimation by EDTA method (problems), 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 – demineralization process – desalination and reverse osmosis.

**UNIT II POLYMERS AND COMPOSITES 9**

Polymers – definition – polymerization – types – addition and condensation polymerization – free radical polymerization mechanism ,Plastics – classification – preparation, properties and uses of PVC, Teflon, polycarbonate, polyurethane, nylon-6,6, PET, Rubber – vulcanization of rubber, synthetic rubbers – butyl rubber, SBR, Composites – definition, types polymer matrix composites – FRP only.

**UNIT III SURFACE CHEMISTRY 9**

Adsorption – types – adsorption of gases on solids – adsorption isotherms – Frendlich and Langmuir isotherms – adsorption of solutes from solution – role of adsorbents in catalysis, ion-exchange adsorption and pollution abatement.

**UNIT IV NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES 9**

Nuclear energy – fission and fusion reactions and light water nuclear reactor for power generation (block diagram only) – breeder reactor – solar energy conversion – solar cells – wind energy – fuel cells – hydrogen-oxygen fuel cell – batteries – alkaline batteries – lead-acid, nickel-cadmium and lithium batteries.

**UNIT V ENGINEERING MATERIALS 9**

Refractories – classification – acidic, basic and neutral refractories – properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling) – manufacture of alumina, magnesite and zirconia bricks, Abrasives – natural and synthetic abrasives – quartz, corundum, emery, garnet, diamond, silicon carbide and boron carbide. Lubricants – mechanism of lubrication, liquid lubricants – properties – viscosity index, flash and fire points, cloud and pour points, oilyness – solid lubricants – graphite and molybdenum sulphide. Nanomaterials – introduction to nanochemistry – carbon nanotubes and their Applications.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. P.C.Jain and Monica Jain, “Engineering Chemistry” Dhanpat Rai Pub.Co., New Delhi (2002).
2. S.S. Dara “A text book of engineering chemistry” S.Chand & Co. Ltd., New Delhi (2006).

**REFERENCES:**

1. B.K.Sharma “Engineering chemistry” Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar “Engineering Chemistry” Tate McGraw-Hill Pub.Co.Ltd., New Delhi (2008).

**BCS101 FUNDAMENTALS OF COMPUTING AND PROGRAMMING L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION TO COMPUTERS 9**

Introduction – Characteristics of Computers – Evolution of Computers – Computer Generations – Classification of Computers – Basic Computer Organization – Number Systems.

**UNIT II COMPUTER SOFTWARE 9**

Computer Software – Types of Software – Software Development Steps – Internet Evolution – Basic Internet Terminology – Getting connected to Internet – Applications.

**UNIT III PROBLEM SOLVING AND OFFICE AUTOMATION 9**

Planning the Computer Program – Purpose – Algorithm – Flow Charts – Pseudocode –Application Software Packages – Introduction to Office Packages (not detailed commands for examination).

**UNIT IV INTRODUCTION TO "C" 9**

Overview of **"C"** – Constants, Variables and Data Types – Operators and Expressions – Managing Input and Output operators – Decision Making –Branching and Looping.

**UNIT V FUNCTIONS AND POINTERS 9**

Handling of Character Strings – User-defined functions – Definitions – Declarations – Call by reference – Call by value – Structures and Unions – Pointers – Arrays – The Preprocessor – Developing a **"C"** Program : Some Guidelines.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Ashok.N.Kamthane, "Computer Programming", Pearson Education (India) (2008).
2. Behrouz A.Forouzan and Richard.F.Gilberg, "A Structured Programming Approach Using C", Second Edition, Brooks-Cole Thomson Learning Publications (2007).

**REFERENCES:**

1. Pradip Dey and Manas Ghoush, "Programming in C", Oxford University Press (2007).
2. Byron Gottfried, "Programming with C", 2nd Edition, (Indian Adapted Edition), TMH publications (2006). (Unit II, III, IV, and V).
3. Stephen G.Kochan, "Programming in C", Third Edition, Pearson Education India (2005).
4. Brian W.Kernighan and Dennis M.Ritchie, "The C Programming Language", Pearson Education Inc. (2005).
5. E.Balagurusamy,"Computing fundamentals and C Programming", Tata McGRaw-Hill Publishing Company Limited (2008).
6. S.Thamarai Selvi and R.Murugan, "C for All", Anuradha Publishers (2008).

**BME101 ENGINEERING GRAPHICS L T P C**
**2 3 0 4**

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

**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.

**FREE HAND SKETCHING:**

Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

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

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

**UNIT III PROJECTION OF SOLIDS 12**

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

**UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 12**

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

**UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 12**

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

**TOTAL: 60 PERIODS**

**TEXT BOOK:**

1. N.D. Bhatt, “Engineering Drawing” Charotar Publishing House, 46th Edition, (2003).

**REFERENCES:**

1. K.V.Natarajan, “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai (2006).
2. M.S. Kumar, “Engineering Graphics”, D.D. Publications (2007).
3. K. Venugopal & V. Prabhu Raja, “Engineering Graphics”, New Age International (P) Limited (2008).
4. M.B. Shah and B.C. Rana, “Engineering Drawing”, Pearson Education (2005).
5. K. R. Gopalakrishnana, “Engineering Drawing” (Vol. I & II), Subhas Publications (1998).
6. Dhananjay A.Jolhe, “Engineering Drawing with an introduction to AutoCAD” Tata McGraw Hill Publishing Company Limited (2008).
7. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi (2008).

**BCS131 COMPUTER PRACTICE LABORATORY – I L T P C**
**0 0 3 2**

**LIST OF EXERCISES**
**I. MS Office**

**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.

**II SIMPLE C PROGRAMMING**

1. Data types, Expression evaluation, Conditional statements.
2. Arrays.
3. Structures and Unions.
4. Functions.

**TOTAL: 45 PERIODS**

For programming exercises Flow chart and pseudocode are essential.

**HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 60 STUDENTS**

**HARDWARE**

- LAN System with 66 nodes (OR) Standalone PCs – 66 Nos.
- Printers – 3 Nos.

**SOFTWARE**

- OS – Windows / UNIX Clone
- Application Package – Office suite
- Compiler – **"C"**

**BPC131 PHYSICS AND CHEMISTRY LABORATORY – I** **L T P C**
**0 0 3 2**

## PHYSICS LABORATORY – I

### LIST OF EXPERIMENTS

1. (a) Particle size determination using Diode Laser.
   (b) Determination of Laser parameters – Wavelength and angle of divergence.
   (c) Determination of acceptance angle in an optical fiber.
2. Determination of thickness of a thin wire – Air wedge method.
3. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
4. Determination of wavelength of mercury spectrum – spectrometer grating.
5. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
6. Determination of Hysteresis loss in a ferromagnetic material.

## B. CHEMISTRY LABORATORY – I

### LIST OF EXPERIMENTS

1. Estimation of hardness of Water by EDTA method.
2. Estimation of Copper in brass by EDTA method.
3. Determination of DO in water (Winkler's method)
4. Estimation of Chloride in Water sample (Argentometric)
5. Estimation of alkalinity of Water sample
6. Determination of molecular weight and degree of polymerization using viscometry.

**BME131 ENGINEERING PRACTICES LABORATORY L T P C**
**0 0 3 2**

**GROUP A (CIVIL & MECHANICAL)**

**I CIVIL ENGINEERING PRACTICE**

**BUILDINGS:**

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

**PLUMBING WORKS**:

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

**CARPENTRY USING POWER TOOLS ONLY:**

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

**II MECHANICAL ENGINEERING PRACTICE**

**WELDING:**

(a) Preparation of arc welding of butt joints, lap joints and tee joints.
(b) Gas welding practice.

**BASIC MACHINING:**

(a) Simple Turning and Taper turning.
(b) Drilling Practice.

**SHEET METAL WORK:**

(a) Forming & Bending:
(b) Model making – Trays, funnels, etc.
(c) Different type of joints.

**MACHINE ASSEMBLY PRACTICE:**

(a) Study of centrifugal pump.
(b) Study of air conditioner.

**DEMONSTRATION ON:**

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and vee – fitting models.

## GROUP B (ELECTRICAL & ELECTRONICS)

### III ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair-case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

### IV ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipments – Resistor colour coding, measurement of AC signal parameters (peak-peak value, rms value period, frequency) usindg CRO.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor for HWR and FWR.

**TOTAL: 45 PERIODS**

### REFERENCES:

1. K.Jeyachandran, S.Natarajan & S, Balasubramanian, “A Primer on Engineering Practices Laboratory” Anuradha Publications (2007).
2. T.Jeyapoovan, M.Saravanapandian & S.Pranitha, “Engineering Practices Lab Manual”, Vikas Publishing House Pvt. Ltd, (2006)
3. H.S. Bawa, “Workshop Practice”, Tata McGraw – Hill Publishing Company Limited (2007).
4. A. Rajendra Prasad & P.M.M.S. Sarma, “Workshop Practice”, Sree Sai Publication (2002).
5. P.Kannaiah & K.L.Narayana, “Manual on Workshop Practice”, Scitech Publications (1999).

**BEG201 TECHNICAL ENGLISH – II** **L T P C**

**(*Common to all branches)*** **3 0 0 3**

**AIM**

To encourage students to actively involve in participative learning of English and to help them acquire communication skills.

**OBJECTIVES**

1. To help the students to develop listening skills for academic and professional purposes.
2. To help the students to acquire the ability of effective speaking in English in real-life situations.
3. To inculcate reading habit and to develop effective reading skills.
4. To help the students to improve their active and passive vocabulary.
5. To familiarize the students with different rhetorical functions of scientific English.
6. To enable the students to write letters and reports effectively in formal and business situations.

**UNIT I** **10**

Technical Vocabulary – meanings in context, sequencing words, Articles – Prepositions, intensive reading and predicting content, Reading and interpretation, extended definitions, process description.

**Suggested activities**

1. Exercises on word formation using the prefix 'self' – Gap filling with preposition Exercises – Using sequence words
2. Reading comprehension exercise with questions based on inference – Reading heading and predicting the content – reading advertisements and interpretation
3. Writing extended definitions – Writing description of processes – Writing paragraphs based on discussions – Writing paragraphs describing the future

**UNIT II** **10**

Phrases / structure indicating cause/purpose – Adverbs – Skimming – Non-verbal communication – Listening – correlating verbal and non-verbal communication – speaking in group discussion – Formal Letter writing – Writing analytical paragraphs.

**Suggested Activities**

1. Reading comprehension exercises with questions on overall content – Discussions analyzing stylistic features (creative and factual description) – Reading comprehension exercises with texts including graphic communication – Exercises in interpreting non-verbal communication.
2. Listening comprehension exercises to categories data in tables.
3. Writing formal letters – quotations, placing orders, clarification, and complaint, Letter seeking permission for industrial visits, writing analytical paragraphs on different debatable issues.

**UNIT III** **10**

Cause and effect expressions – Different grammatical forms of the same word – speaking – stress and intonation, Group Discussions – reading – critical reading – listening – writing – using connectives, report writing – types, structure, data collection, content, form, recommendations.

**Suggested Activities**

1. Exercises combining sentences using cause and effect expressions – Gap filling exercises using the appropriate tense forms – Making sentences using different grammatical forms of the same word.
2. Speaking exercises involving the use of stress and intonation – Group discussions – analysis of problems and offering solutions.
3. Reading comprehension exercises with critical questions, multiple choice questions.
4. Sequencing of jumbled sentences using connectives – Writing different types of reports like industrial accident report and survey report – writing recommendations.

**UNIT IV** **10**

Numerical adjectives – Oral instructions – Descriptive writing – Argumentative paragraphs – Letter of application – content, format (CV/Bio-data) – instructions, imperative forms – preparing checklists, Yes/No question form – Email communication

**Suggested Activities**

1. Rewriting exercises using numerical adjectives.
2. Reading comprehension exercises with analytical questions on content – Evaluation of content.
3. Listening comprehension – entering information in tabular form, intensive listening exercise and completing the steps of a process.
4. Speaking – Role Play – group discussions – Activities giving oral instructions.
5. Writing descriptions, expanding hints – writing argumentative paragraphs – Writing formal letters – writing letter of application with CV/Bio-data – Writing general and safety instructions – Preparing checklists – Writing e-mail messages

**UNIT V** **5**

Speaking – Discussion of problems and solutions – Creative and critical thinking – writing an essay, Writing a proposal.

**Suggested Activities**

1. Case Studies on problems and solutions
2. Brain storming and discussion
3. Writing Critical essays
4. Writing short proposals of 2 pages for starting a project, solving problems, etc.
5. Writing advertisements

**TOTAL 45 periods**

**AREAS TO BE COVERED UNDER DIFFERENT HEADINGS**

**A. Language Focus**

1. Technical vocabulary
2. Sequencing words
3. Articles
4. Prepositions
5. Word formation using prefixes
6. Phrases / Structure indicating purpose
7. Adverbs
8. Cause and effect expressions
9. Tense forms
10. Different grammatical forms of the same word
11. Numerical adjectives
12. Extended definitions

**B. Reading**

1. Intensive reading and predicting content
2. Reading and interpretation
3. Skimming
4. Critical reading
5. Reading comprehension exercises

**C. Listening**

1. Correlating verbal and non-verbal communication
2. Listening comprehension

**D. Speaking**

1. Group Discussions
2. Stress and intonation
3. Role plays and giving oral instructions
4. Discussion of problems and solutions

**E. Writing**

1. Process description
2. Formal letter writing
3. Writing analytical paragraphs
4. Report Writing
5. Descriptive writing
6. Argumentative paragraphs
7. Letter of application
8. Instructions
9. Recommendations
10. Checklists preparation
11. Email Communication
12. Writing critical essays
13. Writing proposals

**TEXT BOOK:**

1. **'**English for Engineers and Technologists' Combined Edition (Volumes 1 & 2), Department of Humanities & Social Sciences, Anna University, Chennai: Orient Longman Pvt. Ltd., 2006. Themes 5 – 8 (Technology, Communication, Environment, Industry)

**REFERENCES:**

1. Mark Abbot son, "Technical English for professionals" (2009).
2. P.K. Dutt, G. Rajeevan and C.L.N Prakash, 'A Course in Communication Skills', Cambridge University Press, India 2007.
3. Krishna Mohan and Meera Banerjee, 'Developing Communication Skills', Macmillan India Ltd., (Reprinted 1994 – 2007).
4. Edgar Thorpe, Showick Thorpe, 'Objective English', Second Edition, Pearson Education, 2007.
5. Rodney Huddleston and Geoffrey Pullum, 'A students introduction to English Grammar', Cambridge University Press, 2007.
6. Jack C.Richards, Jonathan Hull and Susan Protor, 'English for International Communication', Third Edition, Cambridge University Press, 2004.

**Extensive Reading:**

1. Robin Sharma**, '**The Monk Who Sold His Ferrari', Jaico Publishing House, 2007

***Note:***

The book listed under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

| BMA201 | MATHEMATICS – II | L T P C |
|---|---|---|
| | (*Common to all branches)* | 3 1 0 4 |

**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 parallelpipeds.

**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 PERIODS**

**TEXT BOOK:**

1. Bali N. P and Manish Goyal, "Text book of Engineering Mathematics", 3rd Edition, Laxmi Publications (P) Ltd., (2008).
2. Grewal.B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications', Delhi (2007).

**REFERENCES:**

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi (2007).
2. Glyn James, "Advanced Engineering Mathematics", 3rd Edition, Pearson Education (2007).
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 7th Edition, Wiley India (2007).
4. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House Pvt. Ltd., (2007).

**BPH201 ENGINEERING PHYSICS – II** **L T P C**
**(*Common to all branches)*** **3 0 0 3**

**UNIT I CONDUCTING MATERIALS 9**

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs 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 – anti-ferromagnetic materials – Ferrites – applications – magnetic recording and readout – storage of magnetic data – tapes, floppy and magnetic disc drives. Superconductivity – Properties – Types of super conductors – 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 polarization – frequency and temperature dependence of polarisation – Internal field – Claussius-Mosotti relation (derivation) – dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferro electricity and applications.

**UNIT V MODERN ENGINEERING MATERIALS 9**

Metallic glasses: preparation, properties and applications. Shape Memory Alloys (SMA): Characteristics, properties of Ni-Ti alloy, application, advantages and disadvantages of SMA. Nanomaterials: synthesis – plasma arcing – chemical vapour deposition – sol-gels – electrodeposition – ball milling – properties of nanoparticles and applications. Carbon nanotubes: fabrication – arc method – pulsed laser deposition – chemical vapour deposition – structure – properties and applications.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Charles Kittel ‘Introduction to Solid State Physics’, John Wiley & sons 7th Edition, Singapore (2007)
2. Charles P. Poole and Frank J.Ownen, ‘Introduction to Nanotechnology’, Wiley India (2007) (for Unit V)

**REFERENCES:**

1. G.Senthil Kumar, 'Engineering Physics – II' VRB Publishers Pvt Ltd., Chennai (2010)
2. B.N.Sankar and S.O.Pillai, 'Engineering Physics', New Age International Publishers (2008) New Delhi.
3. Jayakumar .S. 'Materials Science', R.K. Publishers, Coimbatore (2008).
4. Palanisamy.P.K, 'Materials Science', Scitech publications (India) Pvt. Ltd., Chennai, 2nd Edition (2007).
5. M. Arumugam, 'Materials Science' Anuradha Publications, Kumbakonam (2006).
6. Rajendran.V and Marikani.A, 'Materials Science' Tata McGraw Hill publications, New Delhi (2004).

**BCY201 ENGINEERING CHEMISTRY – II** **L T P C**

**(*Common to all branches)*** **3 0 0 3**

**AIM**

To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

**OBJECTIVES**

The student should be conversant with the principles of electrochemistry, electrochemical cells, emf and applications of emf measurements.
Principles of corrosion control.
Chemistry of Fuels and combustion.
Industrial importance of Phase rule and alloys.
Analytical techniques and their importance.

**UNIT I ELECTROCHEMISTRY** **9**

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 – electrochemical series – significance – potentiometric titrations (redox $Fe^{2+}$ vs dichromate and precipitation – Ag+ vs $Cl^-$ titration) and conductometric titrations – acid-base (HCI vs NaOH) titrations.

**UNIT II CORROSION AND CORROSION CONTROL** **9**

Chemical corrosion – Pilling-Bedworth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion – factors influencing corrosion – corrosion control – sacrificial anode and impressed current cathodic methods – corrosion inhibitors – protective coatings – paints – constituents and functions – metallic coatings – electroplating (Au) and electroless (Ni) plating.

**UNIT III FUELS AND COMBUSTION** **9**

Calorific value – classification – Coal – proximate and ultimate analysis – metallurgical coke – manufacture by Otto-Hoffmann by product oven method – Petroleum processing and fractions – cracking – catalytic cracking and methods. knocking – octane number and cetane number – synthetic petrol – Fischer Tropsch and Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG – Flue gas analysis – Orsat apparatus – theoretical air for combustion.

**UNIT IV PHASE RULE AND ALLOYS** **9**

Statement and explanation of terms involved – one component system – water system – condensed phase rule – construction of phase diagram by thermal analysis – simple eutectic systems (lead-silver system only) – alloys – importance, ferrous alloys – nichrome and stainless steel – heat treatment of steel, non-ferrous alloys – brass and bronze.

**UNIT V ANALYTICAL TECHNIQUES** **9**

Beer-Lambert's law (problem) – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (problem) (block diagram only) – estimation of iron by Colorimetry. flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry. atomic absorption spectroscopy – principles – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub. Co., New Delhi, 15th Edition (2009).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2006)

**REFERENCES:**

1. A Text book of Physical Chemistry by A.S.Negi & S.C. Anand, New Age International Pvt. Ltd., New Delhi (2009)
2. B.Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd., New Delhi (2008)
3. Principles of Physical Chemistry, AR Puri, LR Sharma, M.S. Pathania, Vishal Publication, (2005)
4. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001)

**(a) BME201 ENGINEERING MECHANICS L T P C**
**(For Mechanical & Civil Branches) 3 1 0 4**

**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 & STATICS OF PARTICLES 12**

Introduction – Units and Dimensions – Laws of Mechanics – Lami'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 Coloumb friction – simple contact friction – Rolling resistance – Belt friction. Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.

**TOTAL: 60 PERIODS**

**TEXT BOOK:**

1. Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers", Vol. 1 Statics and Vol. 2 Dynamics, McGraw-Hill International Edition, 9th edition (2010)

**REFERENCES:**

1. Rajasekaran.S, Sankarasubramanian.G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., 3rd Edition (2010).
2. Hibbeller, R.C., "Engineering Mechanics", Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., 12th Edition (2010).
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).
5. Palanichamy.M.S., Nagam, S., "Engineering Mechanics – Statics & Dynamics", Tata McGraw-Hill (2001).

**(b) BEE201 CIRCUIT THEORY L T P C**
**(For EEE & EIE Branches) 3 1 0 4**

**UNIT I BASIC CIRCUITS ANALYSIS 12**

Ohm's Law – Kirchoffs laws – DC and AC Circuits – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis for D.C and A.C. circuits.

**UNIT II NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS 12**

Network reduction: voltage and current division, source transformation – star delta conversion. Thevenins and Norton Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem.

**UNIT III RESONANCE AND COUPLED CIRCUITS 12**

Series and parallel resonance – their frequency response – Quality factor and Bandwidth – Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

**UNIT IV TRANSIENT RESPONSE FOR DC CIRCUITS 12**

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. input (Sinusoidal).

**UNIT V ANALYSING THREE PHASE CIRCUITS 12**

Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4- wire circuits with star and delta connected loads, balanced & unbalanced loads – phasor diagram of voltages and currents – power and power factor measurements in three phase circuits.

**TOTAL: 60 PERIODS**

**TEXT BOOKS:**

1. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", Tata McGraw Hill, (2007).
2. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", Tata McGraw Hill publishers, 6th edition, New Delhi, (2002).

**REFERENCES:**

1. John Bird "Electrical Circuit Theory and Technology" Fourth Edition, Newnes Publications (2010)
2. Charles K.Alexander, Mathew N.O.Sadik, "Fundamentals of Electric circuits", 2nd Edition, McGraw Hill (2003).
3. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, Tata McGraw-Hill, New Delhi (2001).
4. Paranjothi SR, "Electric Circuits Analysis," New Age International Ltd., New Delhi, (1996).
5. Chakrabati A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi (1999).

**(c) BEC201 ELECTRIC CIRCUITS AND ELECTRON DEVICES L T P C**
**(For ECE, CSE and IT Branches) 3 1 0 4**

**UNIT I CIRCUIT ANALYSIS TECHNIQUES 12**

Kirchoff's current and voltage laws – series and parallel connection of independent sources – R, L and C – Network Theorems – Thevenin, Superposition, Norton, Maximum power transfer and duality – Star-delta conversion.

**UNIT II TRANSIENT & RESONANCE IN RLC CIRCUITS 12**

Basic RL, RC and RLC circuits and their responses to pulse and sinusoidal inputs – frequency response – Parallel and series resonances – Q factor – single tuned and double tuned circuits.

**UNIT III SEMICONDUCTOR DIODES 12**

Review of intrinsic & extrinsic semiconductors – Theory of PN junction diode – Energy band structure – current equation – space charge and diffusion capacitances – Effect of temperature and breakdown mechanism – Zener diode and its characteristics.

**UNIT IV TRANSISTORS 12**

Principle of operation of PNP and NPN transistors – study of CE, CB and CC configurations and comparison of their characteristics – Breakdown in transistors – operation and comparison of N-Channel and P-Channel JFET – drain current equation – MOSFET – Enhancement and depletion types – structure and operation – comparison of BJT with MOSFET – thermal effect on MOSFET.

**UNIT V SPECIAL SEMICONDUCTOR DEVICES (Qualitative Treatment only) 12**

Tunnel diodes, PIN diode, varactor diode – SCR characteristics and two transistor equivalent model – UJT – Diac and Triac – Laser, CCD, Photodiode, Phototransistor, Photoconductive and Photovoltaic cells – LED, LCD.

**TOTAL: 60 PERIODS**

**TEXT BOOKS:**

1. Joseph A. Edminister, Mahmood, Nahri, "Electric Circuits" – Shaum series, Tata McGraw Hill (2001)
2. Salivahanan, N. Suresh kumar and A.Vallavaraj, "Electronic Devices and Circuits", Tata McGraw Hill, 2nd Edition (2008).
3. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition (2008).

**REFERENCES:**

1. William H. Hayt, J.V. Jack, E. Kemmebly and Steven M. Durbin, "Engineering Circuit Analysis", Tata McGraw Hill (2011.)
2. A.Sudhakar, Shyammohan S Palli, "Circuits and Networks-Analysis and Synthesis", Tata McGraw Hill, 4th edition (2010)
3. Robert T.Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, 7th Education (2008).

4. J.Millman & Halkins, Satyebranta Jit, "Electronic Devices & Circuits", Tata McGraw Hill, 2nd Edition (2008).
5. William H. Hayt, J.V. Jack, E. Kemmebly and steven M. Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 6th Edition (2002).

**(a) BEE202 BASIC ELECTRICAL & ELECTRONICS ENGINEERING L T P C**
**(For Mechanical & Civil Branches) 4 0 0 4**

**UNIT I ELECTRICAL CIRCUITS & MEASURMENTS 12**

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and 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, Single Phase Transformer, Single Phase Induction Motor.

**UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 12**

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – 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 (simple 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 PERIODS**

**TEXT BOOKS:**

1. R.S. Sedha, "Applied Electronics" S. Chand & Co., 2006.
2. V.N. Mittle "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.

**REFERENCES:**

1. Gnanavadivel,C. Senthilkumar, A. Vijaykumar, S. Joseph Gladwin, "Basic Electrical and Electronics Engineering", Anuradha Publishers (2011).
2. Muthusubramanian.R, Salivahanan.S and Muraleedharan.K.A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, Second Edition (2006).
3. Nagsarkar T K and Sukhija M S, "Basics of Electrical Engineering", Oxford press (2005).
4. Premkumar N, "Basic Electrical Engineering", Anuradha Publishers (2003).
5. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum Outline Series, McGraw Hill (2002).
6. Mehta V K, "Principles of Electronics", S.Chand & Company Ltd., (1994).

**(b) BME202 BASIC CIVIL & MECHANICAL ENGINEERING L T P C**
**(For CSE, ECE, EEE, EIE & IT branches) 4 0 0 4**

## A – CIVIL ENGINEERING

**UNIT I SURVEYING AND CIVIL ENGINEERING MATERIALS 15**

**Surveying**: Objects – types – classification – principles – measurements of distances – angles – leveling – determination of areas – illustrative examples.

**Civil Engineering Materials:** Bricks – stones – sand – cement – concrete – steel sections.

**UNIT II BUILDING COMPONENTS AND STRUCTURES 15**

**Foundations:** Types – Bearing capacity – Requirement of good foundations.

**Superstructure:** Brick masonry – stone masonry – Beams –Columns – Lintels – Roofing – Flooring – Plastering – Mechanics – Internal and external forces – stress – strain – elasticity – Types of Bridges and Dams – Basics of Interior Design and Landscaping.

**TOTAL: 30 PERIODS**

## B – MECHANICAL ENGINEERING

**UNIT III POWER PLANT ENGINEERING 10**

Introduction, Classification of Power Plants – Working principle of steam, Gas, Diesel, Hydro-electric and Nuclear Power plants – Merits and Demerits – Pumps and turbines – working principle of Reciprocating pumps (single acting and double acting) – Centrifugal Pump.

**UNIT IV IC ENGINES 10**

Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Boiler as a power plant.

**UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 10**

Terminology of Refrigeration and Air Conditioning: Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner.

**TOTAL: 30 PERIODS**

**REFERENCES:**

1. Shanmugam.G and Palanichamy.M.S, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill Publishing Co., New Delhi (1996).
2. Ramamrutham. S, “Basic Civil Engineering”, Dhanpat Rai Publishing Co. (P) Ltd. 1999.
3. Seetharaman S. “Basic Civil Engineering”, Anuradha Agencies (2005).
4. Venugopal K and Prahu Raja V, “Basic Mechanical Engineering”, Anuradha Publishers, Kumbakonam (2000).
5. Shantha Kumar S R J., “Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai (2000).

**BCS231 COMPUTER PRACTICE LABORATORY – II** **L T P C**
***(Common to all branches)*** **0 1 2 2**

**LIST OF EXPERIMENTS**

**1. UNIX COMMANDS**

Study of Unix OS – Basic Shell Commands – Vi Editor.

**2. SHELL PROGRAMMING**

Simple Shell program – Conditional Statements – Testing and Loops.

**3. C PROGRAMMING ON UNIX**

Dynamic Storage Allocation – Pointers – Functions – File Handling.

**TOTAL: 45 PERIODS**

**HARDWARE / SOFTWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS**

**Hardware**

- UNIX Clone Server – 1 No
- Nodes (thin client or PCs) – 33 Nos
- Printer – 3 Nos.

**Software**

- OS – UNIX Clone (33 user license or License free Linux)
- Compiler - C

**BPC231 PHYSICS AND CHEMISTRY LABORATORY – II** **L T P C**

***(Common to all branches)*** **0 0 3 2**

## PHYSICS LABORATORY – II

### 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.

- **A minimum of FIVE experiments shall be offered.**
- **Laboratory classes on alternate weeks for Physics and Chemistry.**

## CHEMISTRY LABORATORY – II

### LIST OF EXPERIMENTS

1. Conductometric titration (Simple acid base)
2. Conductometric titration (Mixture of weak and strong acids)
3. Conductometric titration using $BaCl_2$ Vs $Na_2SO_4$
4. Potentiometric Titration ($Fe^{2+}$ Vs $K_2Cr_2O_7$)
5. pH Titration (Acid & Base)
6. Determination of water of crystallization of a crystalline salt ($CuSO_4$)
7. Estimation of Ferric ion by spectrophotometry.

- **A minimum of FIVE experiments shall be offered.**
- **Laboratory classes on alternate weeks for Physics and Chemistry.**

## (a) BME231 COMPUTER AIDED DRAFTING AND MODELING LABORATORY L T P C
## (For Mechanical & Civil Branches) 0 1 2 2

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

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

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

**List of Equipments for a batch of 30 students:**

1. Pentium IV computer or better hardware, with suitable graphics facility – 30 Nos.
2. Licensed software for Drafting and Modeling – 30 Licenses
3. Laser Printer or Plotter to print / plot drawings – 2 Nos.

**(b) BEE231 ELECTRICAL CIRCUITS LABORATORY** **L T P C**

(For EEE & EIE branches) **0 0 3 2**

**LIST OF EXPERIMENTS**

- Verification of ohm's laws and kirchoff's laws.
- Verification of Thevenin's and Norton's Theorem
- Verification of superposition Theorem
- Verification of maximum power transfer theorem.
- Verification of reciprocity theorem
- Measurement of self inductance of a coil
- Verification of mesh and nodal analysis.
- Transient response of RL and RC circuits for DC input.
- Frequency response of series and parallel resonance circuits.
- Frequency response of single tuned circuits.

**TOTAL: 45 PERIODS**

**(c) BEC231 CIRCUITS AND DEVICES LABORATORY** **L T P C**
**(For ECE, CSE & IT branches)** **0 0 3 2**

- Verification of KVL and KCL
- Verification of Thevenin and Norton Theorems.
- Verification of superposition Theorem.
- Verification of Maximum power transfer and reciprocity theorems.
- Frequency response of series and parallel resonance circuits.
- Characteristics of PN and Zener diode
- Characteristics of CE configuration
- Characteristics of CB configuration
- Characteristics of UJT and SCR
- Characteristics of JFET and MOSFET
- Characteristics of Diac and Triac.
- Characteristics of Photodiode and Phototransistor.

**TOTAL: 45 PERIODS**

**BEG231 ENGLISH LANGUAGE SKILL LABORATORY (Skill of Listening) L T P C**
**(*Common to all branches)* 0 0 3 2**

**UNIT I (Micro Skills I) 4**

**Tasks (Type I): Lexical word identification**

A. Identifying the homophones/words with silent letters/often mispronounced words
B. Identifying the missing words in native speech (Native accent)

**Tasks (Type II): Decompressing structures**

A. Expanding sound units into word clusters (Ex: verbs with multiple auxiliaries/contracted forms)
B. Identifying the constituent words in collocations/compound words/idiomatic phrases

**UNIT II (Micro Skills II): Identifying tonal variations for meaning making 6**

**Tasks:**

A. Punctuating the script after listening to it.
B. Marking word chunks/tone groups in transcript after listening to it.
C. Marking syllable stress in words.
D. Identifying tonal variations expressing rhetorical questions/ information seeking Questions / Exclamations / General statements.

**UNIT III Content Comprehension and Making Inferences 12**

**Tasks:**

A. Listening and filling in the chart
B. Multiple choice questions (Negative/factual)
C. True/False questions
D. Questions with multiple answers (choosing two/three correct answers)
E. Matching information
F. Filling the blanks (not more than three words)
G. Comprehending the text organization

**UNIT IV Listening and act 8**

**Tasks:**

A. Locating spots in a map following the given directions
B. Transferring data to graphs/diagrams/flow charts
C. Diagram/Picture completing tasks
D. Finding the answer through the process of elimination

**TOTAL: 30 PERIODS**

**BMA301 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C**
**(Common to all branches) 3 1 0 4**

**OBJECTIVES**

The course objective is to develop the skills of the students in the areas of Transforms and Partial Differential Equations. This will be necessary for their effective studies in a large number of engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory. The course will also serve as a prerequisite for post graduate and specialized studies and research.

**UNIT I FOURIER SERIES (9L+3T)**

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 TRANSFORMS (9L+3T)**

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

**UNIT III PARTIAL DIFFERENTIAL EQUATIONS (9L+3T)**

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

**UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS (9L+3T)**

Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

**UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS (9L+3T)**

Z-transforms - Elementary properties – Inverse Z-transform – Convolution theorem - Formation of difference equations – Solution of difference equations using Z-transform.

**Lectures: 45 Tutorials: 15 Total: 60 Periods**

**TEXT BOOK**

1. Grewal, B.S, "*Higher Engineering Mathematics",* 40th Edition, Khanna publishers, Delhi, 2007.

**REFERENCES**

1. Bali.N.P and Manish Goyal, "*A Textbook of Engineering Mathematics"*, 7th Edition, Laxmi Publications(P) Ltd., 2007.
2. Ramana.B.V., "*Higher Engineering Mathematics",* Tata Mc-GrawHill Publishing Company limited, New Delhi,2007.
3. Glyn James, "*Advanced Modern Engineering Mathematics"*,3rd Edition, Pearson Education, 2007.
4. Erwin Kreyszig, "*Advanced Engineering Mathematics",* 8th Edition, Wiley India, 2007.

**BME301 MANUFACTURING TECHNOLOGY – I** **L T P C**
**3 0 0 3**

**OBJECTIVE**

- To introduce the students the concepts of some basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and plastics component manufacture.

**UNIT I METAL CASTING PROCESSES 9**

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 – $CO_2$ process– Sand Casting defects – Inspection methods

**UNIT II JOINING PROCESSES 9**

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 – Percussion 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 9**

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 9**

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 9**

Types of plastics - Characteristics of the forming and shaping processes – 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: 45 Periods**

**TEXT BOOKS**

1. Hajra Choudhury, “Elements of Workshop Technology, Vol. I and II”, Media Promotors Pvt Ltd., Mumbai, 2001.
2. S.Gowri, P.Hariharan, and A.Suresh Babu, “Manufacturing Technology 1”, Pearson Education, 2008.

## REFERENCES

1. B.S. Magendran Parashar & R.K.Mittal, "Elements of Manufacturing Processes", Prentice Hall of India, 2003.
2. P.N.Rao, "Manufacturing Technology", Tata McGraw-Hill Publishing Limited, 2nd Edition, 2002.
3. P.C. Sharma, "A text book of production Technology", s.Chand and Company, 4th Edition, 2003.
4. Begman, "Manufacturing Process", John Wilely & Sons, 8th Edition, 2005.
5. Serope Kalpajian, Steven R.Schmid, " Manufacturing Engineering and Technology", Pearson Education, Inc. 2002 (Second Indian Reprint).
6. Beddoes.J and Bibby M.J, "Principles of Metal Manufacturing Processes", Elsevier, 2006.
7. Rajput R.K, "A text book of Manufacturing Technology", Lakshmi Publications, 2007.

**BME302 ENGINEERING THERMODYNAMICS L T P C**
**3 1 0 4**

**OBJECTIVES**

- To achieve an understanding of principles of thermodynamics and to be able to use it in accounting for the bulk behaviour of the simple physical systems.
- To provide in-depth study of thermodynamic principles, thermodynamics of state, basic thermodynamic relations, Principle of Psychrometry & Properties of pure substances.
- To enlighten the basic concepts of vapour power cycles.

**UNIT I BASIC CONCEPT AND FIRST LAW 9(L)+3(T)**

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 9(L)+3(T)**

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 – availability.

**UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 9(L)+3(T)**

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 IV IDEAL AND REAL GASES AND THERMODYNAMIC RELATIONS 9(L)+3(T)**

Gas mixtures – properties ideal and real gases, equation state, Avagadro's Law, Vander Waal's equation of state, compressibility factor, compressibility chart – Dalton's law of partial pressure, exact differentials, T-D relations, Maxwell's relations, Clausius Clapeyron equations, Joule – Thomson coefficient.

**UNIT V PSYCHROMETRY 9(L)+3(T)**

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

**Lectures: 45 Tutorials: 15 Total: 60**

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

**TEXT BOOKS**

1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw - Hill, New Delhi, 4th Edition, 2008.
2. Cengel, "Thermodynamics – An Engineering Approach",3rd Edition, – Tata McGraw Hill, New Delhi, 2003.

**REFERENCES**

1. Holman.J.P., "Thermodynamics", 4th Edition, McGraw-Hill, 2005.
2. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1997.
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.

**BME303 FLUID MECHANICS AND MACHINERY L T P C**
**3 1 0 4**

**OBJECTIVES**

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

**UNIT I INTRODUCTION 6(L)+3(T)**

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(L)+3(T)**

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(L)+3(T)**

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

**UNIT IV ROTO DYNAMIC MACHINES 13(L)+3(T)**

Homologous 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 8(L)+3(T)**

Reciprocating pumps, Indicator diagrams, Work saved by air vessels. Rotary pumps. Classification. Working and performance curves.

**Lectures: 45 Tutorials: 15 Total: 60**

**TEXT BOOKS**

1. Streeter. V. L., and Wylie, E.B., "Fluid Mechanics", McGraw Hill, 1983.
2. Rathakrishnan. E, "Fluid Mechanics", Prentice Hall of India, 2nd Edition, 2007.

**REFERENCES:**

1. Ramamritham. S, "Fluid Mechanics, Hydraulics and Fluid Machines", Dhanpat Rai & Sons, Delhi, 1988.
2. Kumar. K.L., "Engineering Fluid Mechanics", 7th Edition, Eurasia Publishing House (P) Ltd., New Delhi, 2004.
3. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", Laxmi Publications (P) Ltd., New Delhi, 2005.

**BME304 KINEMATICS OF MACHINERY L T P C**
**3 1 0 4**

**OBJECTIVES**

- To understand the concept of machines, mechanisms and related terminologies.
- To analyse a mechanism for displacement, velocity and acceleration at any point in a moving link
- To understand the theory of gears, gear trains and cams
- To understand the role of friction in drives and brakes.

**UNIT I BASICS OF MECHANISMS 7(L)**

Definitions – Link, Kinematic pair, Kinematic chain, Mechanism, and Machine - Degree of Freedom – Mobility - Kutzbach criterion (Gruebler's equation) - Grashoff's law - Kinematic Inversions of four - bar chain and slider crank chain - Mechanical Advantage - Transmission angle. Description of common Mechanisms - Offset slider mechanism as quick return mechanisms, Pantograph, Straight line generators (Peaucellier and Watt mechanisms), Steering gear for automobile, Hooke's joint, Toggle mechanism, Ratchets and escapements - Indexing Mechanisms.

**UNIT II KINEMATIC ANALYSIS 10(L)+5(T)**

Analysis of simple mechanisms (Single slider crank mechanism and four bar mechanism) - Graphical Methods for displacement, velocity and acceleration; Shaping machine mechanism - Coincident points – Coriolis acceleration - Analytical method of analysis of slider crank mechanism and four bar mechanism. Approximate analytical expression for displacement, velocity and acceleration of piston of reciprocating engine mechanism.

**UNIT III KINEMATICS OF CAMS 8(L)+3(T)**

Classifications - Displacement diagrams - Parabolic, Simple harmonic and Cycloidal motions – Graphical construction of displacement diagrams and layout of plate cam profiles - circular arc and tangent cams - Pressure angle and undercutting.

**UNIT IV GEARS 10(L)+4(T)**

Classification of gears – Gear tooth terminology - Fundamental Law of toothed gearing and involute gearing – Length of path of contact and contact ratio - Interference and undercutting - Gear trains – Simple, compound and Epicyclic gear trains - Differentials.

**UNIT V FRICTION 10(L)+3(T)**

Dry friction – Friction in screw jack – Pivot and collar friction - Plate clutches - Belt and rope drives - Block brakes, band brakes.

**Lectures: 45 Tutorials: 15 Total: 60**

**TEXT BOOKS**

1. Ambekar.A.G., "Mechanism and Machine Theory", Prentice Hall of India, New Delhi, 2007.
2. Uicker.J.J., Pennock.G.R., Shigley.J.E., "Theory of Machines and Mechanisms",Indian Edition, Oxford University Press, 2003.

**REFERENCES**

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2. Ramamurti,V.,' Mechanism and Machine Theory", 2nd Edition, Narosa Publishing House, 2005.
3. Ghosh A and A.K.Mallick, "Theory of Mechanisms and Machines", Affiliated East - West Pvt. Ltd., New Delhi, 1998.
4. Rao J.S and Dukkipati R.V, "Mechanism and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.

5. John Hannah and Stephens.R.C, "Mechanics of Machines", Viva Low-Prices Student Edition, 1999.

**BIS Codes of Practice/Useful Websites**

1. IS 2458 : 2001, Vocabulary of Gear Terms – Definitions Related to Geometry
2. IS 2467 : 2002 (ISO 701: 1998), International Gear Notation – Symbols for Geometric Data.
3. IS 5267 : 2002 Vocabulary of Gear Terms – Definitions Related to Worm Gear Geometry.
4. IS 5037 : Part 1 : 2004, Straight Bevel Gears for General
5. Engineering and Heavy Engineering - Part 1: Basic Rack.
6. IS 5037 : Part 2 : 2004, Straight Bevel Gears for General
7. Engineering and Heavy Engineering - Part 2: Module and Diametral Pitches.

WEBSITE: www.howstuffworks.com

**BEE304 ELECTRICAL DRIVES AND CONTROLS L T P C**
**3 0 0 3**

**OBJECTIVES**

- 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 8(L)**

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

**UNIT II DRIVE MOTOR CHARACTERISTICS 9(L)**

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors.

**UNIT III STARTING METHODS 8(L)**

Types of D.C Motor starter –Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.

**UNIT IV CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C.DRIVES 10(L)**

Speed control of DC series and shunt motors – Armature and field control, Ward- Leonard control system - Using controlled rectifiers and DC choppers –applications.

**UNIT V CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C.DRIVES 10(L)**

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications**.**

**Total: 45 Periods**

**TEXT BOOKS**

1. Vedam Subrahmaniam, "Electric Drives (concepts and applications)", Tata McGraw-Hill, 2001.
2. Nagrath.I.J. & Kothari.D.P, "Electrical Machines", Tata McGraw-Hill, New delhi, 2004.

**REFERENCES**

1. Pillai.S.K "A first course on Electric drives", Wiley Eastern Limited, 1998.
2. M.D.Singh, K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 1998.
3. H.Partab, "Art and Science and Utilisation of Electrical Energy", Dhanpat Rai and Sons, 1994.

**BME331 MANUFACTURING TECHNOLOGY LABORATORY – I** **L T P C**
**0 0 3 2**

**OBJECTIVE**

- To gain hands on experience on working of general purpose machine tools and on various manufacturing processes.

**UNIT I LATHE**

1.1. Facing, plain turning and step turning
1.2. Taper turning using compound rest, Tailstock set over, etc
1.3. Single and Multi-start V thread, cutting and knurling
1.4. Boring and internal thread cutting.

**UNIT II WELDING EXCERCISES**

2.1. Horizontal, Vertical and Overhead welding.
2.2. Gas Cutting, Gas Welding
2.3. Brazing - for demonstration purpose

**UNITIII SHEET METAL WORK**

3.1. Fabrication of sheet metal tray
3.2. Fabrication of a funnel

**UNIT IV PREPARATION OF SAND MOULD**

4.1. Mould with solid, split patterns
4.2. Mould with loose-piece pattern
4.3. Mould with Core

**UNIT V PLASTIC MOULDING**

5.1. Injection Moulding- for demonstration purpose

**Total: 45**

**LIST OF EQUIPMENTS**

| | | | |
|---|---|---|---|
| 1. | | **Centre Lathe with accessories** | 15 |
| 2. | | **Welding** | |
| | 2.1 | Arc welding machine | 04 |
| | 2.2 | Gas welding machine | 01 |
| | 2.3 | Brazing machine | 01 |
| 3. | | **Sheet Metal Work facility** | |
| | 3.1 | Hand Shear 300mm | 01 |
| | 3.2 | Bench vice | 05 |
| | 3.3 | Standard tools and calipers for sheet metal work | 05 |
| 4. | | **Sand moulding Facility** | |
| | 4.1 | Moulding Table | 05 |
| | 4.2 | Moulding boxes, tools and patterns | 05 |
| 5. | | **Plastic Moulding** | |
| | 5.1 | Injection Moulding Machine | 01 |

**BME332 FLUID MECHANICS AND MACHINERY LABORATARY L T P C**
**0 0 3 2**

## LIST OF EXPERIMENTS

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

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

1. Orifice meter setup
2. Venturi meter setup
3. Rotameter setup
4. Pipe Flow analysis setup
5. Centrifugal pump/submergible pump setup
6. Reciprocating pump setup
7. Gear pump setup
8. Pelton wheel setup
9. Francis turbine setup
10. Kaplan turbine setup

Quantity: one each.

**Total: 45**

**BEE333 ELECTRICAL ENGINEERING LABORATORY** **L T P C**
**0 0 3 2**

**LIST OF EXPERIMENTS**

1. Load test on DC Shunt & DC Series motor
2. O.C.C & Load characteristics of DC Shunt and DC Series generator
3. Speed control of DC shunt motor (Armature, Field control)
4. Load test on single phase transformer
5. O.C & S.C Test on a single phase transformer
6. Regulation of an alternator by EMF & MMF methods.
7. V curves and inverted V curves of synchronous Motor
8. Load test on three phase squirrel cage Induction motor
9. Speed control of three phase slip ring Induction Motor
10. Load test on single phase Induction Motor.
11. Study of DC & AC Starters

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

| Equipment | No. |
|---|---|
| 1. DC Shunt motor | - 2 |
| 2. DC Series motor | - 1 |
| 3. DC shunt motor-DC Shunt Generator set | - 1 |
| 4. DC Shunt motor-DC Series Generator set | - 1 |
| 5. Single phase transformer | - 2 |
| 6. Three phase alternator | - 2 |
| 7. Three phase synchronous motor | - 1 |
| 8. Three phase Squirrel cage Induction motor | - 1 |
| 9. Three phase Slip ring Induction motor | - 1 |
| 10. Single phase Induction motor | - 1 |

**TOTAL: 45**

**BEG331 COMMUNICATION SKILLS AND TECHNICAL SEMINAR – I L T P C**
**(Common to all branches) 0 0 3 2**

(To be conducted as a Practical Paper by the Dept of English for 3 hrs per week)

**OBJECTIVES**

- To improve the learners' oral fluency in English
- To help the learners acquire the readiness to speak in English
- To develop the sub-skills required for paper presentations and group discussions
- To help the learners improve their vocabulary related to specific fields of technology
- To facilitate the development of the learners' proficiency in meaningful interaction
- To provide them linguistic support for managing vital sub-functions of Communication

**COURSE CONTENT:**

**A) Phonetic practice (7 hrs)**

- English phonemes with special emphasis on the diphthongs
- Stress patterns for words that end with specific suffixes.
  ***('ion' , 'ic' 'ical' 'ious','ate' , 'ise/-ize', 'fy', 'logy', 'ity' )***

**B) Speech practice (8 hrs)**

- Speaking on the themes by developing the hints provided.

The themes are:

1. Cloning
2. Artificial satellites
3. Renewable sources
4. Telecommunication
5. Cyber Revolution
6. Space research
7. Polythene pollution
8. Fossil fuels
9. Climate change
10. Ecological threats
11. Water resources
12. Nuclear technology
13. Scientific farming
14. Thermal power plants
15. Natural calamities
16. Robotics
17. Artificial intelligence
18. Role of Fibre Optics
19. Exploration of Mars
20. Gas turbines

**C) Group Quiz on technical aspects related to the themes (4hrs)**

**D) Language Functions (8 hrs)**

1. comparing and contrast
2. reporting the conversation of others.
3. talking about future plans and intentions
4. giving reasons
5. expressing preferences
6. quantifying
7. expressing certainty and uncertainty
8. expressing opinions and impressions
9. making suggestions

10. expressing assumptions
11. evaluating options
12. hypothesing/deducing
13. defending a point of view

**E) Seminar presentation on the themes allotted (18 hrs)**

**PROCEDURE:**

**A) Phonetic practice**

All the speech sounds should be taught .The learners should be given drills in the pronunciation of at least 30 words for each sound. While practicing stress patterns, they should be encouraged to identify as many words as possible for each suffix endings.

**B) Speech practice**

Every student should be allowed to choose one theme to specialize in. (However not more than 4 students in a section can choose the same theme).The teacher has to prepare at least 4 hints development tasks on each theme and should provide chance to each learner to speak on those hints related to his/ her theme (5 minutes).The hints may be supplied to the students in advance. When a student speaks, the class should be encouraged to ask questions as well as note down the words related to the different fields.

**C) Group Quiz on technical phrases related to the themes.**

The class should be divided into groups that specialize on a particular theme. Each group should conduct a quiz (question & answer session) which will be answered by the other groups.

**D) Language Functions**

The teacher should build micro activities to develop the use of language required to handle these sub-functions of communication. In the process, the learners should get used to the linguistic elements needed for these functions.

**E) Seminar presentation on the themes allotted**

Each student should collect materials from books, journals and newspapers for his/her theme and prepare a short seminar paper. The presentation should be for 10 minutes. It should be followed 'open house' during which others should come forward to question, clarify, supplement or evaluate.

**RECORD LAY OUT:**

Every student has to maintain a record in which he/she has to incorporate the following details.

- First page containing learner details and the topic of specialization.
- Twenty words for each phoneme
- Twenty words with stress marks for each suffix ending
- Vocabulary list (technical words and compound words) related to the 20 themes identified for this semester.
- Three news paper items, two journal items and three internet sources related to the special theme selected by the student.(To be pasted on the pages)
- The Quiz questions of the group with expected answers.
- The seminar paper presented by the learner with details about the open house.
- Notes of observation. ( Details about any three seminar paper presentations by others)
- The record should be duly signed by the course teacher and submitted to the External Examiner for verification during the semester practicals.

**P = 45 Total = 45**

**BMA401 STATISTICS AND NUMERICAL METHODS L T P C**
**3 1 0 4**

**AIM**

To provide the required skill to apply the statistical tools in engineering problems and give procedures for solving numerically the different kinds of problems occurring in engineering and technology

**OBJECTIVES**

To make the students

- Acquire knowledge of the concepts of statistical inference
- Get exposure to the basic concepts of numerical methods and their applications

**UNIT I TESTING OF HYPOTHESIS (9L+3T)**

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 (9L+3T)**

Completely randomized design – Randomized block design – Latin square design - $2^2$ - factorial design.

**UNIT III SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS (9L+3T)**

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

**UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION (9L+3T)**

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 (9L+3T)**

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 predictor-corrector methods for solving first order equations - Finite difference methods for solving second order equation.

**Lectures: 45 Tutorials: 15 Total: 60 Periods**

**TEXT BOOKS**

1. R.A. Johnson and C.B. Gupta, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007 (For units 1 and 2).
2. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, New Delhi, 2004(For units 3, 4 and 5).

**REFERENCES**

1. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.
2. M.R. Spiegel, J. Schiller and R.A. Srinivasan, "Schaum's Outlines Probability and Statistics", Tata McGraw Hill Edition, 2004.
3. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 5th Edition, Tata McGraw - Hill, New Delhi, 2007.
4. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", 6th Edition, Pearson Education Asia, New Delhi, 2006.

**BME401 HEAT AND MASS TRANSFER L T P C**
**3 1 0 4**

**OBJECTIVE**

- To identify the mode of heat transfer involved in real time applications.
- To calculate the rate of heat transfer using appropriate emperical laws.
- To understand the physical concepts of boiling and condensation.
- To learn the basic concepts involved in design of heat exchanger and understand the concepts of mass transfer.

**UNIT I CONDUCTION 11(L)+3(T)**

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation– Fourier Law of Conduction - General Differential equation of Heat 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 10(L)+3(T)**

Basic Concepts –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 EXCHANGES 9(L)+3(T)**

Nusselts theory of condensation-pool boiling, flow boiling, correlations in boiling and condensation. Types of Heat Exchangers – Heat Exchanger Analysis – LMTD Method and NTU - Effectiveness – Overall Heat Transfer Coefficient – Fouling Factors.

**UNIT IV RADIATION 8(L)+3(T)**

Basic Concepts, Laws of Radiation – Stefan Boltzman Law, Kirchoffs Law –Black Body Radiation – Grey body radiation -Shape Factor Algebra – Electrical Analogy – Radiation Shields –Introduction to Gas Radiation

**UNIT V MASS TRANSFER 7(L)+3(T)**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations

**Lectures: 45 Tutorials: 15 Total: 60**

**TEXT BOOKS**

1. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer",New Age International, 2009.
2. Frank P. Incropera and David P. DeWitt, "Fundamentals of Heat and Mass Transfer", John Wiley and Sons, 2007.

**REFERENCES**

1. Yadav R "Heat and Mass Transfer" , Central Publishing House, 1995.
2. Ozisik M.N, "Heat Transfer", McGraw-Hill Book Co., 1994.
3. Nag P.K, " Heat Transfer", Tata McGraw-Hill, New Delhi, 2002.
4. Holman J.P "Heat and Mass Transfer", Tata McGraw-Hill, 2000.
5. Kothandaraman C.P "Fundamentals of Heat and Mass Transfer" ,New Age International, New Delhi, 2008.

**BME402 MANUFACTURING TECHNOLOGY – II L T P C**
**3 0 0 3**

**OBJECTIVE**

To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching. To understand the basic concepts of computer numerical control (CNC) machine tool and CNC programming.

**UNIT I THEORY OF METAL CUTTING 9(L)**

Introduction: material removal processes, types of machine tools – theory of metal cutting: chip formation, orthogonal cutting, cutting tool materials, tool wear, tool life, surface finish, cutting fluids.

**UNIT II CENTRE LATHE AND SPECIAL PURPOSE LATHES 9(L)**

Centre lathe, constructional features, cutting tool geometry, various operations, taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes – automats – single spindle, Swiss type, automatic screw type, multi spindle - Turret Indexing mechanism, Bar feed mechanism.

**UNIT III OTHER MACHINE TOOLS 9(L)**

Reciprocating machine tools: shaper, planer, slotter - Milling : types, milling cutters, operations - Hole making : drilling - Quill mechanism , Reaming, Boring, Tapping - Sawing machine: hack saw, band saw, circular saw; broaching machines: broach construction – push, pull, surface and continuous broaching machines

**UNIT IV ABRASIVE PROCESSES AND GEAR CUTTING 9(L)**

Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding – honing, lapping, super finishing, polishing and buffing, abrasive jet machining - Gear cutting, forming, generation, shaping, hobbing.

**UNIT V CNC MACHINE TOOLS AND PART PROGRAMMING 9(L)**

Numerical control (NC) machine tools – CNC: types, constructional details, special features – design considerations of CNC machines for improving machining accuracy – structural members – slide ways –linear bearings – ball screws – spindle drives and feed drives. Part programming fundamentals – manual programming – computer assisted part programming**.**

**Total: 45 Periods**

**TEXT BOOKS**

1. Hajra Choudry, "Elements of Work Shop Technology – Vol. II", Media Promoters, 2002.
2. HMT – "Production Technology", Tata McGraw-Hill, 1998.

**REFERENCES**

1. Rao, P.N. "Manufacturing Technology", Metal Cutting and Machine Tools, Tata McGraw – Hill, New Delhi, 2003.
2. P.C. Sharma, "A Text Book of Production Engineering", S.Chand and Company Ltd, Fourth Edition, 1993.
3. Shrawat N.S. and Narang J.S, "CNC Machines', Dhanpat Rai & Co., 2002.
4. P.N.Rao, "CAD/CAM Principles and Applications", Tata Mc Graw Hill, 2007.
5. M.P.Groover and Zimers Jr., "CAD/CAM", Prentice Hall of India Ltd., 2004.
6. Milton C.Shaw, "Metal Cutting Principles", Oxford University Press, 2nd Edition, 2005.
7. Rajput R.K, "A text book of Manufacturing Technology", Lakshmi Publications, 2007.
8. Philip F.Ostwald and Jairo Munoz, "Manufacturing Processes and systems", John Wiley and Sons, 9th Edition, 2002.

9. Mikell P.Groover, "Fundamentals of Modern Manufacturing, Materials, Processes and Systems", John Wiley and Sons, 9th Edition, 2007.
10. Chapman. W.A.J and S.J.Martin, "Workshop Technology", Part III, Viva Books Private Ltd., 2006.

**BME403 ENGINEERING MATERIALS AND METALLURGY L T P C**
**3 0 0 3**

**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.

**Review (Not for Exam):**

Crystal structure – BCC, FCC and HCP structure – unit cell – crystallographic planes and directions, miller indices – crystal imperfections, point, line, planar and volume defects – Grain size, ASTM grain size number.

**UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9(L)**

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectoid, eutectic, peritectic, and peritectoid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast Iron, microstructure, properties and applications.

**UNIT II HEAT TREATMENT 9(L)**

Definition – Full annealing, stress relief, recrystallisation and spheroidizing –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 - carburising, nitriding, cyaniding, carbonitriding, flame and induction hardening.

**UNIT III MECHANICAL PROPERTIES AND TESTING 9(L)**

Mechanism of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Impact test - Izod and Charpy, Fatigue and creep tests, fracture toughness tests.

**UNIT IV FERROUS AND NON FERROUS METALS 9(L)**

Effect of alloying elements on steel (Mn, Si, Cr, Mo, V, Ti & W) - stainless and tool steels – HSLA - maraging steels – Cast Irons - Grey, White malleable, spheroidal – Graphite, Alloy cast irons, Copper and Copper alloys - Brass, Bronze and Cupronickel – Aluminum and Al-Cu alloy – precipitation hardening – Bearing alloys.

**UNIT V NON-METALLIC MATERIALS 9(L)**

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE Polymers – Urea and Phenol Formaldehydes – Engineering Ceramics – Introduction to Fibre reinforced plastics.

**Total: 45 Periods**

**TEXT BOOK**

1. Kenneth G.Budinski and Michael K.Budinski “Engineering Materials” ,Prentice-Hall of India Private Limited, Fourth Indian Reprint ,2002.

**REFERENCES**

1. William D Callister “Material Science and Engineering”, John Wiley and Sons, 2007.
2. Raghavan.V “Materials Science and Engineering”, Prentice Hall of India Pvt., Ltd., 2007.
3. Sydney H.Avner “Introduction to Physical Metallurgy”, McGraw Hill Book Company, 2007.
4. Dieter G. E., “Mechanical Metallurgy”, Mc Graw Hill Book Company, 1988.
5. O.P. Khanna , “A text book of Materials Science and Metallurgy”, Khanna Publishers, 2003.
6. Vijaya. M.S. and G. Rangarajan, “Material Science”, Tata McGraw-Hill, 2007.

**BME406 STRENGTH OF MATERIALS L T P C**
**3 1 0 4**

**OBJECTIVES**

- To gain knowledge of simple stresses, strains and deformation in components due to external loads.
- To assess stresses and deformations through mathematical models of beams, twisting bars or combinations of both.
- Effect of component dimensions and shape on stresses and deformations are to be understood.
- The study would provide knowledge for use in the design courses.

**UNIT I STRESS STRAIN DEFORMATION OF SOLIDS 9(L) + 3(T)**

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(L) + 3(T)**

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(L) + 3(T)**

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(L) + 3(T)**

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

**UNIT V ANALYSIS OF STRESSES IN TWO DIMENSIONS 9(L) + 3(T)**

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.

**Lectures: 45 Tutorials: 15 Total: 60**

**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, 3rd 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, 2003.
3. Ryder G.H, "Strength of Materials, Macmillan India Ltd"., 3rd 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, 2004.

**BEC406 ELECTRONICS AND MICROPROCESSOR L T P C**
**3 0 0 3**

**OBJECTIVE**

- To enable the students to understand the fundamental concepts of Semi Conductors, Transistors, Rectifiers, Digital Electronics and 8085 Microprocessors.

**UNIT I SEMICONDUCTORS AND RECTIFIERS 9(L)**

Classification of solids based on energy band theory-Intrinsic semiconductors-Extrinsic semiconductors-P type and N type-PN junction-Zenor effect-Zenor diode characteristics- Half wave and full wave rectifiers -Voltage regulation

**UNIT II TRANSISTORS AND AMPLIFIERS 12(L)**

Bipolar junction transistor- CB, CE, CC configuration and characteristics-Biasing circuits- Class A, B and C amplifiers- Field effect transistor-Configuration and characteristic of FET amplifier-SCR, Diac, Triac, UJT-Characteristics and simple applications-Switching transistors-Concept of feedback-Negative feedback-Application in temperature and motor speed control.

**UNIT III DIGITAL ELECTRONICS 9(L)**

Binary number system - AND, OR, NOT, NAND, NOR circuits-Boolean algebra- Exclusive OR gate - Flip flops-Half and full adders-Registers-Counters-A/D and D/A conversion.

**UNIT IV 8085 MICROPROCESSOR 9(L)**

Block diagram of microcomputer-Architecture of 8085-Pin configuration-Instruction set-Addressing modes-Simple programs using arithmetic and logical operations.

**UNIT V INTERFACING AND APPLICATIONS OF MICROPROCESSOR 6(L)**

Basic interfacing concepts - Interfacing of Input and Output devices - Applications of microprocessor Temperature control, Stepper motor control, traffic light control.

**Total: 45 Periods**

**TEXT BOOKS**

1. Milman and Halkias, “Integrated Electronics”, Tata McGraw-Hill publishers, 1995.
2. Ramesh Goankar, “Microprocessor Architecture”, Programming and Applications with 8085, Wiley Eastern, 1998.

**REFERENCES**

1. Malvino and Leach, “Digital Principles and Applications”, Tata McGraw-Hill, 1996.
2. Mehta V.K, “Principles of Electronics”, S. Chand and Company Ltd., 2000.
3. Dougles V.Hall, “Microprocessor and Interfacing”, Programming and Hardware, Tata McGraw-Hill, 2003.
4. Salivahanan S, Suresh Kumar N, Vallavaraj A, “Electronic Devices and Circuits”, 1st Edition, Tata McGraw-Hill, 1999.

**BME434 MATERIALS TESTING LABORATORY L T P C**
**0 0 3 2**

**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 a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical properties Comparison
    (i) Unhardened specimen
    (ii) Quenched Specimen and
    (iii) Quenched and tempered specimen.
11. Microscopic Examination of
    (i) Hardened samples and
    (ii) Hardened and tempered samples.

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

| | |
|---|---|
| Universal Tensile Testing machine with double Shear attachment – 40 Ton Capacity | 1 |
| Torsion Testing Machine (60 NM Capacity) | 1 |
| Impact Testing Machine (300 J Capacity) | 1 |
| Brinell hardness Testing Machine | 1 |
| Rockwell Hardness Testing Machine | 1 |
| Spring Testing Machine for tensile and compressive loads (2500 N) | 1 |
| Metallurgical Microscopes | 3 |
| Muffle Furnace ($800^{o}C$) | |

**Total: 45 Periods**

**BME431 COMPUTER AIDED MACHINE DRAWING LABORATORY L T P C**
**1 0 3 2**

**OBJECTIVE**

- To make the students understand and interpret drawings of machine components so as to prepare assembly drawings either manually and using standard CAD packages.
- To familiarize the students with Indian Standards on drawing practices and standard components.

**DRAWING STANDARDS**

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc.

**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)**

Manual parts drawing and preparation of assembled views given part details for components followed by practicing the same using CAD packages.

**Suggested Assemblies:**

Shaft couplings – Plummer block – Screw jack- Lathe Tailstock – Universal Joint – Machine Vice – Stuffing box- safety Valves - Non-return valves- Connecting rod -Piston and crank shaft- Multi plate clutch- Preparation of Bill of materials and tolerance data sheet.

**Lectures: 15 Practicals: 45 Total: 60**

Use of standard CAD application packages is recommended from the point of view of requirement by industries. However to encourage our national efforts in indigenous development of software packages with focus on open source, students may be encouraged to work with "CollabCAD Software", developed by:
National Informatics Centre (CAD Group), Govt. of India, A-Block, C.G.O. Complex, Lodhi Road, New Delhi 110003, 2003" www.collabcad.com

**REFERENCES**

1. BHATT.N.D.and PANCHAL.V.M., "Machine Drawing", Charotar Publishing House, 388001, 38th Edition, 2003.
2. P.S.G. Design Data Book Luzadder,Warren.J., and Duff, Jon.M. "Fundamentals of Engineering Drawing", Prentice Hall India Pvt. Ltd., Eastern Economy Edition, 11th Edition.

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

1. **Computer System** 30

   17" Graphics Terminal

   Pentium IV Processor
   80 GB HDD
   512 MB RAM
   Advanced graphics accelerator

2. **Laser Printer** 01

3. **Plotter (A2 size)** 01

**Software:**

30 seats of latest/recent versions of **AutoCAD / CATIA / SOLIDWORKS / SOLID EDGE / NX / PRO-E / COLLAB CAD** or equivalent software

**BME432 MANUFACTURING TECHNOLOGY LABORATORY – II L T P C**
**0 0 3 2**

**OBJECTIVE**

- To give a practical hand on exposure to students in the various metal cutting operations using commonly used machine tools

**EXERCISES**

1. Two or More Measurements in Metal Cutting Experiment (Example: Shear Angle, Cutting Force, Tool Wear etc.)
2. One or More Exercises in Shaper, Slotter, Planner, Drilling, Milling Machines
   (Example: Round to Square, Dovetail in shaper, Internal keyway cutting in Slotter, Round to square in Planner, Drilling, reaming and tapping in Drilling machine, Gear Milling and Keyway milling in Milling machine.)
3. Two or More Exercises in Grinding / Abrasive machining
   (Example: Surface Grinding, Cylindrical Grinding.)
4. Two or More Exercises in Assembly of Machined Components for different fits.
   (Example: Parts machined using Lathes, Shapers, Drilling, Milling, and Grinding Machines etc.)
5. One or More Exercises in Capstan or Turret Lathes
6. One or More Exercises in Gear Machining
   (Example: Gear Milling, Gear Hobbing etc.)

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

| | | | |
|---|---|---|---|
| 1. | Centre Lathes | - | 2 Nos. |
| 2. | Turret and Capstan Lathes | - | 1 No |
| 3. | Horizontal Milling Machine | - | 1 No |
| 4. | Vertical Milling Machine | - | 1 No |
| 5. | Surface Grinding Machine | - | 1 No. |
| 6. | Cylindrical Grinding Machine | - | 1 No. |
| 7. | Shaper | - | 2 Nos. |
| 8. | Slotter | - | 1 No. |
| 9. | Planner | - | 1 No. |
| 10. | Radial Drilling Machine | - | 1 No. |
| 11. | Tool Dynamometer | - | 1 No |
| 12. | Gear Hobbing Machine | - | 1 No |
| 13. | Tool Makers Microscope | - | 1 No |

**Total Number of Periods: P = 45**

**BEG431 COMMUNICATION SKILLS AND TECHNICAL SEMINAR – II L T P C**
**(Common to all branches) 0 0 3 2**

(To be conducted as a Practical Paper by the Dept of English for 3 hrs per week)

**OBJECTIVES**

- To improve the learners' oral fluency in English
- To help the learners acquire the readiness to speak in English
- To develop the sub-skills required for paper presentations and group discussions
- To help the learners improve their vocabulary related to specific fields of technology
- To facilitate the development of the learners' proficiency in meaningful interaction
- To provide them linguistic support for managing vital sub-functions of communication.

**COURSE CONTENT:**

**A) Phonetic practice (7 hrs)**

All the English phonemes with special emphasis on the following

1. /ae/ and /ei/
2. /e/ and /i/
3. First syllable and second syllable stress
4. Three different ways of pronouncing 'ed' past tense endings eg. *'played', 'walked', 'wanted'*
5. Correct pronunciation of commonly used words ( A list of 1000 words will be suggested by the university)
6. Silent letters

**B) Speech practice (8 hrs)**

Speaking on the themes by developing the hints provided.

The themes are:

1. Indian space missions
2. Converting agricultural wastes for useful purposes
3. Developments in transportation
4. Technology and agriculture
5. Impact of global warming
6. Desalination of water
7. Technology for national security
8. Industrial development and ecological issues
9. Applications of nano technology
10. Hazards of e-waste

**C) Preparation of power point frames on the given topic (2 hrs)**

(Only pictures, graphs, equations should be given through power point and not the text of the presentation as such)

**D) Language Functions (14 hrs)**

Reporting the conversation of others
Using the third conditional
Expressing agreement and disagreement
Numerical expressions
Describing manner and frequency
Evaluating different standpoints
Developing an argument
Describing daily routines, events, and weather

**D) Seminar presentation on the themes allotted using power point frames (14 hrs)**

**PROCEDURE:**

**A) Phonetic practice**

The learners should be given drills in the pronunciation of at least 30 words for each sound. While practicing stress patterns, they should be encouraged to identify as many words as possible for each pattern.

**B) Speech practice**

Every student should be allowed to choose one theme to specialize in. (However not more than 7 students in a section can choose the same theme).The teacher has to prepare at least 4 hints development tasks on each theme and should provide chance to each learner to speak on those hints related to his/ her theme (5 minutes).The hints may be supplied to the students in advance. When a student speaks, the class should be encouraged to ask questions as well as note down the words related to the different fields.

**C) Language Functions**

The teacher should build micro activities to develop the use of language required to handle these sub-functions of communication. In the process, the learners should get used to the linguistic elements needed for these functions.

**D) Seminar presentation on the themes allotted**

Each student should collect materials from books, journals and newspapers for his/her theme and prepare a short seminar paper. The presentation should be for 10 minutes using power point frames. It should be followed by an 'open house' during which others should come forward to question, clarify, supplement or evaluate.

**RECORD LAY OUT:**

Every student has to maintain a record in which he/she has to incorporate the following details.

- First page containing learner details and the topic of specialization.
- Twenty words for each phoneme /ae/, /ei/, /i/ and /e/
- Fifty words with first syllable stress and fifty for second syllable stress (The learner will be required to pronounce some of these words during the practical exam)
- Vocabulary list (technical words and compound words) related to the 10 themes identified for this semester.
- Three newspaper items, two journal items and three internet sources related to the special theme selected by the student.(To be pasted on the pages)
- The seminar paper presented by the learner with a soft copy of the power point frames.
- Notes of observation. ( Details about any two seminar paper presentations by others)
- The record should be duly signed by the course teacher and submitted to the External Examiner for verification during the semester practicals.

**P = 45 Total = 45**

**BCE301 ENVIRONMENTAL SCIENCE AND ENGINEERING** **L T P C**
***(Common to 3rd Sem – Civil, CSE, IT, EEE and EIE*** **3 0 0 3**
***5th Sem – Mechanical, 7th Sem - ECE)***

**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 nongovernment organization in environment managements.

**UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14**

Definition, scope and importance of environment – need for public awareness – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) –Introduction to biodiversity definition: genetic, species and ecosystem diversity –biogeographically classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity –threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts –endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common - plants, insects, birds. Field study of simple ecosystems – pond, river, hill slopes, etc.

**UNIT II ENVIRONMENTAL POLLUTION 8**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

**UNIT III NATURAL RESOURCES 10**

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

**UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7**

From unsustainable to sustainable development – urban problems related to energy –water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non governmental organization- environmental ethics: Issues and possible solutions –climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – 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 6**

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

**TOTAL: 45 PERIODS**

**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, New Delhi, 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.

**BME501 THERMAL ENGINEERING L T P C**
**3 1 0 4**

**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

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

**UNIT I GAS POWER CYCLES 10**

Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure and air Standard efficiency – Comparison of Otto, Diesel, Dual, Brayton cycles - Actual and theoretical PV diagram of four stroke and two stroke engines

**UNIT II INTERNAL COMBUSTION ENGINES 13**

Classification , Components and their functions Valve timing diagram and Port timing diagram - Comparison of two stroke and four stroke engines – Working principle of simple carburetor, Properties of fuels used in engines – Combustion stages of SI and CI engines, Abnormal Combustion - Knocking and detonation, Scavenging and supercharging in engines, Diesel pump and injector system. - Comparison of petrol and diesel engine - Lubrication system and Cooling system - Battery and Magneto Ignition System – Performance calculation & Heat Balance Test - Formation and Control of exhaust emissions in SI and CI engines

**UNIT III STEAM NOZZLES AND TURBINES 12**

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow, Steam Turbines - Impulse and Reaction principles, compounding, degree of reaction, velocity diagram for simple and multi-stage turbines, speed regulations –Governors.

**UNIT IV RECIPROCATING AND ROTARY AIR COMPRESSORS 12**

Reciprocating Compressor - Classification and working principle, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling –working principles of Rotary Compressors , Fan and blowers (Description only).

**UNIT V REFRIGERATION AND AIR CONDITIONING 13**

Air refrigeration system - Vapour compression refrigeration cycle- super heat, sub cooling – Performance calculations - working principle of vapour absorption system, Ammonia –Water, Lithium bromide –water systems (Description only) –Types & Properties of Refrigerants – Comparison between vapour compression and absorption systems. Psychrometry, Psychrometric chart, Psychrometry process-Types of Air conditioning systems - Requirements for comfort and industrial air-conditioning

**TOTAL: 60 PERIODS**

**TEXT BOOKS:**

1. Rajput. R. K., "Thermal Engineering", Laxmi Publications, Ltd., 9th Edition, 2013.
2. Kothandaraman.C.P., Domkundwar.S, Domkundwar.A.V., "A course in Thermal Engineering," Dhanpat Rai& sons, 5th Edition, 2002.
3. B. K. Sarkar., "Thermal Engineering" Tata McGraw Hill Education, 1st Edition, 2001.

**REFERENCES:**

1. Stoeckr W.P. and Jones J.W., “Refrigeration and Air conditioning”, Tata McGraw-Hill, New Delhi, 1995.
2. Arora.C.P, "Refrigeration and Air Conditioning”, Tata McGraw-Hill Publishers, 2nd Edition, 2008.
3. Ganesan V. “Internal Combustion Engines”, Tata McGraw-Hill Publishers, 3rd Edition, 2007.
4. Rudramoorthy. R, “Thermal Engineering “, Tata McGraw-Hill, New Delhi, 2003.
5. NPTEL Lectures.

**BME502 DYNAMICS OF MACHINERY L T P C**
**3 1 0 4**

**OBJECTIVES:**

- To understand the method of static force analysis and dynamic force analysis of mechanisms.
- To study the undesirable effects of unbalances in rotors and engines.
- To understand the concept of vibratory systems and their analysis.
- To understand the principles of governors and gyroscopes.

**UNIT I FORCE ANALYSIS AND FLYWHEELS 12**

Static force analysis of mechanisms – D"Alemberts principle - Inertia force and Inertia torque – Dynamic force analysis - Dynamic Analysis in Reciprocating Engines – Gas Forces - Equivalent masses – Bearing loads - Crank shaft Torque–Engine shaking Forces - Turning moment diagrams - Flywheels of engines and punch press

**UNIT II BALANCING 12**

Static and dynamic balancing - Balancing of rotating and reciprocating masses - Balancing a single cylinder Engine – Primary and secondary unbalanced forces - Balancing Multi-cylinder Engines – Firing order.

**UNIT III FREE VIBRATION 12**

Basic features of vibratory systems - Basic elements and lumping of parameters -Degrees of freedom - Single degree of freedom - Free vibrations - Equations of motion - natural frequency - Types of Damping - Damped free vibration – Whirling of shafts and critical speed - Torsional systems; Natural frequency of two and three rotor systems.

**UNIT IV FORCED VIBRATION 12**

Response to periodic forcing - Harmonic Forcing – Forced vibration 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 – Quality of governors – effect of friction. Gyroscopes - Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in Automobiles and ships

**L:45 T:15, TOTAL :60 PERIODS**

**TEXT BOOKS:**

1. Ambekar A. G., "Mechanism and Machine Theory", Prentice Hall of India, New Delhi, 2007.
2. S.S Rattan, "Theory of Machines", Tata McGraw-Hill Companies, New Delhi, 3rd Edition, 2009.

**REFERENCES:**

1. Thomas Bevan, "Theory of Machines", Pearson Education Ltd., 3rd Edition, 2010.
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., 3rd Edition, 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, 3rd Edition 2012.

7. V.P.Singh, “Theory Of Machines”, DhanpatRai Publishing Company Pvt. Ltd, 2012.

**BME503 DESIGN OF MACHINE ELEMENTS L T P C**
**3 1 0 4**

**OBJECTIVES:**

- To familiarize the various steps involved in the Design Process.
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data.
- To learn to use catalogues and standard machine components.

**UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 12**

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties -- Preferred numbers, fits and tolerances –Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principal 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 12**

Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys, key ways and splines - Design of rigid and flexible couplings.

**UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS 12**

Threaded fasteners - Design of bolted joints including eccentric loading, Knuckle joints – Design of welded joints, riveted joints for structures - theory of bonded joints.

**UNIT IV DESIGN OF ENERGY STORING ELEMENTS 12**

Design of various types of springs, optimization of helical springs -- rubber springs -- Design of flywheels considering stresses in rims and arms for engines and punching machines.

**UNIT V DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS 12**

Sliding contact and rolling contact bearings -- Design of hydrodynamic journal bearings, McKee"s Equation, Sommerfield Number, Raimondi & Boyd graphs, -- Selection of Rolling Contact bearings -- Design of Seals and Gaskets -- Design of Connecting Rod and Design of crankshafts.

**L: 45 T: 15 TOTAL :60 PERIODS**

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

**TEXT BOOKS:**

1. Shigley J.E and Mischke C. R., "Mechanical Engineering Design", 6th Edition, TataMcGraw-Hill , 2003.
2. Bhandari V.B, "Design of Machine Elements", 2nd Edition, Tata McGraw-HillBook Co, 2007.

**REFERENCES:**

1. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
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.

**STANDARDS:**

1. IS 10260: Part 1: 1982 Terms, definitions and classification of Plain bearings Part 1: Construction.
2. IS 10260: Part 1: 1982 Terms, definitions and classification of Plain bearings Part 2: Friction and Wear.
3. IS 10260: Part 1: 1982 Terms, definitions and classification of Plain bearings Part 3: Lubrication.

**BME504 ENGINEERING METROLOGY AND MEASUREMENTS**

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

**OBJECTIVE:**

- To understand the basic principles of measurements.
- To learn the various linear and angular measuring equipments, their principle of operation and applications.
- To learn about various methods of measuring Mechanical parameters.

**UNIT I CONCEPT OF MEASUREMENT 9**

General concept – Generalized 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 - optical flats, - Comparators: limit gauges Mechanical, pneumatic and electricalcomparators, 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- 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- Laser Interferometers in manufacturing and machine tool alignment testing - 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 PERIODS**

**TEXT BOOK:**

1. Jain R.K., “Engineering Metrology”, Khanna Publishers, 2005.

**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.
5. John A.Bosch, Giddings and Lewis Dayton, “Co-ordinate Measuring Machines and Systems”, Marcel Dekker, Inc, 1999.

**BME505 APPLIED HYDRAULICS AND PNEUMATICS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To know the advantages and applications of Fluid Power Engineering and Power Transmission System.
- To learn the Applications of Fluid Power System in automation of Machine Tools and others Equipments.

**UNIT I FUNDAMENTALS OF FLUID POWER SYSTEMS 9**

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, desirable properties of hydraulic fluids – General types of fluids – Fluid power symbols. Basics of Hydraulics - Laminar and Turbulent flow – Reynolds number – Losses in pipe, valves and fittings.

**UNIT II HYDRAULIC SYSTEM & COMPONENTS 9**

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 tandem, Rod less, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators – Fluid motors, Gear, Vane and Piston motors.

**UNIT III HYDRAULIC VALVES, PNEUMATIC SYSTEMS AND COMPONENTS 9**

Construction of Control Components: Direction control valve – 3/2 way valve – 4/2 way valve 4/3 way valve– Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves Pneumatic Components: Properties of air – Compressors – Filter, Regulator, Lubricator Unit – Air control valves, Quick exhaust valves, pneumatic actuators.

**UNIT IV DESIGN OF HYDRAULIC & PNEUMATIC CIRCUITS 9**

Fluid Power Circuit Design Speed control circuits, Synchronizing circuit, Automatic cylinder reciprocating circuit, Regenerative circuit, Fail-Safe circuits, Pneumo hydraulic circuit, Sequential circuit design for simple applications using cascade method.
Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier – Intensifier circuit.

**UNIT V LOGIC CONTROL SYSTEMS 9**

Advanced Control for Fluid Power Systems 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: 45 PERIODS**

**TEXT BOOK:**

1. Anthony Esposito, “Fluid Power with Applications”, Pearson Education, 2011.

**REFERENCES:**

1. Majumdar S.R., “Pneumatic Systems – Principles and Maintenance”, Tata McGraw Hill, 2006.
2. Majumdar S.R., “Oil Hydraulic Systems – Principles & Maintenance”, Tata McGraw-Hill, 2006.
3. Illango. S and Soundararajan. V, “Introduction to Hydraulics and Pneumatics”, Prentice Hall of India, 2007.
4. John S. Cundiff, “Fluid Power Circuits and Controls – Fundamentals & Applications”, CRC Press, 2002.
5. James L. Johnson, “Introduction to Fluid Power”, Cengage Learning, 2001.

6. William Bolton, "Pneumatic & Hydraulic Systems", Elsevier Science and Technology Book, 1997.

| BME531 | THERMAL ENGINEERING LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |

**OBJECTIVE:**

- To attain practical knowledge in thermal engineering concepts especially in Internal Combustion Engine.

**LIST OF EXPERIMENTS (Minimum 12 experiments to be conducted)**

Valve Timing Diagram for 4-stroke Engine.
Port Timing Diagram for 2-stroke Engine.
Determination of oil Viscosity using Red Wood Viscometer.
Determination of oil Viscosity using Saybolt Viscometer.
Determination of Flash Point and Fire Point using Abel Apparatus.
Determination of Flash Point and Fire Point using Pensky Marten Apparatus.
Performance Test on 4-stroke slow Speed Diesel Engine Fitted with Mechanical Dynamometer.
Performance Test on 4- Stroke Diesel Engine fitted with AC Generator.
Performance Test on 4- Stroke Petrol Engine with Electrical Loading.
Performance Test on Variable Compression Ratio engine to find the effect of Compression ratio on Performance parameters.
Heat Balance Test on 4-stroke Diesel Engine fitted with DC Generator.
Heat Balance Test on Computerized Single Cylinder Diesel Engine Fitted With Eddy Current Dynamometer.

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

1. I.C Engine – 2 stroke and 4 stroke model 1 set
2. Red Wood Viscometer 1 No.
3. Apparatus for Flash and Fire Point 1 No.
4. Four stroke Diesel Engine with mechanical loading. 1 No.
5. Four stroke Diesel Engine with hydraulic loading. 1 No.
6. Four stroke Diesel Engine with electrical loading. 1 No.
7. Multi-cylinder Petrol Engine 1 No.
8. Single cylinder Petrol Engine 1 No.
9. Data Acquisition system with any one of the above engines 1 No.
10. Saybolt Viscometer 1 No

| BME532 | COMPUTER AIDED DESIGN AND COMPUTER AIDED MANUFACTURING LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |

**OBJECTIVES:**

- To be able to understand and handle design problems in a systematic manner.
- To gain practical experience in handling 2D drafting and 3D modeling software systems.
- To be able to apply CAD in real life applications.
- To understand the concepts G and M codes and manual part programming.
- To expose students to modern control systems (Fanuc, Siemens etc)
- To know the application of various CNC machines
- To expose students to modern CNC application machines EDM, EDM wire cut and Rapid Prototyping.

**LIST OF EXPERIMENTS Minimum 12 Experiments to be conducted**

**CAD-Modeling**

1. Part Drawing – Hinged Bearing
2. Part Drawing – Support Block
3. Three Dimensional Modeling and Assembly of Screw Jack
4. Three Dimensional Modeling and Assembly of Flange Coupling
5. Three Dimensional Modeling and Assembly of Plummer Block
6. Three Dimensional Modeling and Assembly of Universal Coupling
7. Three Dimensional Modeling and Assembly of Knuckle Joint

**CAM –Manual Part Programming**

1. Simple Turning
2. Thread Cutting
3. Multiple Turning
4. Contouring
5. Square Profile
6. Circular Interpolation
7. Peck Drilling

**CNC Code Generation**

1. Generation of CNC code for Lathe Operation
2. Generation of CNC code for Milling Operation

**BME601 AUTOMOBILE ENGINEERING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the construction and working principle of various parts of an automobile.
- To gain knowledge about alternate fuels for gasoline and diesel and their impact on performance, emission and combustion.

**UNIT I VEHICLE STRUCTURE AND ENGINES 9**

Types of automobiles, vehicle construction and different layouts, types of 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 types – transistorized coil ignition system, Capacitive discharge ignition system, Turbo and super 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 and norms –Electric and Hybrid Vehicles, Fuel Cell

**Note:** Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Kirpal Singh, "Automobile Engineering Vol 1 & 2", Standard Publishers, 7th 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", 2nd Edition, East-West Press, 1999.
3. Heinz Heisler, "Advanced Engine Technology," SAE International Publications,USA, 1998.
4. Ganesan V "Internal Combustion Engines", 3rd Edition, Tata McGraw-Hill, 2007.

**BME602 DESIGN OF TRANSMISSION SYSTEMS L T P C**
**3 1 0 4**

**OBJECTIVES:**

- To gain knowledge on the principles and procedure for the design of power Transmission Components.
- To understand the standard procedure available for Design of Transmission systems
- 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 GEARS AND CROSSED 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. Crossed -helical Terminology-helix angles – Estimating the size of the pair of Crossed-helical gears.

**UNIT IV DESIGN OF GEAR BOXES 12**

Geometric progression – Standard step ratio – Ray diagram, kinematic layout – Design of sliding mesh gear box- Constant mesh gearbox – 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.

**L:45 T:15, TOTAL: 60 PERIODS**

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

**TEXT BOOKS:**

1. Shigley J.E and Mischke C. R., "Mechanical Engineering Design", 6th Edition, Tata McGraw-Hill , 2003.
2. Sundararajamoorthy T. V and Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

**REFERENCES:**

1. Maitra G.M. and Prasad L.V., "Hand book of Mechanical Design", 2nd 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. and Schmid S.R., "Fundamentals of Machine Elements", Tata McGraw-Hill Book Co., 1999.

5. Ugural A.C, "Mechanical Design, An Integrated Approach", Tata McGraw-Hill, 2003.

**STANDARDS:**

1. IS 4460: Parts 1 to 3: 1995, Gears – Spur and Helical Gears – Calculation of Load Capacity.
2. IS 7443 : 2002, Methods of Load Rating of Worm Gears
3. IS 15151: 2002, Belt Drives – Pulleys and V-Ribbed belts for Industrial applications – PH, PJ, PK, Pl and PM Profiles : Dimensions
4. IS 2122: Part 1: 1973, Code of practice for selection, storage, installation and maintenance of belting for power transmission: Part 1 Flat Belt Drives.
5. IS 2122: Part 2: 1991, Code of practice for selection, storage, installation and maintenance of belting for power transmission: Part 2: V-Belt Drives.

**BME603 FINITE ELEMENT ANALYSIS L T P C**
**3 1 0 4**

**OBJECTIVES:**

- To equip the students with the Finite Element Analysis fundamentals.
- To formulate the design problems into FEA.
- To perform engineering simulations using Finite Element Analysis.

**INTRODUCTION (**Not for examination) **5**
Solution to engineering problems – mathematical modeling – discrete and continuum modeling – need for numerical methods of solution – relevance and scope of finite element methods – engineering applications of FEA

**UNIT I FINITE ELEMENT FORMULATION OF BOUNDARY VALUE PROBLEMS 8**
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 12**
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 14**
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 – need for quadrature formula – transformations to natural coordinates – Gaussian quadrature – example problems in plane stress, plane strain and axisymmetric applications

**UNIT IV DYNAMIC ANALYSIS USING FINITE ELEMENT METHOD 12**
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 eigenvalue 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 and 2-dimensional heat transfer element – applications - Application of 2-D fluid mechanics problems.

**TOTAL: 60 PERIODS**

**TEXT BOOK:**

1. P.Seshu, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., NewDelhi, 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. ISBN-0-07-051355-4.
2. Chandrupatla&Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice-Hall of India, Eastern Economy Editions. ISBN-978-81-203-2106-9.
3. David V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw-Hill Edition 2005. ISBN-0-07-239536-2.
4. Cook, Robert.D., Plesha,Michael.E&Witt,Robert.J. "Concepts and Applications of Finite Element Analysis",Wiley Student Edition, 2004. ISBN-10 81-265-1336-5.

**BME604 GAS DYNAMICS AND JET PROPULSION L T P C**
**3 1 0 4**

**OBJECTIVES:**

- To understand the basic difference between incompressible and compressible flow.
- To understand the flow through nozzles and diffusers.
- To understand the flow through constant area ducts with heat transfer and friction.
- 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 Approved Gas Tables is permitted in the examination)*

**UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 12**

Energy and momentum equations of compressible fluid flows –Stagnation states, Mach waves and Mach cone – Mach number, critical Mach number and Crocco Number -Effect of Mach number on compressibility – Isentropic flow through variable area- Use of Gas tables.

**UNIT II FLOW THROUGH DUCTS 12**

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow), Isothermal Flow – variation of flow properties – Use of tables and charts.

**UNIT III NORMAL AND OBLIQUE SHOCKS 12**

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl- Meyer relations – Rankine-Hugoniot equation - Use of table and charts – Applications.

**UNIT IV JET PROPULSION 12**

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

**UNIT V SPACE PROPULSION 12**

Types of rocket engines – Propellants – feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.

**TOTAL: 60 PERIODS**

**TEXT BOOKS:**

1. Anderson, J.D., "Modern Compressible flow", McGraw Hill, 3rd Edition, 2003.
2. S.M. Yahya, "Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion", New Age International (P) Limited, New Delhi, 4th Edition, 2010.

**REFERENCES:**

1. P. Hill and C. Peterson, "Mechanics and Thermodynamics of Propulsion", Addison – Wesley Publishing Company, 1992.
2. N.J. Zucrow, "Aircraft and Missile Propulsion", vol.1 & II, John Wiley, 1975.
3. N.J. Zucrow, "Principles of Jet Propulsion and Gas Turbines", John Wiley, New York, 1970.
4. G.P. Sutton, "Rocket Propulsion Elements", John Wiley, New York, 7th Edition, 2000.
5. A.H. Shapiro, "Dynamics and Thermodynamics of Compressible fluid Flow", John Wiley, New York, 1953.
6. V. Ganesan, "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2003.
7. V. Babu, "Fundamentals of Gas Dynamics", ANE Books Pvt. Ltd., 1st Edition 2008.
8. E.Radhakrishnan, "Gas Dynamics, Prentice Hall of India", New Delhi, 4th Edition, 2008.

9. H. I. H. Saravanamuttoo, Gordon F. C. Rogers, Henry Cohen, "Gas Turbine Theory", Prentice Hall, 4th Edition, 2001.

**BGE004 PROFESSIONAL ETHICS IN ENGINEERING L T P C**
**3 0 0 3**

**OBJECTIVE:**

- Introduction to engineering ethics, which stresses analytical reasoning and emphasizes clear thinking regarding the application of professional ethical codes to specific cases.

**UNIT I ENGINEERING ETHICS 9**

Senses of "Engineering Ethics" – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg"s theory – Gilligan"s theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories

**UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION 9**

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

**UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY 9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator"s Approach to Risk - Chernobyl Case Studies and Bhopal

**UNIT IV RESPONSIBILITIES AND RIGHTS 9**

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

**UNIT V GLOBAL ISSUES 9**

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics -Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 2005.
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, 2000.

**REFERENCES:**

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999.
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003.
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.
4. Prof. Col P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, 2004.
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, 2003.

| BME631 | HEAT TRANSFER LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |

**LIST OF EXPERIMENTS (Minimum 12 Experiments to be conducted)**

1. Thermal conductivity of slab by two slab guarded hot plate method.
2. Thermal conductivity of insulating material using lagged pipe apparatus.
3. Heat transfer through composite walls.
4. Heat transfer from a pin-fin (natural & forced convection modes)
5. Heat transfer in forced convection.
6. Performance test on Parallel and Counter flow Heat Exchanger.
7. Performance test on Vapour compression refrigeration system.
8. Performance test on LPG refrigeration system.
9. Determination of Emissivity of gray bodies.
10. Performance test on Air Conditioning Test rig.
11. Performance test on two stage reciprocating air compressor
12. Performance test on Rotary Air compressor.

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

1. Guarded plate apparatus – 1 No.
2. Lagged pipe apparatus – 1 No.
3. Natural convection-vertical cylinder apparatus – 1 No.
4. Forced convection inside tube apparatus – 1 No.
5. Pin-fin apparatus – 1 No.
6. Stefan-Boltzmann apparatus – 1 No.
7. Emissivity measurement apparatus – 1 No.
8. Parallel/counter flow heat exchanger apparatus – 1 No.
9. Single/two stage reciprocating air compressor. – 1 No.
10. Refrigeration test rig – 2 Nos
11. Air-conditioning test rig – 1
12. Rotary Air Compressor

| BME632 | METROLOGY,MEASUREMENTS AND DYNAMICS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
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**LIST OF EXPERIMENTS (Minimum 12 Experiments to be conducted)**

1. Calibration of Vernier /Micrometer/ Dial Gauge Checking
2. Measurements of Gear Tooth Dimensions
3. Measurement of Angle using sine bar /sine center
4. Measurement of straightness and flatness
5. Setting up of comparators for inspection Mechanical/Pneumatic/Electrical)
6. Measurement of Temperature using Thermocouple/Measurement of Displacement
7. Motorized gyroscope – Study of gyroscopic effect and couple.
8. Governor - Determination of range sensitivity, effort for Porter Governor.
9. Governor -Determination of range sensitivity, effort for Proell Governor.
10. Cams – Cam profile drawing.
11. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
12. Balancing of rotating masses.

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

| | | |
|---|---|---|
| Micrometer | - | 5 |
| Vernier Caliper | - | 5 |
| Vernier Height Gauge | - | 2 |
| Vernier depth Gauge | - | 2 |
| Slip Gauge Set | - | 1 |
| Gear ToothVernier | - | 1 |
| SineBar | - | 1 |
| Sine Center | - | 1 |
| Bevel Protractor | - | 1 |
| Profile Projector/Tool Makers Microscope | - | 1 |
| Mechanical/Electrical/Pneumatic Comparator | - | 1 |
| Autocollimator | - | 1 |
| Temperature Measuring Setup | - | 1 |
| Displacement Measuring Setup | - | 1 |
| Motorized gyroscope | - | 1 |
| Governor setup | - | 1 |
| Cam and follower arrangement | - | 1 |
| Whirling of shaft apparatus | - | 1 |
| Dynamic balancing apparatus | - | 1 |

Students should be familiar with the use of the following device/equipments depending upon availability.

1. Tachometers – Contact and non contact
2. Dial gauge
3. Dynamic Balancing Machine.

**BMG701 TOTAL QUALITY MANAGEMENT L T P C**
**3 0 0 3**

**OBJECTIVES**

- To understand the Total Quality Management concept and principles and the various tools available to achieve Total Quality Management.
- To understand the statistical approach for quality control.
- To create an awareness about the ISO and QS certification process and its need for the industries.

**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 –- Contributions of Deming, Juran and Crosby – Cost of Quality, Analysis Techniques for Quality Costs -Barriers to TQM.

**UNIT II TQM PRINCIPLES 9**

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, - Business Excellence Model-Rajiv Gandhi National Quality Award

**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 Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

**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 PERIODS**

**TEXT BOOKS**

1. Dale H.Besterfiled, et at., “Total Quality Management”, Pearson Education Asia, 3rd Edition, Indian Reprint (2010).
2. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, 6th Edition, South-Western (Thomson Learning), 2005.

**REFERENCES**

1. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Limited, Oxford, 3rd Edition, 2003.
2. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Private Limited, 2006.
3. Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”, Prentice Hall (India) Private Limited, 2006.
4. Ramachandran, S. “Total Quality Management”, Air Walk Publications, 2nd Edition 2008.

**BMG702 OPERATIONS RESEARCH**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**OBJECTIVES**

- To create awareness about optimization in utilization of resources.
- To understand and apply operations research techniques to industrial operations.

**UNIT I LINEAR MODEL** **12**

The phases of OR study – Mathematical formulation of L.P. Problems. Graphical solution methods – The Simplex method - slack, surplus and artificial variables, two phase method, dual simplex method, degeneracy and procedure for resolving degenerate cases. (Introduction to Application software's. – Not for Exams)

**UNIT II TRANSPORTATION, ASSIGNMENT AND TRAVELLING SALES MAN PROBLEMS** **12**

Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problem, Degeneracy in transportation problems, Applications of Transportation problems. Assignment Problem: Formulation, unbalanced assignment problem, Traveling salesman problem.

**UNIT III PERT-CPM TECHNIQUES AND INVENTORY MODEL** **12**

CPM -Network construction, determining critical path, floats, scheduling by network, project duration, PERT -variance under probabilistic models, prediction of date of completion, crashing of simple networks.

Types of Inventory- EOQ –ERL- Deterministic inventory problems – Price breaks - Stochastic inventory problems- selective inventory control techniques.

**UNIT IV REPLACEMENT AND SEQUENCING MODELS** **12**

Replacement of items that deteriorate with time – value of money changing with time – not charging with time – optimum replacement policy – individual and group replacement. Sequencing problem: models with n jobs with 2 machines – problem with n jobs with m machines.

**UNIT V QUEUING THEORY** **12**

Queuing models – queuing systems and structures – notation –parameter – single server and multi-server models – Poisson input – exponential service – constant rate service – infinite population.

**L: 45 T:15, TOTAL: 60 PERIODS**

**TEXT BOOKS:**

1. Wayne.L.Winston, "Operations research applications and algorithms", Thomson learning, 4th Edition 2007.
2. Taha H.A, "Operation Research", Pearson Education, 9th Edition, 2010

**REFERENCES:**

1. Frederick.S.Hiller and Gerald.J.Lieberman, "Operations research concepts and cases", TMH (SIE) 8th Edition.
2. J.K.Sharma, "Operations research theory and applications", Macmillan India, 3rd Edition 2007.
3. Hira and Gupta "Problems in Operations Research", S.Chand and Co, 3rd Edition 2002.
4. Panneerselvam, "Operations Research", Prentice Hall of India, 2003.
5. G Srinivasan, "Operations research principles and applications", PHI (EEE) 2007.
6. Wagner, "Operations Research", Prentice Hall of India, 2000.

**BME701 COMPUTER INTEGRATED MANUFACTURING L T P C**
**3 0 0 3**

**OBJECTIVES**

- To gain knowledge about the concept of CAD.
- To gain knowledge on how computers are integrated at various levels of planning and manufacturing.

**UNIT I INTRODUCTION TO COMPUTER AIDED DESIGN 9**

Output primitives – Point. Line, Circle drawing algorithms - Attributes of output primitives – 2D and 3D Geometric transformation – Scaling, Rotation, Translation. Two dimensional viewing –Line, Polygon, Curve and Text clipping algorithms

**UNIT II GEOMETRIC MODELING 9**

Wire frame modeling -Mathematical representation of curves, wire frame models, wire frame entities. Surface Modeling -Mathematical representation of surfaces, Surface model, Surface entities, surface representation. Solid Modelling - Solid Representation - Boundary Representation (B-rep), Constructive Solid Geometry (CSG) and other methods.

**UNIT III 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 IV 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 V SHOP FLOOR CONTROL AND INTRODUCTION TO FMS 9**

Shop floor control – phases – factory data collection system – automatic identificationmethods – 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. **TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Ibrahim Zeid, "CAD/CAM Theory and Practice", Tata McGraw Hill Education, 2nd Edition, 2010.
2. Mikell. P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education 2001.
3. Donald Hearn, Pauline Baker, Computer Graphics – C Version, 2nd Edition, Pearson Education, 2004.

**REFERENCES:**

1. Mikell. P. Groover and Emory Zimmers Jr., "CAD/CAM", Prentice hall of India Pvt. Ltd., 1998.
2. James A. Regh and Henry W. Kreabber, "Computer Integrated Manufacturing", PearsonEducation second edition, 2005.
3. ChrisMcMahon and Jimmie Browne, "CAD/CAM Principles, Practice and Manufacturing Management", Pearson Education second edition, 2005.
5. Ranky, Paul G., "Computer Integrated Manufacturing", prentice hall of India Private Limited, 2005.
6. Yorem Koren, "Computer Integrated Manufacturing", McGraw Hill, 2005.
7. P N Rao, "CAD/CAM Principles and Applications", TMH Publications, 2007.
8. F.S. Hill, Computer Graphics using OPENGL, 2nd Edition, Pearson Education, 2003.

**BME702 MECHATRONICS AND MODERN CONTROL L T P C**
**3 0 0 3**

**OBJECTIVES**

- To understand the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical and Electronic Systems.

**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, Electro mechanical Systems – Hydraulic – Mechanical Systems. Continuous and discrete process Controllers – Control Mode –Two–Step mode – Proportional Mode – Derivative Mode– Integral Mode – PID Controllers – Introduction.

**UNIT IV INTRODUCTION TO 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 PERIODS**

**TEXT BOOKS**

1. Bolton.W, "Mechatronics" , Pearson education, 2nd edition, fifth Indian Reprint, 2003.
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.
3. Dan Necsulesu, "Mechatronics", Pearson Education (Asia), 2002 (Indian Reprint).
4. Lawrence J. Kamm, "Understanding Electro – Mechanical Engineering: An Introduction to Mechatronics", Prentice – Hall of India Private Limited, 1st Edition, 2000.
5. Nitaigour Premchand Mahadik, "Mechatronics", Tata McGraw-Hill Publishing Company Limited, 2003.

| BME731 | COMPUTER AIDED SIMULATION AND ANALYSIS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 2 |

**LIST OF EXERCISES USING STANDARD FEA SOFTWARE**

**One dimensional**

1. Structural analysis of a cantilever beam and bar.
2. Stress analysis of a simply supported beam
3. Structural analysis of a fixed beam

**Two dimensional**

1. Stress analysis of rectangular plate with hole
2. Stress analysis of an axisymmetric component
3. Structural analysis of an L bracket
4. Modal analysis of Different beam
5. Modal analysis of rectangular plate
6. Conductive heat transfer analysis of a rectangular plate
7. Combined conductive and convective heat transfer analysis of a rectangular plate
8. Thermal stress analysis of a rectangular beam
9. Transient conduction heat transfer analysis
10. Harmonic analysis of Cantilever beam

**TOTAL: 45 PERIODS**

| BME732 | MECHATRONICS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
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**LIST OF EXPERIMENTS**

1. Design and testing of fluid power 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 -Full step resolution
9. Stepper motor interfacing with 8051 Micro controller - half step resolution.
10. Modeling and analysis of basic electrical, hydraulic and pneumatic systems usingLAB VIEW.
11. Computerized data logging system with control for process variables like pressure flow and temperature.

**TOTAL: 45 PERIODS**

**LIST OF EQUIPMENT** (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 No.
4. 8051 - Microcontroller kit with stepper motor and drive circuit sets - 2 No.
5. LAB VIEW software with Sensors to measure Pressure, Flow rate, direction, speed, velocity and force seats - 2 No.

| BME733 | COMPREHENSION | L | T | P | C |
|---|---|---|---|---|---|
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**OBJECTIVE**

- The objective of comprehension is to provide opportunity for the student to apply the knowledge acquired during the earlier semesters to real life problems which he / she may have to face in future as an engineer.

**METHODOLOGY**

- While learning as how to solve the real life problems, student will receive guidance from the faculty and also review various courses learnt earlier.
- Further this comprehension is to achieve an understanding of the fundamentals of contemporary manufacturing systems including materials, manufacturing process, product and process control, computer integrated manufacture and quality.
- The students work in groups and solve a variety of problems given to them.
- The problems given to the students should be of real like industrial problems selected by a group of faculty members of the concerned department.
- A minimum of three small problems have to be solved by each group of students.
- The evaluation is based on continuous assessment by a group of Faculty Members constituted by the professor in-charge of the course.

**TOTAL: 45 PERIODS**

**BMG601 PRINCIPLES OF MANAGEMENT L T P C**
**3 0 0 3**

**OBJECTIVES**

- To get the skills needed to successfully manage an organization.
- To understand concepts of strategic and tactical organizational planning.
- Implement employee motivational approaches and conflict management skills.
- To describe common performance appraisal processes.
- To understand group and team management, management development, and employee training.
- Describe concepts of controlling and control systems.

**UNIT I FOUNDATIONS 9**

Historical developments – approaches to management – Management and Administration – Development of Management Thought – Contribution of Taylor and Fayol – Functions of Management – Types of Business Organization, Meaning, features merits and demerits.

**UNIT II MANAGERS AND ENVIRONMENT 9**

Social responsibility – Planning – Objectives – Setting Objectives – Process of Managing through Objectives – Strategies – Policies and Planning Premises – Forecasting – Decision-making.

**UNIT III FUNCTIONAL AREA OF ORGANISATION 9**

Formal and informal organization – Organization Chart – Structure and Process – Departmentation by different strategies – Line and Staff authority – Benefits and Limitations – De-Centralization and Delegation of Authority – Staffing – Selection Process - Techniques – HRD – Managerial Effectiveness.

**UNIT IV MOTIVATION AND DIRECTIONS 9**

Objectives– Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment – Communication.

**UNIT V CONTROLLING STRATEGIES 9**

System and process of Controlling – Requirements for effective control – The Budget as Control Technique – Information Technology– Computers in handling the information – Productivity – Problems and Management – Control of Overall Performance – Direct and Preventive Control – Reporting – The Global Environment – Globalization and Liberalization – International Management and Global theory of Management.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**


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 South western, 7th Edition, 2007.


**REFERENCES**


1. Stephen P. Robbins and Mary Coulter, "Management", Prentice Hall of India", 8th Edition, 2012.
2. Charles W.L Hill, Steven L McShane, "Principles of Management", Mcgraw Hill Education, Special Indian Edition, 2007.
3. Vijayaraghavan G.K & Sivakumar M. "Principles of Management", Lakshmi Publications, 1st Edition, 2011.
4. Ramachandran. S. "Principles of Management", Air Walk Publications, 1st Edition, 2007.

**BME801 POWER PLANT ENGINEERING L T P C**
**3 0 0 3**

**OBJECTIVE**

- To understand the various components, operations and applications of different types of power plants

**UNIT I INTRODUCTION TO POWER PLANTS AND BOILERS 9**

Layout of Steam,Hydel, Diesel, MHD, Nuclear and Gas turbine Power Plants Combined Power cycles -– Steam boilers and cycles – High pressure and Super Critical Boilers – Fluidized Bed combustion and boilers

**UNIT II STEAM POWER PLANT 9**

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 hydelPowerplants – Pumped storage power plant.

**UNIT IV DIESEL AND GAS TURBINE POWER PLANT 9**

Types of diesel plants, components, Selection of Engine type, applications-Gas turbinepower plant-Fuels- Gas turbine material – open and closed cycles- reheating – Regeneration and intercooling – combines cycle

**UNIT V UNCONVENTIONAL POWER PLANTS AND ECONOMICS 9**

Geo thermal - OTEC – Wind power plant – Tidal – 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. Load Curves

**TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. EI-WakilM.M ,"Power Plant Technology," Tata McGraw-Hill, 2010
2. Nag P.K, "Power Plant Engineering", 4th Edition, Tata McGraw- Hill , 2008

**REFERENCES**

1. Arora S.C and Domkundwar S, "A Course in Power Plant Engineering", Dhanpat Rai, 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.

**BGE801 ENGINEERING ECONOMICS AND COST ANALYSIS L T P C**
**3 0 0 3**

**OBJECTIVES**

- To learn about the basics of economics and cost analysis related to engineering so as to take economically sound decisions.

**UNIT I INTRODUCTION TO ECONOMICS 9**

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics- Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

**UNIT II VALUE ENGINEERING 9**

Make or buy decision, Value engineering – Function, aims, and Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate.

**UNIT III CASH FLOW 9**

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method.

**UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS 9**

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

**UNIT V DEPRECIATION 9**

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Inflation adjusted decisions – procedure to adjust inflation, comparison of alternatives and determination of economic life of asset.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. PanneerSelvam, R, “Engineering Economics”, Prentice Hall of India Limited, New Delhi, 2001.
2. Suma Damodaran, “Managerial economics”, Oxford University press 2006.

**REFERENCES**

1. Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2002.
2. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis”, Engineering Press, Texas, 2002
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, New York, 1984
4. Grant.E.L., Ireson.W.G., and Leaven worth, R.S, “Principles of Engineering Economy”, Ronald Press, New York, 1976.
5. Smith, G.W., “Engineering Economy”, Lowa State Press, Iowa, 1973.
6. Truett &Truett, “Managerial economics- Analysis, problems & cases “Wiley India 8th Edition 2004.
7. Luke M Froeb / Brian T Mccann, “Managerial Economics – A problem solving approach” Thomson learning 2007.

| BME831 | PROJECT WORK | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 18 | 9 |

## OBJECTIVES

- The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

## TEAM WORK AND INCLUSION

The objective of the project work is to enable the students in convenient groups of not more than 4 members on a project involving theoretical and experimental studies related to the branch of study.

- Every project work shall have a guide who is the member of the faculty of the institution.
- Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.
- The progress of the project is evaluated based on a minimum of three reviews.
- The review committee may be constituted by the Head of the Department.
- Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.
- This final report shall be typewritten form as specified in the guidelines.
- The continuous assessment shall be made as prescribed in the regulations.

**BME001 QUALITY CONTROL AND RELIABILITY ENGINEERING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the concept of SQC
- To understand process control and acceptance sampling procedure and their application.
- To learn the concept of reliability.

**UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES 10**

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 variables – X chart, R chart and σ chart -process capability – process capability studies and simple problems. Six sigma concepts.

**UNIT II PROCESS CONTROL FOR ATTRIBUTES 8**

Control chart for attributes –control chart for nonconforming– 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, mean 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.

**TOTAL: 45 PERIODS**

**Note:** Use of approved statistical table permitted in the examination.

**TEXT BOOKS:**

1. Douglas.C.Montgomery, "Introduction to Statistical quality control", John wiley, 4th Edition, 2001.
2. L.S.Srinath, "Reliability Engineering", Affiliated East west press, 1991.

**REFERENCES:**

1. John.S. Oakland. Statistical process control", Elsevier, 5th Edition, 2005.
2. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 1993.
3. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 1996.
4. Monohar Mahajan, "Statistical Quality Control", DhanpatRai& Sons, 2001.
5. R.C.Gupta, "Statistical Quality control", Khanna Publishers, 1997.
6. Besterfield D.H., "Quality Control", Prentice Hall, 1993.
7. Sharma S.C., "Inspection Quality Control and Reliability", Khanna Publishers, 1998.
8. Danny Samson, "Manufacturing & Operations Strategy", Prentice Hall, 1991.

**BME002 REFRIGERATION AND AIR CONDITIONING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To provide knowledge on various refrigeration cycles, system components and refrigerants.
- To provide knowledge on design aspects of Refrigeration & Air conditioning Systems.

**UNIT I REFRIGERATION CYCLE 7**

Review of thermodynamic principles of refrigeration. Carnot refrigeration cycle – Vapour compression refrigeration cycle – use of P.H. charts – multistage and multiple evaporator systems – cascade system – COP comparison.Air Refrigeration cycles.

**UNIT II REFRIGERANTS AND SYSTEM COMPONENTS 10**

Compressors – (reciprocating and rotary elementary treatment), Types of condensers, evaporators, cooling towers – Functional aspects. Refrigerants – properties – selection of refrigerants, Alternate Refrigerants, Cycling controls.

**UNIT III PSYCHROMETRY 10**

Psychrometric processes - use of psychrometric charts – Grand and Room Sensible Heat Factors – bypass factor – air washers, requirements of comfort air conditioning, summer and Winter Air conditioning.

**UNIT IV AIR CONDITIONING SYSTEMS 9**

Cooling load calculation and working principles of – Centralized Air conditioning systems, Split, Ductable split, Packaged Air conditioning, VAV & VRV Systems. Duct Design by equal friction method, Indoor Air quality concepts.

**UNIT V UNCONVENTIONAL REFRIGERATION CYCLES 9**

Solar cooling -Vapor Adsorption system – Ejector jet, Steam jet refrigeration, thermo electric refrigeration. Applications – ice plant – food storage plants – milk – chilling plants.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Manohar Prasad, “Refrigeration and Air Conditioning”, Wiley Eastern Ltd., 1983.
2. Arora C.P., “Refrigeration and Air Conditioning”, Tata McGraw Hill, New Delhi, 1988.

**REFERENCES:**

1. Roy. J. Dossat, “Principles of Refrigeration”, Pearson Education 1997.
2. Jordon and Priester, “Refrigeration and Air Conditioning”, Prentice Hall of India Pvt. Ltd., New Delhi, 1985.
3. Stoecker N.F. and Jones, “Refrigeration and Air Conditioning”, TMH, New Delhi, 1981.

**BME003 RENEWABLE SOURCES OF ENERGY L T P C**
**3 0 0 3**

**OBJECTIVES:**

- At the end of the course, the student are expected to Understand and analyze the pattern of renewable energy resources Suggest methodologies / technologies for its utilization Economics of the utilization and environmental merits

**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. **(Qualitative Approach only)**

**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 HYDROGEN AND FUEL CELLS 9**

Hydrogen, generation, storage, transport and utilization, Applications: power generation, transport – Fuel cells – technologies, types – economics and the power generation

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. G.D. Rai, “Non Conventional Energy Sources”, Khanna Publishers, New Delhi, 1999.
2. S.P. Sukhatme, “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. G.N. Tiwari, “Solar Energy – Fundamentals Design, Modelling and applications”, Narosa Publishing House, New Delhi, 2002.
4. L.L. Freris, “Wind Energy Conversion systems”, Prentice Hall, UK, 1990.

**BME004 INDUSTRIAL TRIBOLOGY L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To recognize the laws of friction, mechanisms of friction, friction space, stiction, stick slip, and surface temperature.
- Appreciate the various modes of wear: (adhesive, delamination, fretting, abrasive, erosive, Corrosive, oxidational mild and severe), melt, and the wear-mechanism maps.
- Identify types of lubrication: boundary, solid-film, hydrodynamic, and hydrostatic lubrication.

**UNIT I SURFACES AND FRICTION 9**

Topography of Engineering surfaces- Contact between surfaces - Sources of sliding Friction – Adhesion-Ploughing- Energy dissipation mechanisms Friction Characteristics of metals - Friction of non metals. Friction of lamellar solids - friction of Ceramic materials and polymers - Rolling Friction - Source of Rolling Friction – Stick slip motion - Measurement of Friction.

**UNIT II WEAR 9**

Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear – Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture - wear - Wear of Ceramics and Polymers - Wear Measurements.

**UNIT III LUBRICANTS AND LUBRICATION TYPES 9**

Types and properties of Lubricants - Testing methods - Hydrodynamic Lubrication – Elasto-hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication- Hydrostatic Lubrication.

**UNIT IV FILM LUBRICATION THEORY 9**

Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds Equation for film Lubrication - High speed unloaded journal bearings-Loaded journal bearings – Reaction torque on the bearings - Virtual Co-efficient of friction - The Sommerfield diagram.

**UNIT V SURFACE ENGINEERING AND MATERIALS FOR BEARINGS 9**

Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes – Surface coatings - Plating and anodizing - Fusion Processes – Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1. A.Harnoy “Bearing Design in Machinery”, Marcel Dekker Inc, NewYork, 2003.

**REFERENCES:**

1. M.M.Khonsari & E.R.Booser, “Applied Tribology”, John Willey & Sons, New York, 2001.
2. E.P.Bowden and Tabor.D., “Friction and Lubrication”, Heinemann Educational Books Limited, 1974.
3. A.Cameron, “Basic Lubrication Theory”, Longman, U.K., 1981.
4. M.J.Neale Editor, “Tribology Handbook”, Newnes. Butter worth, Heinemann, U.K., 1995.

**BME005 VIBRATION AND NOISE CONTROL L T P C**
**3 0 0 3**

**OBJECTIVE:**

- The student will be able to understand the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components

**UNIT I BASICS OF VIBRATION 9**

Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

**UNIT II BASICS OF NOISE 9**

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

**UNIT III AUTOMOTIVE NOISE SOURCES 9**

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.

**UNIT IV CONTROL TECHNIQUES 9**

Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

**UNIT V SOURCE OF NOISE AND CONTROL 9**

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. SingiresuS.Rao - “Mechanical Vibrations”, Pearson Education, ISBM –81-297- 0179-0 - 2004.
2. KewalPujara, “Vibrations and Noise for Engineers”, DhanpatRai & Sons, 1992.

**REFERENCES:**

1. Bernard Challen and Rodica Baranescu - “Diesel Engine Reference Book” – 2nd Edition - SAE International - ISBN 0-7680-0403-9 – 1999.
2. Julian Happian-Smith, “An Introduction to Modern Vehicle Design”, Butterworth-Heinemann, ISBN 0750-5044-3 – 2004.
3. John Fenton, “Handbook of Automotive body Construction and Design Analysis”, Professional Engineering Publishing, ISBN 1-86058-073- 1998.

**BME006 UNCONVENTIONAL MACHINING PROCESSES L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications

**UNIT I INTRODUCTION 5**

Unconventional machining Process – Need – classification – Brief overview.

**UNIT II MECHANICAL ENERGY BASED PROCESSES 10**

Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining Ultrasonic Machining(AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR-Variation in techniques used – Applications.

**UNIT III ELECTRICAL ENERGY BASED PROCESSES 8**

Electric Discharge Machining (EDM)- working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.

**UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 12**

Chemical machining and Electro-Chemical machining (CHM and ECM) – Etchantsmaskant – techniques of applying maskants – Process Parameters – Surface finish and MRR – Applications. Principles of ECM – equipments – Surface Roughness and MRR Electrical circuit – Process Parameters – ECG and ECH- Applications.

**UNIT V THERMAL ENERGY BASED PROCESSES 10**

Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques –Applications.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1. Vijay.K. Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd., New Delhi, 2007.

**REFERENCES:**

1. Benedict. G.F. “Nontraditional Manufacturing Processes”, Marcel Dekker Inc., New York, 1987.
2. Pandey P.C. and Shan H.S. “Modern Machining Processes” Tata McGraw-Hill, New Delhi, 2007.
3. McGeough, “Advanced Methods of Machining”, Chapman and Hall, London, 1998.
4. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, “Material and Processes in Manufacturing”, Prentice Hall of India Pvt. Ltd., New Delhi, 8th Edition, 2001.

**BME007 PROCESS PLANNING AND COST ESTIMATION L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To introduce the process planning concepts to make cost estimation for various Products after process planning

**UNIT I WORK STUDY AND ERGONOMICS 10**

Method study – Definition – objectives-Motion economy- Principles – Tools and Techniques- Applications – Work measurements- purpose – use – procedure – tools and techniques- Standard time –Ergonomics – principles – applications.

**UNIT II PROCESS PLANNING 10**

Definition – objective – Scope –- Types of Production - Standardization, Simplification- approaches to process planning - Process planning activities – machine selection – material selection parameters - Set of documents for process planning- Developing manufacturing logic and knowledge- production time calculation – selection of cost optimal processes.

**UNIT III INTRODUCTION TO COST ESTIMATION 7**

Importance and aim of cost estimation - costing – cost accounting- classification of cost- Elements of cost.

**UNIT IV COST ESTIMATION 8**

Types of estimates – methods of estimates – data requirements and sources- collection of cost- allowances in estimation- Difference between costing and estimation.

**UNIT V PRODUCTION COST ESTIMATION 10**

Estimation of material cost, labour cost and over heads, allocation of overheads – Estimation for different types of jobs in forging and welding shops.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1. Sinha.B.P., "Mechanical Estimating and Costing", Tata McGraw-Hill, Publishing Co. 1995.

**REFERENCES:**

1. Phillip.F.Ostwalal and JairoMunez, "Manufacturing Processes and systems", John Wiley, 9th Edition, 1998.
2. Russell.R.S and Tailor, B.W, "Operations Management", PHI, 4th Edition, 2003.
3. T.R. Banga and S.C.Sharma, “Mechanical Estimating and Costing”, Khanna Publishers, Delhi.

**BME008 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- 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**

Objectives 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, Die set, 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 FORMING AND DRAWING DIES 10**

Difference between bending, forming 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 re-drawing and combination dies – Blank development for axi- symmetric, rectangular and elliptic parts – Single and double action dies.

**UNIT V MISCELLANEOUS TOPICS 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 - Course should be supplemented with visits to industries.

**(Use of PSG design Data Book permitted). TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Joshi, P.H. “Jigs and Fixtures”, 2nd Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2004.
2. Donaldson, Lecain and Goold “Tool Design”, 3rd Edition, Tata McGraw Hill, 2000.

**REFERENCES:**

1. K. Venkataraman, “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, New Delhi, 2005.
2. Kempster, “Jigs and Fixture Design”, Hoddes and Stoughton – 3rd Edition, 1974.
3. Joshi, P.H. “Press Tools” – Design and Construction”, Wheels publishing, 1996.
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.

**BME009 COMPOSITE MATERIALS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- 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 INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS MANUFACTURING 12**

Definition –Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke"s Law.Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina –Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding – Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes

**UNIT II FLAT PLATE LAMINATE CONSTITUTE EQUATIONS 10**

Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates.Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates.Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

**UNIT III LAMINA STRENGTH ANALYSIS 5**

Introduction - Maximum Stress and Strain Criteria.Von-Misses Yield criterion for Isotropic Materials.Generalized Hill"s Criterion for Anisotropic materials. Tsai-Hill"s Failure Criterion for Composites Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure

**UNIT IV THERMAL APPLICATIONS 8**

Assumption of Constant C.T.E"s. Modification of Hooke"s Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E"s. C.T.E"s for special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates

**UNIT V ANALYSIS OF LAMINATED FLAT PLATES 10**

Equilibrium Equations of Motion.Energy Formulations.Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Gibson, R.F., "Principles of Composite Material Mechanics", McGraw-Hill, 1994, 2nd Edition - CRC press in progress.
2. Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw-Hill, 1998.

**REFERENCES:**

1. Issac M. Daniel and OriIshai, "Engineering Mechanics of Composite Materials", Oxford University Press, 2006, First Indian Edition ,2007.
2. Mallick, P.K., Fiber,"Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, 1993.
3. Halpin, J.C., "Primer on Composite Materials, Analysis", Techomic Publishing Co., 1984.
4. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
5. Mallick, P.K. and Newman, S., "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.

**BME010 THERMAL TURBO MACHINES L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To understand the various systems, principles, operations and applications of different types of turbo machinery components.

**UNIT I PRINCIPLES 9**

Energy transfer between fluid and rotor-classification of fluid machinery,-dimensionless parameters-specific speed-applications-stage velocity triangles-work and efficiency.

**UNIT II CENTRIFUGAL FANS AND BLOWERS 9**

Types- stage and design parameters-flow analysis in impeller blades-volute and diffusers, losses, characteristic curves and selection, fan drives and fan noise.

**UNIT III CENTRIFUGAL COMPRESSOR 9**

Construction details, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

**UNIT IV AXIAL FLOW COMPRESSOR 9**

Stage velocity diagrams, enthalpy-entropy diagrams, stage losses and efficiency, work done, simple stage design problems and performance characteristics.

**UNIT V AXIAL AND RADIAL FLOW TURBINES 9**

Stage velocity diagrams, reaction stages, losses and coefficients, blade design principles, testing and performance characteristics.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1. Yahya, S.M., “Turbines, Compressor and Fans”, Tata McGraw Hill Publishing Company, 1996.

**REFERENCES:**

1. Bruneck, “Fans”, Pergamom Press, 1973.
2. Earl Logan, Jr., “Hand book of Turbo machinery”, Marcel Dekker Inc., 1992.
3. Dixon, S.I., “Fluid Mechanics and Thermodynamics of Turbo machinery”, Pergamon Press, 1990.
4. Shepherd, D.G., “Principles of Turbo machinery”, Macmillan, 1969.
5. Stepanpff, A.J., “Blowers and Pumps”, John Wiley and Sons Inc. 1965.
6. Ganesan, V., “Gas Turbines”, Tata McGraw Hill Pub. Co., 1999.
7. Gopalakrishnan.G and Prithvi Raj.D, “A Treatise on Turbo machines”, Scitech Publications India Pvt. Ltd., 2002.

**BME011 APPLIED COMPUTATIONAL FLUID DYNAMICS AND FINITE ELEMENT ANALYSIS**

| L | T | P | C |
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| 3 | 0 | 0 | 3 |

**COURSE DESCRIPTION**

This course will provide core knowledge of the fundamentals of CFD/FEA for engineers, and an introduction to the methods and analysis techniques used in CFD/FEA. It also provides an introduction to the use of commercial CFD/FEA codes to analyse flow and heat transfer, Stress, Thermal and modal analysis in problems of practical engineering interest.

**COURSE OBJECTIVE**

- To introduce students to applied computational fluid dynamics and to teach them how to solve a fluid flow and Static and Dynamic Strutural problem using commercially available CFD/FEA software
- Equip the students with the Computational Fluid Dynamics and Finite Element Analysis fundamentals.
- Enable the students to formulate the design problems into CFD/FEA.

**COURSE OUTCOMES**

After successfully completing this course you will be able to:

- Have a working knowledge of a variety of computational techniques that can be used for solving engineering problems
- To develop an understanding for the major theories, approaches and methodologies used in CFD/FEM;
- To build up the skills in the actual implementation of CFD methods (e.g. boundary conditions, turbulence modelling etc.) in using commercial CFD codes;
- To gain experience in the application of CFD/FEM analysis to real engineering designs.
- Using software to perform Pressure, Velocity, stress, thermal and modal analysis
- Proficiency in engineering design
- Ability to conduct an engineering project

**UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9**

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Physical boundary conditions – Laminar and Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

**UNIT II TURBULENCE MODELS AND MESH GENERATION 9**

Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement Adaptive mesh – Software tools

**UNIT III APPLIED PROJECTS CFD – I 9**

Internal Fluid flow - Pipe bends, Branch and lateral –Symmetric – Transient - Header Flow Distribution Post processing - Different CFD Outputs : Contour plots –, Surface Plots, Plotting, Vectors, Turbulence Modelling External Flow – Flow over a circular cylinder, simple car and an aeroplane

**UNIT IV APPLIED PROJECTS CFD – II 9**

Radiation problems - Heat Transfer distribution – Porous media – Pump – Fan – Gaseous Combustion – Particle Study – Multi phase problems

**UNIT V APPLIED PROJECTS FEA 9**

Stress – Strain – FOS – Machine elements under Static Structural Loads – Modal Analysis – Thermal Analysis – Vibrations - Non-Linear Analysis.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd., 2nd Edition, 2007
2. Jiyuan TL, Guan Heng Yeoh, "Computational Fluid Dynamics A Practical Approach" Butterworth-Heinemann, 1st Edition 2008
3. Anderson "Computational Fluid Dynamics The Basics with Application" Mcgraw Hill

**REFERENCES**

1. Hyoung Woo Oh, "Applied Computational Fluid Dynamics", InTech Publishers, 2012
2. Chung, T.J. "Computational Fluid Dynamics", Cambridge University, Press, 2002.
3. Ghoshdastidar P.S., "Heat Transfer", Oxford University Press, 2005
4. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.
5. ProdipNiyogi, Chakrabarty, S.K., Laha, M.K. "Introduction to Computational Fluid Dynamics", Pearson Education, 2005.
6. Anil W. Date "Introduction to Computational Fluid Dynamics" Cambridge University Press, 2005.

**BME012 UTILIZATION OF SOLAR ENERGY L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To learn and study the radiation principles with respective solar energy estimation
- To study the various collecting techniques of solar energy and storage
- To learn about PV technology principles and techniques of various solar cells / materials for energy conversion
- To learn economical and environmental merits of solar energy for variety of applications

**UNIT I SOLAR RADIATION 9**

Source of radiation – Sun earth relationship- extra-terrestrial radiation– Atmospheric attenuation – Solar Constant, Monthly average daily global radiation and diffuse radiations- Monthly average hourly global radiation and diffuse radiations. Radiations on tilted surfaces. Radiation Measurement - pyranometer.

**UNIT II SOLAR FLAT PLATE COLLECTORS 9**

Design considerations – classification- Flat plate collectors- air heating collectors liquid heating – Temperature distributions- Heat removal rate- Useful energy gain – Losses in the collectors-for efficiency of flat plate collectors – selective surfaces –Testing of flat plate collectors

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**UNIT III SOLAR CONCENTRATING COLLECTORS 9**

Introduction- Types of concentric collectors – Cylindrical Parabolic collector – orientation and tracking modes. Compound parabolic collector- Geometry –Tracking requirements. Material for solar concentrations.

**UNIT IV PHOTOVOLTAIC SYSTEMS 9**

Conversion of Solar energy into Electricity - Photovoltaic Effect, Photovoltaic material - Solar Cell – Module – Silicon solar cell –Polycrystalline, Amorphous silicon – Efficiency of solar cells – PV Systems – Stand alone – Grid connected PV systems, Photovoltaic applications.

**UNIT V APPLICATIONS OF SOLAR HEAT 9**

Solar Thermal Power Plant, Solar Desalination – Simple solar still – basics – Materials, Wick type Solar still, Solar Water Heating- Advantages – Natural circulation and forced circulation-Solar cookers Paraboloid and hot box solar cookers

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Sukhatme S P, “Solar Energy”, 3rd Edition, Tata McGraw-Hill Education, 2008.
2. H.P. Garg and J. Prakash, “Solar Energy- Fundamentals & Applications”, Tata McGraw-Hill, 2000.

**REFERENCES**

1. L D. Partain, L M. Fraas, “Solar Cells and Their Applications”, 2nd Edition, John Wiley and Sons, 2010.
2. SoterisKalogirou, “Solar Energy Engineering”, Academic Press, 2009.
3. Duffie, J. A. and Beckman, W. A., “Solar Engineering of Thermal Processes”,3rd Edition, Wiley, 2006.
4. A Luque, S Hegedus, “Handbook of Photovoltaic Science and Engineering”, John Wiley and Sons, 2003.
5. G. N. Tiwari, “Solar energy”, CRC Press, 2002.

**BME013 NUCLEAR ENGINEERING L T P C**
**3 0 0 3**

**OBJECTIVE**

- To gain some fundamental knowledge about nuclear physics, nuclear reactor, nuclear fuels, reactors and safe disposal of nuclear wastes.

**UNIT I NUCLEAR PHYSICS 9**

Nuclear model of an atom-Equivalence of mass and energy-binding- radio activity-half life-neutron interactions-cross sections.

**UNIT II NUCLEAR REACTIONS AND REACTION MATERIALS 9**

Mechanism of nuclear fission and fusion- radio activity- chain reactions- critical mass and composition nuclear Fuel cycles and its characteristics- uranium production and purification-Zirconium, thorium, beryllium.

**UNIT III REPROCESSING 9**

Reprocessing: nuclear fuel cycles-spent fuel characteristics-role of solvent extraction in reprocessing solvent Extraction equipment.

**UNIT IV NUCLEAR REACTOR 9**

Nuclear reactors: types of fast breeding reactors-design and construction of fast breeding reactors-heat transfer techniques in nuclear reactors- reactor shielding. Fusion reactors.

**UNIT V SAFETY AND DISPOSAL 9**

Safety and disposal: Nuclear plant safety-safety systems-changes and consequences of accident-criteria for safety-nuclear waste-types of waste and its disposal-radiation hazards and their prevention-weapons proliferation.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1. Thomas J.Cannoly, “Fundamentals of nuclear Engineering” John Wiley, 1978.

**REFERENCES:**

1. Collier J.G., and Hewitt G.F, “Introduction to Nuclear power”, Hemisphere publishing, New York. 1987.
2. WakilM.M.El, “Power Plant Technology” – McGraw-Hill International, 1984.

**BME014 FUNDAMENTALS OF NANO TECHNOLOGY L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To study the basics and important applications of nano technology.

**UNIT I INTRODUCTION 10**

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

**UNIT II PREPARATION METHODS 10**

Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

**UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES 5**

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, (dry Plasma /reactive ion) etching, Etch resists-dip pen lithography

**UNIT IV PREPARATION ENVIRONMENTS 10**

Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

**UNIT V CHARECTERISATION TECHNIQUES 10**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale charecterisation of surfaces & Interfaces", 2nd Edition, Weinheim Cambridge, Wiley-VCH, 2000.

**REFERENCES:**

1. G Timp Editor, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia Editor, "The Hand Book of Nano Technology, "Nanometer Structure", Theory, Modeling and Simulations", Prentice-Hall of India (P) Ltd, New Delhi, 2007.

**BME015 PRODUCTION PLANNING AND CONTROL L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning MRP II and Enterprise Resource Planning ERP.

**UNIT I INTRODUCTION 9**

Objectives and benefits of planning and control-Functions of production control-Types of production-job- batch and continuous-Product development and design-Marketing aspect - Functional aspect-Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration-Standardization, Simplification &specialization Break even analysis-Economics of a new design.

**UNIT II WORK STUDY 9**

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

**UNIT III PRODUCT PLANNING AND PROCESS PLANNING 9**

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning-Steps in process planning-Quantity determination in batch production-Machine capacity, balancing-Analysis of process capabilities in a multi product system.

**UNIT IV PRODUCTION SCHEDULING 9**

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance – Flow production scheduling-Batch production scheduling-Product sequencing – Production Control systems-Periodic batch control-Material requirement planning kanban –Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques for aligning completion times and due dates.

**UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9**

Inventory control – Purpose of holding stock - Effect of demand on inventories – Ordering Procedures. Two bin system -Ordering cycle system-Determination of Economic order quantity and economic lot size-ABC analysis-Recorder procedure-Introduction to computer integrated production planning systems-elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Martand Telsang, “Industrial Engineering and Production Management”, S. Chand and Company, 1st Edition, 2000.
2. James.B.Dilworth, “Operations management – Design, Planning and Control for manufacturing and services”, McGraw Hill International Edition, 1992.

**REFERENCES:**

1. Samson Eilon, "Elements of production planning and control", Universal Book Corpn. 1984.
2. Elwood S.Buffa, and RakeshK.Sarin, "Modern Production / Operations Management", 8th Eition, John Wiley and Sons, 2000.
3. KanishkaBedi, "Production and Operations management", Oxford University press, 2nd Edition, 2007.
4. Melynk, Denzler, "Operations management – A value driven approach", Irwin Mc Graw Hill.
5. Norman Gaither, G. Frazier, "Operations management" ,Thomson learning, 9th Edition, IE, 2007.
6. K.C.Jain& L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers, 1990.
7. S.N.Chary, "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.
8. UpendraKachru, " Production and operations management – Text and cases", Excel books, 1st Edition, 2007.

**BME016 MAINTENANCE ENGINEERING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- To explain the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.
- To illustrate some of the simple instruments used for condition monitoring in industry.

**UNIT I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 10**

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems –Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability –Maintenance organization – Maintenance economics.

**UNIT II MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE 9**

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repairs cycle - Principles and methods of lubrication – TPM.

**UNIT III CONDITION MONITORING 9**

Condition Monitoring – Cost comparison with and without CM – On-load testing and offload testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis

**UNIT IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS 9**

Repair methods for beds, slideways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.

**UNIT V REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT 8**

Repair methods for Material handling equipment - Equipment records –Job order systems -Use of computers in maintenance.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Srivastava S.K., “Industrial Maintenance Management”, S. Chand and Co., 1981.
2. Bhattacharya S.N., “Installation, Servicing and Maintenance”, S.Chand and Co., 1995.

**REFERENCES:**

1. White E.N., “Maintenance Planning”, I Documentation, Gower Press, 1979.
2. Garg M.R., “Industrial Maintenance”, S. Chand & Co., 1986.
3. Higgins L.R., “Maintenance Engineering Hand book”, McGraw Hill, 5th Edition, 1988.
4. Armstrong, “Condition Monitoring”, BSIRSA, 1988.
5. Davies, “Handbook of Condition Monitoring”, Chapman &Hall, 1996.
6. “Advances in Plant Engineering and Management”, Seminar Proceedings - IIPE, 1996.

**BME017 PRODUCT DESIGN AND COSTING L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To enable the student to understand the several aspects of the design process and to apply them in practice. Also to train the student in the concept of product costing and other manufacturing economics in optimization of product design.

**UNIT I PRODUCT DESIGN AND DEVELOPMENT 8**

Principles of creativity in design- integrated product development and concurrent engineering – Product analysis – Criteria for product design – Market research – Design for customer and design for manufacture – Product life cycle.

**UNIT II ECONOMICS OF DESIGN 9**

Breaks even point - Selection of optimal materials and processes – Material layout planning – Value analysis – Re-engineering and its impact on product development.

**UNIT III PRODUCT MODELING 9**

Product modeling – Definition of concept - fundamental issues – Role and basic requirement of process chains and product models –Types of product models – model standardization efforts – types of process chains – industrial demands.

**UNIT IV PRODUCT COSTING 10**

Bill of materials – Outline Process charts – Concepts of operational standard time - Work measurement by analytical estimation and synthesis of time – Budgets times – Labor cost and material cost at every stage of manufacture – W.I.P. costing

**UNIT V RECENT ADVANCES AND CONCEPTS IN PRODUCT DESIGN 9**

Fundamentals of FEM and its significance to product design – Product life cycle management – Intelligent information system – Concept of Knowledge based product and process design.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. SAMEULEilon – “Elements of Production Planning and Control” – McMillan and Company, 1962.
2. Jones S.W., “Product Design and Process Selection”, Butterworth Publications, 1973.
3. Karl T. Ulrich, Stephen D. Eppinger – “Product Design and Development”, McGraw-Hill, 1994.

**REFERENCES:**

1. Harry Nystrom – “Creativity and Innovation”, John Wiley & Sons, 1979.
2. George E. Dieter, “Engineering Design – Materials and process approach”, Tata McGraw-Hill, 1991.
3. Donald E. Carter – “Concurrent Engineering”, Addison Wesley, 1992.

**BME018 PRESSURE VESSEL AND PIPING DESIGN L T P C**
**3 0 0 3**

**OBJECTIVES:**

- 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 ASMEcode 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 VESSELS 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 behaviour.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Harvey J F., “Pressure vessel design”,CBS publication, 1963.
2. Brownell. L. E & Young. E. D., “Process equipment design”, Wiley Eastern Ltd., India, 1959.

**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.
4. Stanley M Wales, “Chemical Process equipment, selection and design”, Butterworth”s, series in Chemical Engineering, 1988.
5. William.j.,Bees, “Approximate methods in the Design and Analysis of pressure vessels and piping”, ASME Pressure vessels and piping conference, 1997.

**BME019 ADVANCED INTERNAL COMBUSTION ENGINES L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To study combustion chambers and combustion process of S.I and C.I. engines.
- To update the knowledge in engine exhaust emission & its control and alternate fuels.
- To enable the students to understand the recent developments in IC Engines.

**UNIT I SPARK IGNITION ENGINES 9**

Air-fuel ratio requirements, Design of carburetor –fuel jet size and venture size, Stages of combustion-normal and abnormal combustion, Factors affecting knock, Combustion chambers, Introduction to thermodynamic analysis of SI Engine combustion process.

**UNIT II COMPRESSION IGNITION ENGINES 9**

Stages of combustion-normal and abnormal combustion – Factors affecting knock, Direct and Indirect injection systems, Combustion chambers, Turbo charging, Introduction to Thermodynamic Analysis of CI Engine Combustion process.

**UNIT III ENGINE EXHAUST EMISSION AND CONTROL 9**

Formation of NOX , HC/CO mechanism, Smoke and Particulate emissions, Green House Effect, Methods of controlling emissions, Three way catalytic converter and Particulate Trap, Emission (HC, CO, NO and NOX) measuring equipments, Smoke and Particulate measurement, Indian Driving Cycles and emission norms

**UNIT IV ALTERNATE FUELS 9**

Oxygenated Fuels (Alcohols & Ethers), Vegetable oils and bio-diesel, Bio-gas, Natural Gas, Liquefied Petroleum Gas, Hydrogen-Properties, Suitability, Engine Modifications, Performance, Combustion and Emission Characteristics of SI and CI Engines using these alternate fuels.

**UNIT V RECENT TRENDS IN IC ENGINES 9**

Homogeneous Charge Compression Ignition Engine, Lean Burn Engine, Stratified Charge Engine, Surface Ignition Engine,Variable Compression Ratio Engine, Dual Fuel Engine, Common Rail Direct Injection Diesel Engine, Gasoline Direct Injection Engine, Engine Electronics Management, Data Acquisition System – pressure pick up, charge amplifier PC for Combustion and Heat release analysis in Engines and different sensors

*(Simulation of IC Engines Processes may be encouraged)*

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Heinz Heisler, "Advanced Engine Technology," SAE International Publications, USA, 1998.
2. Ganesan V, "Internal Combustion Engines", 3rd Edition, Tata McGraw-Hill, 2007.

**REFERENCES:**

1. John B Heywood, "Internal Combustion Engine Fundamentals", Tata McGraw-Hill, 1988.
2. Patterson D.J. and Henein N.A, "Emissions from combustion engines and their control", Ann Arbor Science publishers Inc, USA, 1978.
3. Gupta H.N, "Fundamentals of Internal Combustion Engines", Prentice Hall of India, 2006.
4. Ultrich Adler, "Automotive Electric / Electronic Systems", Robert Bosh GmbH, 1995.
5. Mathur.M.L and Sharma.R.P, "Internal Combustion Engines", DhanpatRai and Sons, 2005.

**BME020 HEAT EXCHANGER DESIGN**

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**OBJECTIVE:**

- To learn the sizing of heat exchangers, thermal and mechanical stress analysis for various heat exchange 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 multipass; 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 analyzing perforated analysis, flow induced vibration risks including acoustic issues and remedies, tube to tubesheet 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 heat exchangers, performance influencing parameters, limitations

**UNIT V CONDENSORS AND COOLING TOWERS 9**

Design of surface and evaporative condensers – cooling tower –performance characteristics

**TOTAL: 45 PERIODS**

**REFERENCES:**

1. T.Taborek, G.F.Hewitt and N.Afgan, “Heat Exchangers, Theory and Practice”, McGraw-Hill Book Co.1980.
2. Walker, “Industrial Heat Exchangers- A Basic Guide”, McGraw Hill Book Co. 1980.
3. Nicholas Cheremistoff, “Cooling Tower”, Ann Arbor Science Pub, 1981.
4. Arthur, P. Frass, “Heat Exchanger Design”, John Wiley and Sons, 1988.
5. J.P. Gupta, “Fundamentals of heat exchangers and pressure vessel technology”, Hemisphere publishing corporation, Springer-Verlag outside (NA), 1986.
6. Donald Q. Kern and Alban D. Kraus, “Extended surface hear transfer”, McGraw Hill Book Co., 1972.
7. E.A.D. Sanders, “Heat Exchangers, Selection Design and Construction”, Layman Scientific & Technical; John Wiley & sons, 1988.

**BME021 ROBOTICS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the basic concepts associated with the design and functioning and applications of Robots. To study about the drives and sensors used in Robots.
- To learn about analyzing robot kinematics and robot programming.

**UNIT I FUNDAMENTALS OF ROBOT 7**

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 II ROBOT DRIVE SYSTEMS AND END EFFECTORS 10**

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 III SENSORS AND MACHINE VISION 10**

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 - Algorithms. Applications – Inspection, Identification, Visual Serving and Navigation.

**UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 10**

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom in 2 Dimensional, Four Degrees of Freedom in 3 Dimensional – Deviations and Problems. Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effecter commands, and Simple programs

**UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 8**

RGV, AGV; Implementation of Robots in Industries – Various Steps; Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method.

**TOTAL: 45 PERIODS**

**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.

**BME022 SOLAR PHOTOVOLTAIC FUNDAMENTALS AND APPLICATIONS** **L T P C 3 0 0 3**

**OBJECTIVES:**

To impart knowledge on

1. Capability of understanding the fundamentals of solar cells
2. Proficient to recognize various technology up gradations along with their benefits
3. Competent to design & analyze on-grid PV applications
4. Skilled to design & analyze off-grid PV applications
5. Ability to realize cost benefit analysis of PV installations

**UNIT I ESSENTIAL BASICS OF SOLAR CELL 9**

Solar cell – physics - Photovoltaics in Global Energy Scenario - Fundamentals of Semiconductors, Energy band, Charge carriers - Motion, PN Junction diode, Solar cells – Design characteristics, Solar radiation.

**UNIT II COMMERCIAL AND DEVELOPING TECHNOLOGIES 9**

Commercial technologies - Mono crystalline and Multi crystalline, Silicon - Wafer based Solar cell, Thin film solar cells – A-Si, Cd-Te and CIGS, Concentrated PV cells, Developing technologies – Organic cells, Dye sensitized cells.

**UNIT III SOLAR PV FOR ON-GRID APPLICATIONS 9**

Solar cells to solar array – On-Grid PV system – With and Without storage – Balance of system - DC-DC converters - Inverters – Net Metering – Design and analysis - Performance evaluation and monitoring – Field visit – Grid tied PV power plant.

**UNIT IV SOLAR PV FOR OFF-GRID APPLICATIONS 9**

Off-Grid stand alone PV system - System sizing – Module and Battery - Storage – Batteries for PV systems – Sun Tracking mechanism – Types of tracking – One-axis, Two-axis - Maximum power point tracking – Design and analysis - Performance evaluation and monitoring - Field visit – Off-grid PV system

**UNIT V COST BENEFIT ANALYSIS FOR SOLAR PV INSTALLATIONS 9**

Cost and manufacturability – Manufacturing economics – scaling – Pricing – Trends in retail pricing – energy economics – grid tied power plant –solar street lighting system

**L =45, Total = 45 Periods**

**TEXT BOOK :**

**1.** "Solar Photovoltaics Fundamentals, Technologies and Applications", Second Edition by Chetan Singh Solanki, Prentice Hall of India.

**REFERENCE BOOKS:**

**1.** "Photovoltaic Systems", Second Edition by James P. Dunlop, American Technical Publishers
**2.** "Solar Electricity: Engineering of Photovoltaic Systems" by Eduardo Lorenzo, PROGENSA.
**3.** "SOLAR ENERGY - Renewable Energy and the Environment" Robert Foster, Majid Ghassemi, Alma Cota, CRC Press
**4.** www.pveducation.org

**BME023 PIPING DESIGN ENGINEERING L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

- Apply the fundamental principles for designing pipes and creating engineering drawings.
- Explain the working principle of piping components and Design pipes for various piping codes and standards
- Analyze the stress induced in the pipes under static loading condition
- Design pipes and piping support structures considering welding reinforcement and stress intensifications
- Predict mathematically the behavior of pipes under dynamic conditions

**UNIT I FUNDAMENTALS 9**

Engineering drawing fundamentals - Piping drawings - P& ID – Plot Plan - Layout –Mechanical Design fundamentals – Pressure, Temperature, Flow rates, stress, strain, theory of failure, young's modulus, moment of inertia, section modulus, radius of gyration. Dynamic loads – Harmonic, Modal, Spectrum, frequencies

**UNIT II PIPING ELEMENTS AND MATERIALS 9**

Introduction to piping –Piping Components – Pipe, Fittings, Flanges, Gaskets, Bolting – Valves – Isolation, Regulation, Non – return, Special purpose. Piping Materials – Piping Codes and Standards – Pipe Sizing, Diameter and Pressure drop calculations

**UNIT III PIPING SUPPORTS AND STATIC STRESS ANALYSIS 9**

Piping Supports – Restraints and hangers – Variable and Constant load spring hanger's selection design methodologies - Stress analysis introduction - Method of analysis – Static Stress analysis exercises – Piping Flexibility – Code Stress requirement

**UNIT IV WRC AND SIF IN PIPING 9**

Welding reinforcement calculations – Nozzle design - Stress intensification at elbows, tees and branch – Structure basics - Piping supporting structure modelling.

**UNIT V DYNAMIC ANALYSIS 9**

Wind and Seismic analysis– Damping – Lumped Mass – Steady state vibration and harmonic analysis – Time history Analysis

**TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Mohinder L.Nayyar, "Piping Handbook", McGraw Hill Handbook, Seventh Edition, 1999
2. George A. Antaki, "Piping and Pipeline Engineering: Design, Construction, Maintenance, Integrity, and Repair", CRC Press, 2003

**REFERENCES**

1. "Power and Process Piping Standards" ASME B31.1 & B31.3, 2012
2. Kellog M W, "Design of Piping Systems", John Wiley & Sons, Second Revised Second Edition, 1991
3. Liang-Chuan Peng and Tsen-Loong Peng, "Pipe Stress Engineering", ASME Press, New York, 2009

**BME024 ADVANCED MODELING TECHNIQUES L T P C**
**2 0 2 3**

**COURSE OUTCOMES**

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

1. Describe the principles and concepts of Geometric modeling, solid modeling, and assembly.
2. Apply advanced modeling and computational tools for complex mechanical parts.
3. Produce detailed exploded assembly views with Bills of Materials.
4. Execute weldment and sheet metal CAD drawings for mechanical engineering applications in the current industrial practice.
5. Create and export computer-generated animations showing the assembly and operation of mechanical problems.

**UNIT I MODELING CORE CONCEPTS 6**

**Sketch** – Line, Rectangle, arcs, relations, Fully defined sketch. **Part** – Extrude, Revolve, Sweep, Loft, Rib, Fillet, Chamfer, Shells, Mirroring, Patterns, Drafts, Custom properties, planes and Axis. **Assembly** – Mates, Smart mates, Interference, Collision, Dynamic Clearance, Exploding and Assembly.

**UNIT II ADVANCED PARTS AND ASSEMBLY 12**

**Sketch** – 3D Sketch, Parabola, Conics, Splines, Derived sketches. **Part** – Flex, Bending, Twisting, Tapering and stretching, splitting, Multi body Configurations. **Assembly** – Flexible sub assembly, Path, linear coupler, Gear, Cam, Screw, Limit and Hinge mates, Assembly Configurations.

**UNIT III ADVANCED DRAWINGS 9**

Model view, Projection view, Section view, Detail view, Broken view, Exploded view, Dimensions – ordinate, driving, baseline, annotations, ballons, Bill of materials, tables, Tolerances. Geometric Dimensioning and Tolerance

.

**UNIT IV WELDMENT AND SHEET METAL 9**

**Weldment** – Structural members, Trim Extend, Gusset end caps, Weld beads, Cut List, Sub-weldment, Custom profiles. **Sheet Metal** – Cone, Cylinder, Lofts, Base Flange, Edge Flange, Swept Flange, Mitre Flange, sketched bend, Jog, Hem.

**UNIT V ANIMATIONS AND ADVANCED CONCEPTS 9**

Animations – walkthrough videos, Tool Analyst, Photoview, Rendering, Mold, Plastics, Introduction to CAM.

**TOTAL: 45 PERIODS**

**REFERENCES**

1. Ibrahim Zeid, “Mastering CAD/CAM”- Tata McGraw Hill Publishing Limited
2. Donald Hearn, “Computer Graphics”- Pearson Education Limited, Matt Lombard, Solidworks 2010 Bible.

**BME025 QUALITY CONTROL OF WELDED STRUCTURES L T P C**
**2 0 2 3**

**COURSE OUTCOMES**

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

- Select appropriate welding process for making welded structures for various material combinations.
- Assess the quality of the welded structure and acquires skills to work as a welding inspector.
- Apply ASME standards to assess the mechanical properties of the weldments for the Welding procedure Specification (WPS) and Welder qualification (WQR).
- Practice Visual testing, LPT, MPT, RT and UT to detect defects in weldments.

**UNIT I INTRODUCTION TO WELDING PROCESSES 6**

Introduction to welding processes – principle – fusion welding – SMAW, SAW, MIG, TIG – equipments –welding techniques.

Welding inspection-weld defects – formation – preventing defects and rectification – weld repair techniques.

**UNIT II INTRODUCTION TO QUALITY IN WELDED STRUCTURES 7**

Introduction to quality and welded fabrication – quality assurance – quality control – role and responsibilities of a welding inspector. Quality assurance plan – contents- basis of preparation – implementation - manufacturing quality plan – quality control plan (OCP)

**UNIT III QUALITY CONTROL IN WELDING 16**

Raw Material Inspection – Types of raw material – plates – pipes, tubes – standard sections – importance of raw material properties for design – ensuring techniques - technical delivery condition document (TDCs) - Indian standard, – raw material standard sizes

Mechanical testing – tensile, bend, hardness, impact – practices as per codes and standards. chemical testing – ladle testing – product testing Weld symbols - Types of welds, types of joints - Edge preparation- purpose - types – comparison of different edge preparations.

Weld fit-up - weld backing - metallic and non metallic– integral– removable backing - testing of fit up

Visual Inspection of welds –visual testing – gadgets for visual testing – types of weld gages and their application – visual acceptance as per codes and standards – surface defects in welding PT, MPT, RT, UT - Principle – consumables – testing techniques – advantages – Limitations - Application and Codes.

**UNIT IV QUALIFICATION OF WELDING PROCEDURE AND PERFORMANCE 4**

Welding procedure Specification (WPS) – purpose – material classification P nos – G nos - WPS as per ASME – establishing WPS – tests for WPS qualification – writing PQR – limits of qualification

Welder qualification (WQR) as per ASME – welding positions - qualifying a welder – Establishing a WQR – limits of qualification

**UNIT V PRACTICAL SESSIONS 12**

Manufacturing quality Plan evaluation

Study of a typical product drawing - study a MQP for the product – establish the number of tests, documents to be prepared for a product –report preperation

Raw Material TC Reading

Reading IS standard for plate, pipe, rolled sections – preparing list of tests required for the product – reading TC and evaluate whether it meets the standard

Reading Weld Symbols

Reading drawing and establish the types and lengths of welds in the assembly – position of welds – weld document preparation (welding plan)

Welding Procedure Specification (WPS)

Study Procedure qualification record and check its completeness - studying WPS and identify whether it is suitable for particular product

Welders Qualification Evaluation

WQR reading – read welder qualification record and check if the welder is suitable for a particular weld.

Weld Visual inspection & PT

Evaluation of weld and identification of surface defects – size the weld and establish the acceptance for a particular product –report preperation - Penetrate testing

Weld inspection - RT evaluation

RT weld radiograph interpretation

**TOTAL: 45 PERIODS**

**REFERENCES**

1. R Halmshaw, "Introduction to the Non-Destructive Testing of Welded Joints", 2nd Edition, Woodhead Publishing, 1997.
2. Little R.L, "Welding and Welding Technology" - Tata McGraw Hill Publishing Limited, New Delhi, 1989.
3. Welding handbook Vol.1 publisher American welding society
4. Pocket book for visual inspection http://www.aws.org/files/205/2009011/AWSPHB~2.PDF
5. Certification Manual for Welding Inspectors by Hobart school of welding
6. Modern welding technology by Howard Cary
7. Metals Handbook Vol.6 Welding, brazing, and soldering by ASM
8. Parmer R.S, "Welding Engineering and Technology", 2nd Edition, Khanna publishers, Delhi, 2010.

**BME026 QUALITY ASSURANCE FOR WELDED STRUCTURES L T P C**
**2 0 2 3**

**COURSE OUTCOMES**

Upon successful completion of this course, the student will be able to

- Explain the various welding processes, welding defects and weld repair techniques.
- Describe the quality system practiced in welding process.
- Express the importance of design, mechanical testing and weld symbols.
- Prepare welding procedure specification and welder qualification record.
- Produce product drawing and practice visual inspection of weld joints.

**UNIT I INTRODUCTION TO WELDING PROCESSES 9**

Introduction to welding processes – Types - Fusion Welding Processes – SMAW, TIG, MIG, SAW– principle - equipments – welding techniques - welding inspection. Advanced welding processes – resistance, friction, plasma, laser, electron Beam welding - principle - equipments – welding techniques - welding inspection. Weld defects - defect rectification – weld repair techniques.

**UNIT II INTRODUCTION TO QUALITY ASSURANCE 9**

Introduction to Quality - welded fabrication – Quality assurance - Quality control – role and responsibilities of a welding inspector - Quality assurance Plan – manufacturing quality plan – preparation – contents - quality control plan. Introduction to Quality System: ISO 9001 – aspects covered in quality system – types of documents and records. Introduction to Quality systems for laboratories: ISO/ IEC 17025 – difference between ISO 9001 and ISO IEC 17025

**UNIT III QUALITY CONTROL IN WELDING 9**

Raw Material Inspection – Types – plates, pipes, tubes – standard sections –properties - important for design – technical delivery condition document - Indian standard – standard sizes. Mechanical testing – tensile, bend, hardness testing, impact testing practices – chemical testing – ladle testing – product testing – practices. Weld symbols - types of welds - types of joints - edge preparation - types of edge preparations – purpose – comparison. Weld fit-up - weld backing - metallic and non metallic backing – integral backing – removable backing - testing.

**UNIT IV QUALIFICATION OF WELDING PROCEDURE AND PERFORMANCE 9**

Welding Procedure Specification (WPS) - purpose – material classification P nos – G nos - WPS as per ASME – establishing a WPS – tests for a WPS qualification – writing PQR – limits of qualification. Welder Qualification Record (WQR) as per ASME – welding positions - qualification of welder – Establishing a WQR – limits of qualification. Visual Inspection of welds – visual testing – gadgets for visual testing – types of weld gages and their application – visual acceptance – surface defects in welding

**UNIT V PRACTICAL SESSIONS 9**

Manufacturing quality plan evaluation -Typical product drawing - study a MQP for the product – establish the number of tests, documents - prepare the reports. Raw Material TC Reading - Read a IS standard for plate, pipe, rolled sections – prepare a list of tests – read a TC and evaluate. Reading Weld Symbols - read a drawing and establish the types and lengths of welds in the assembly – position of welds – prepare weld documentation (welding plan). Welding Procedure Specification (WPS) - Procedure qualification record and check its completeness – study a WPS and identify whether it is suitable for a particular product – Welder Qualification Evaluation – WQR reading – read welder qualification record and check. Weld visual inspection - Evaluate a weld and identify the surface defects – size the weld and establish the acceptance – make a report.

**TOTAL: 45 PERIODS**

**REFERENCES**

1. Welding handbook Vol 1 publisher American welding society
2. Pocket book for visual inspection
   http://www.aws.org/files/205/2009011/AWSPHB~2.PDF
3. Certification Manual for Welding Inspectors by Hobart school of welding
4. Modern welding technology by Howard Cary
5. Metals Handbook Vol.6 Welding, brazing, and soldering by ASM
6. Parmer R.S, "Welding Engineering and Technology", Khanna publishers, 2nd Edition, Delhi, 2010.

**BME027 CREATIVITY, INNOVATION AND PRODUCT DEVELOPMENT L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

- Demonstrate the concepts in creativity and innovation.
- Evaluate the new project planning
- Identify new products for commercialization
- Discuss the importance of Intellectual Property Rights (IPR)

**UNIT I CREATIVITY 8**

Concept and history of creativity, need for creativity, creative environment, stages of creativity process, creativity and intelligence, creativity in various contexts, economic view of creativity, measuring creativity, fostering creativity, creative problem solving – brain storming and various techniques, lateral thinking. Role of creativity in entrepreneurship – Research and development (R&D). Case studies on creative solutions to contemporary issues.

**UNIT II INNOVATION 8**

Definition, creativity vis-à-vis innovation, conceptualizing innovation, types of innovation, sources of innovation, goals of innovation, process of technological innovation, diffusion of innovation, factors contributing to successful technological innovation, failure of innovations, innovation management, measures of innovation.

Case studies - Innovations in health sector, Agriculture, Education, Entrepreneurship and Corporate R & D.

**UNIT III PROJECT PLANNING AND EVALUATION 10**

Definition and purpose of project, collection of ideas, screening ideas, selection criteria for new projects, development of project plan, project evaluation – purpose, kinds of evaluation, stages of evaluation process, techniques of project evaluation, project analysis, benefits and risks of new projects.

**UNIT IV PRODUCT DEVELOPMENT AND EVALUATION 10**

Research and new product development – process and types of new products, creative design, design of prototype – purpose, process, and types, model preparation, testing and quality evaluation; marketing research – purpose and process, types and methods; introducing new products, cost evaluation, Product deployment and commercialization - Case Studies.

**UNIT V PROTECTION OF INNOVATION 9**

Intellectual property (IP), classes of IP – industrial property and copyrights; Intellectual Property Rights (IPR); Patents, patentability, patent acts, governing laws, history of patent laws and acts, patent administration; patenting process – patent application, patent search, prosecution, publication, examination, opposition, grant, renewal, patent rights; international code for patents, patents vis-à-vis economics.

**TOTAL: 45 PERIODS**

**REFERENCES**

1. Frederick Betz, Managing Technological innovation, John Wiley & Sons, Inc., Third Edition
2. Tom Kelly, the Art of Innovation, Doubleday, Random House Inc. USA, 2001.
3. Christensen, C. M. and Raynor, M. E., The Innovator's Solution: Creating and Sustaining Successful Growth, Boston, MA: Harvard Business School Press, 2003.
4. Paul Windrum and Per Koch, Innovation in Public Sector Services: Entrepreneurship, Creativity and Management, Edward Elgar Publishing Limited, 2008.
5. Harry Nystrom, Creativity and innovation, John Wiley & sons, (1979).
6. I.P.R. Bulletins, TIFAC, New Delhi, 1997.

**BME028 ADVANCED COMPUTER AIDED MANUFACTURING L T P C**
**2 0 2 3**

**COURSE OUTCOMES**

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

- Recognize the concept and need of APT, NC and CNC Part Programming.
- Develop Simple 2D CNC Programming with Subroutines through Manual Part Programming or Computer Aided Part Programming Techniques.
- Operate CNC Machining through Integration of CAD/CAM software.
- Describe DNC, FMS and Robot technology and also perform simple manufacturing system simulation.

**UNIT I** **9**

Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre-features and applications, Automatic tool changers and Multiple pallet system, types of control systems, CNC controllers, General information on CAM, APT, NC manual part programming, Introduction to CAD/CAM software.

**UNIT II** **9**

Basic components of an NC system, NC motion control, interpolation, part programming formats, manual part programming, NC coding systems (ISO and EIA)-NC words, macro statements, Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre. Writing simple 2D manual part programming.

**UNIT III** **9**

Computer Numerical Control (CNC) and DNC: Features of CNC, Elements of CNC machines, the machine control unit for CNC, CNC softwares, direct numerical control, and Distributed numerical control (DNC). Introduction to post processers, general structure and functions of post processor, DAPP based post processer.

**UNIT IV** **9**

Features and selections of CNC turning and milling centers. Practice in part programming and operation of CNC turning machines using NC and APT programming using subroutine techniques and cycles. Practice in part programming and operating a machining center, tool planning and selection of sequence of operations, tool setting on machine.

**UNIT V** **9**

Introduction to FMS, components, applications, benefits, FMS layout, FMS planning and implementation issues. Introduction to robot programming and its languages. Robot simulation using software. Robot path control, preparation of various reports and routs sheets, simulation of simple manufacturing system using any one software

**TOTAL: 45 PERIODS**

**REFERENCES**

1. Computer control of manufacturing systems, Yoram Koren, Mc Graw Hill, 1983.
2. Computer Aided Design Manufacturing, K.Lalit Narayan, K.Mallikarjuna Rao and M.M.M.Sarcar, PHI, 2008.
3. CAD/CAM Principles and Applications, P.N. Rao, Tata Mc Graw Hill
4. Steve Krar and Arthar Gill, CNC Technology and Programming, McGraw Hill Publication Company, New Delhi.
5. Mikell P. Grover, Automation, Production Systems and Computer-Integrated Manufacturing, Pearson Education, New Delhi.

6. Warren.S.Seames, Computer Numerical Control: Concepts and Programming, 4th Edition, Delmar Thomson Learning Inc., 2002.
7. CAD/CAM Theory and practice, McGraw Hill, International Edition, 2007.
8. Principles of Computer Aided Design and Manufacturing, Farid Amirouche, Pearson
9. Radhakrishnan.P "Computer Numerical Control Machines", New Central Book Agency, 2002.
10. "Mechatronics", HMT, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.

**BME029 DESIGN OF HEAT EXCHANGER AND PRESSURE VESSEL L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

After successfully completing this course student will be able to:

- To conceive a design based on the information provided for a particular application
- To learn the sizing of the equipment
- To predict the thermal behavior and carry out a stress analysis
- To come up with a mechanical design as per the relevant codes
- To do the cost economic analysis

**UNIT I HEAT EXCHANGER INTRODUCTION 9**

Types of heat exchangers, shell and tube heat exchangers – regenerators and recuperators – Parts description, classification as per Tubular Exchanger Manufacturers Association

**UNIT II DESIGN OF HEAT EXCHANGERS 9**

Thermal design using ε-NTU, P-NTU and LMTD methods – Effectiveness- Optimization - Calculation of heat Transfer Coefficient - Calculation of Pressure Drops - Mechanical design of baffles and tube sheets - Complete Problems

**UNIT III COMPACT HEAT EXCHANGERS, CONDENSERS, COOLING TOWERS 9**

Types- Merits and Demerits- Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations - Design of surface and evaporative condensers – cooling tower – performance characteristics

**UNIT IV RESSURE VESSEL INTRODUCTION, STRESSES IN PRESSURE VESSEL 9**

Methods for determining stresses – Terminology and Ligament Efficiency – Applications. Introduction – Stresses in a circular ring, cylinder –Dilation of pressure vessels, Membrane stress Analysis of Vessel – Cylindrical, spherical and, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.

**UNIT V DESIGN OF PRESSURE VESSEL 9**

Design of Tall cylindrical self supporting process columns – Supports for short vertical vessels – Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – Pressure Vessel Design.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. SadikKakac and Hongtan Liu, "Heat Exchangers Selection", Rating and Thermal Design, CRC Press, 2002.
2. R.Mukherjee, "Practical thermal design of Shell & Tube Heat Exchanger", Begell House Inc
3. Somnath Chattopadhyay, "Pressure Vessel Design and Practice", CRC press, 2005
4. Henry H. Bedner,-"Pressure Vessels, Design Hand Book", CBS publishers and Distributors

**REFERENCES**

1. Shah,R. K., Dušan P. Sekulić, "Fundamentals of heat exchanger design", John Wiley & Sons, 2003.
2. T Kuppan, "Heat Exchanger design handbook", Marcel Dekker, INC, 2000
3. M.Podhorsky, " HEAT EXCHANGER: A Pratical approach to mechanical construction, Design and Calculations", Begell House, Inc, 1998
4. ASME Pressure Vessel and Boiler code, Section VIII Div 1 & 2, 2003
5. Stanley M Wales, Chemical Process equipment, selection and design, Butterworths Series in Chemical Engineering,1988
6. Dennis Moss, "Pressure Vessel Design Manual" Gulf professional Publishing, Third Edition 2004.

**BME030 AIRCRAFT ENGINEERING L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

After successfully completing this course student will be able to:

- Identify the component of Flight
- Identify suitable materials for Aircraft structure
- Know the operation of airplane control system, Engine system.
- Ability to built Digital avionics architecture

**UNIT I AIRCRAFT CONFIGURATIONS 9**

Different types of flight vehicles, classifications .components of an airplane and their functions. a conventional control, powered control, basic instruments for flying - typical systems for control actuation brake system – components, landing gear systems – classification – shock absorbers – retractive mechanism.

**UNIT II AIRPLANE STRUCTURES AND MATERIALS 9**

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

**UNIT III ENGINE SYSTEMS 9**

Fuel systems – piston and jet engines – components - multi-engine fuel systems, lubricating systems -piston and jet engines – starting and ignition systems – piston and jet engines

**UNIT IV AVIONICS AND AUTO PILOT SYSTEMS 9**

Need for avionics in aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

**UNIT V RECENT AIRCRAFT TECHNOLOGIES 9**

Supersonic air craft- wing in ground aircraft-uninhabited aerial vehicle (UAV)-Invincible aircraft

**TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Anderson, J.D “Introduction to Flight”, McGraw-Hill, 1995.
2. Stephen. A. Brandt, "Introduction to Aeronautics: A design perspective" American Institute of Aeronautics & Astronautics ,1997
3. Mekinley , J.L. and R.D. Bent, "Aircraft Power Plants", McGraw Hill 1993.
4. Pallet, E.H.J, "Aircraft Instruments & Principles", Pitman & Co 1993
5. Albert Helfrick.D., "Principles of Avionics", Avionics Communications Inc., 2004
6. Collinson.R.P.G. "Introduction to Avionics", Chapman and Hall, 1996.

**BME031 NON DESTRUCTIVE TESTING FOR WELDED STRUCTURES**

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

**COURSE OBJECTIVES**

- To provide the personnel with full theoretical and practical knowledge of Penetrant Testing method, ultrasonic Testing, magnetic particle testing, radiographic film interpretation and related standards.
- At the end of the course, the student will be able to undertake Penetrant testing, magnetic particle Testing, Radiography testing film interpretation and Ultrasonic Testing , interpret and evaluate results as per standards.

**UNIT I PENETRANT TESTING** 7

Introduction & Physics - Penetrant Groups, Types of Developers - Testing techniques - Stages of Penetrant Testing - Inspection Procedures - Selection of Techniques Evaluation of Test Equipment, consumables

**UNIT II ULTRASONIC TESTING** **12**

Introduction to UT - Physics of UT. UT equipment – Probes – purpose, how to use them; cables, connectors, couplants. Calibration blocks, reference blocks purpose, how to use them; cables, connectors, couplants. Test Techniques - Pulse echo, through transmission, resonance techniques and applications, test variables.Testing - calibration of test equipment -Discontinuities , Distance Amplitude Correction ( DAC) curve.Testing techniques - method of scanning, scanning pattern, selection of parameters , Testing of Raw material, weld, casting

**UNIT III MAGNETIC PARTICLE TESTING** **4**

Physics of Magnetism - magnetization techniques - magnetic fields - test equipment, accessories, media - Fluorescent, non fluorescent consumables, systems check. TECHNIQUES Testing techniques, interpretation, demagnetisation

**UNIT IV RADIOGRAPHIC TESTING FILM INTERPRETATION** **8**

Overview of RT - Interaction of Radiation with Matter - Radiation safety.Sources of Radiation and their characteristics - Film Radiography - Film Processing.Sensitivity & Definition, I.Q.Is, Other Accessories Techniques in radiography.Manufacturing processes and discontinuities Interpretation & Evaluation of Radiographs , Acceptance Standards Radiographic artifacts

**UNIT V CODES & STANDARDS** **2**

Codes, Procedures, and Written Practices - Penetrant Testing, Ultrasonic Testing, magnetic particle testing Radiographic Report generation

**UNIT VI NDT PRACTICAL** **12**

Practical 1 - PT - Pre-cleaning , etching, Testing - Testing - fluorescent type, visible, comparison of consumables, qualifying of consumables
Practical 2 - RT - Familiarization with equipment
Practical 3 RT - calculation of geometric unsharpness – source strength calculations - safe distance -.calibration of densitometer
Practical 4 RT - evaluation of radiographs
Practical 5 RT - evaluation of radiographs
Practical 6 MT - Testing of welds – Qualification of equipments
Practical 7 UT - familiarity of equipment. - thickness measurement , sizing of machined reflector,– Raw material Testing
practical 8 UT - calibration of equipment
Practical 9 - UT - DAC - plate 25 , 50 mm
Practical 10 UT weld testing - plate
Practical 11 – UT weld testing - plate
Practical 12 – UT weld testing – plate

**TOTAL: 45 PERIODS**

**REFERENCES**

1. Nondestructive Testing Handbook, Third Edition: Vol 2, Liquid Penetrant Testing, published by ASNT
2. Nondestructive Testing Handbook, Third Edition: Vol 7, Ultrasonic Testing published : ASNT, USA
3. Nondestructive Testing Handbook, Third Edition: Vol 8, Magnetic Testing published by ASNT, USA
4. Nondestructive Testing Handbook Third Edition: Vol. 4 Radiographic Testing published by ASNT USA
5. ASM Metals Handbook Vol 17 –Non destructive testing, published by ASM, USA
6. ASME Sec V, 2013 Non destructive testing, publ ASME
7. Introduction to the Non-Destructive Testing of Welded Joints - Second edition by Halmshaw, published by Woodside publications
8. ASTM E165 Standard Practice for Liquid Penetrant Examination for General Industry
9. ASTM E-94 Standard Guide for Radiographic Examination
10. ASTM E-747 Standard Practice for Design, Manufacture and Material Grouping Classification of Wire image Quality Indicators (IQI) used for Radiology .
11. Industrial Radiography, Image forming Techniques published in Internet by GE Inspection Technologies
12. ASTM -709 Standard Guide for Magnetic Particle Testing
13. ASTM A-435 Standard Specification for Straight-Beam Ultrasonic Examination of
14. Steel Plates
15. ASTM A-578 Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications
16. ASTM E–797 Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method

**BMG001 MARKETING MANAGEMENT**

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

**OBJECTIVES:**

- Introduction to all aspects of marketing, including strategic marketing planning, marketing research, product planning and development, promotion planning, distribution and pricing.
- To provides an understanding of the theories of the marketing mix variables, and a practical application in the context of the marketing management cycle processes of research, planning, organization, implementation and control.

**UNIT I MARKETING PROCESS 9**

Definition, Marketing process, dynamics, needs, wants and demands, marketing concepts, environment, mix, types. Philosophies, selling versus marketing, organizations, industrial versus consumer marketing, consumer goods, industrial goods, product hierarchy

**UNIT II BUYING BEHAVIOUR AND MARKET SEGMENTATION 9**

Cultural, demographic factors, motives, types, buying decisions, segmentation factors - demographic - Psycho graphic and geographic segmentation, process, patterns.

**UNIT III PRODUCT PRICING AND MARKETING RESEARCH 9**

Objectives, pricing, decisions and pricing methods, pricing management. Introduction, uses, process of marketing research.

**UNIT IV MARKETING PLANNING AND STRATEGY FORMULATION 9**

Components of marketing plan-strategy formulations and the marketing process, implementations, portfolio analysis, BCG, GEC grids.

**UNIT V ADVERTISING, SALES PROMOTION AND DISTRIBUTION 9**

Characteristics, impact, goals, types, and sales promotions- point of purchase- unique selling proposition. Characteristics, wholesaling, retailing, channel design, logistics, and modern trends in retailing.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Govindarajan. M, “Marketing Management – Concepts, Cases, Challenges and Trends”, Prentice Hall of India, 2nd Edition, 2007.
2. Philip Kolter,KoshyJha “Marketing Management”, Pearson Education, Indian adapted Edition, 2007.

**REFERENCES:**

1. Ramasamy and Namakumari, “Marketing Environment: Planning, implementation and control the Indian context”, 1990.
2. Czinkota&Kotabe, “Marketing Management”, Thomson learning, Indian Edition, 2007.
3. Adrain palmer, “Introduction to Marketing Theory and Practice”, Oxford University Press IE, 2004.

**BMG002 ENTREPRENEURSHIP DEVELOPMENT L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To develop the entrepreneurship potential by providing requisite skills and knowledge to start a successful business enterprise.

**UNIT I ENTREPRENEURSHIP 9**

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur – Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurical Growth.

**UNIT II MOTIVATION 9**

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, self Rating, Business Game, Thematic Apperception Test – Stress management, Entrepreneurship Development Programs – Need, Objectives.

**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, Network Analysis Techniques of PERT/CPM – Taxation – Income Tax, Excise Duty – Sales Tax.

**UNITV SUPPORT TO ENTREPRENEURS 9**

Sickness in small Business – Concept, Magnitude, causes and consequences, Corrective Measures – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. S.S.Khanka “Entrepreneurial Development” S.Chand and Co. Ltd., New Delhi, 2008.
2. Hisrich R D and Peters M P, “Entrepreneurship”, 5th Edition, Tata McGraw-Hill, 2002.

**REFERENCES:**

1. Rabindra N. Kanungo, “Entrepreneurship and innovation”, Sage Publications, New Delhi, 2010.
2. EDII “Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers Entrepreneurship Development Institute of India, Ahmadabad, 1986.

**BMG003** **OPERATIONS MANAGEMENT** **L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To provide the students with the concepts and techniques that are applied to the design, planning, control and improvement of manufacturing and service operating systems.

**UNIT I INTRODUCTION TO PRODUCTION AND OPERATIONS MANAGEMENT 9**

Production Systems – Nature, Importance and organizational function.Characteristics of Modern Production and Operations function. Organization of Production function.Recent Trends in Production and Operations Management.Role of Operations in Strategic Management.Production and Operations strategy –Elements and Competitive Priorities.Nature of International Operations Management.

**UNIT II FORECASTING, CAPACITY AND AGGREGATE PLANNING 9**

Demand Forecasting – Need, Types, Objectives and Steps. Overview of Qualitative and Quantitative methods. Capacity Planning–Long range, Types, Rough cut plan, Capacity Requirements Planning (CRP), developing capacity alternatives. Aggregate Planning –Approaches, costs, relationship to Master Production schedule. Overview of MRP, MRP II and ERP

**UNIT III DESIGN OF PRODUCT, SERVICE AND WORK SYSTEMS 9**

Product Design – Influencing factors, Approaches, Legal, Ethical and Environmental issues. Process – Planning, Selection, Strategy, Major Decisions.Service Operations – Types, Strategies, Scheduling Multiple resources and cyclical scheduling. Work Study – Objectives, Procedure. Method Study and Motion Study. Work Measurement and Productivity – Measuring Productivity and Methods to improve productivity.

**UNIT IV MATERIALS MANAGEMENT 9**

Materials Management – Objectives, Planning, Budgeting and Control.Overview of Materials Management Information Systems (MMIS). Purchasing – Objectives, Functions, Policies, Vendor rating and Value Analysis. Stores Management – Nature, Layout, Classification and Coding. Inventory – Objectives, Costs and control techniques. Overview of JIT.

**UNIT V PROJECT AND FACILITY PLANNING 9**

Project Management – Scheduling Techniques, PERT, CPM, Crashing CPM networks – Simple Problems. Facility Location – Theories, Steps in Selection, Location Models – Simple Problems. Facility Layout – Principles, Types, Planning tools and techniques.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**


1. Aswathappa K and ShridharaBhat K, “Production and Operations Management”, Himalaya Publishing House, Revised Second Edition, 2008.
2. Pannerselvam R, “Production and Operations Management”, Prentice Hall India, 2nd Edition, 2008.
3. Norman Gaither and Gregory Frazier, “Operations Management”, South Western Cengage Learning, 2002.


**REFERENCES:**


1. KanishkaBedi, “Production and Operations Management”, Oxford University Press, 2004.
2. Russel and Taylor, “Operations Management”, Wiley, 5th Edition, 2006.
3. Chary S. N, “Production & Operations Management”, Tata McGraw Hill, 3rd Edition, 2008.
4. Chase Jacobs, Aquilano & Agarwal., “Operations Management”, Tata McGraw Hill, 2006.
5. Mahadevan B, “Operations Management Theory and practice”, Pearson Education, 2007.

**BGE002 INDUSTRIAL SAFETY ENGINEERING**

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

**OBJECTIVE:**

- To understand the basic concepts and Principles in the area Safety, health and hazards.

**UNIT I ACCIDENT INVESTIGATION AND ANALYSIS 9**

Concept of an Accident, reportable and non reportable accidents, reporting to statutory authorities. Principles of accident prevention-accident investigation and analysis-Unsafe act and unsafe condition-Domino sequence-cost of accidents-permanent total disabilities, Permanent partial disabilities, Temporary total disabilities-Calculation of frequency rate and severity rate of accidents.

**UNIT II ERGONOMICS AND HUMAN BEHAVIOUR 9**

Introduction to ergonomics and its area of application in the work system. Anatomy, Posture and body mechanics-low back pain, risk factors for musculoskeletal disorders in the work place-behavioral aspects of posture - effectiveness. Individual differences, Factors contributing to personality, fitting the man to the job. Motivation -job satisfaction - Frustration and conflicts, reaction to frustration, emotion and frustration. Attitudes - determination of attitudes- changing attitudes.

**UNIT III HAZARDS AND THEIR CONTROL 9**

Physical hazards-Noise, heat, vibration, ionizing and non ionizing radiations, and effects. Chemical hazards-dusts, fumes, mist, vapor, fog, gases, types, concentration, exposure Vs dose, TLV. Mechanical hazards. Engineering control methods- use of personal protective equipments.

**UNIT IV FIRE PREVENTION AND PROTECTION 9**

Fire triangle-principles of fire extinguishing- various classes of fires- A, B, C, D types of fire extinguishers- Industrial fire protection systems. Sprinklers- Fire hydrants- Alarm and detection systems- other suppression systems- $CO_2$ system, foam system and DCP system.

**UNIT V SAFETY MANAGEMENT TECHNIQUES, EDUCATION AND TRAINING 9**

Incident Recall Technique (IRT), disaster control, Job safety Analysis, Safety survey, safety inspection. Safety training programs, seminars, conferences, competitions- method of promoting safe practice- motivation- creating awareness, awards, celebrations, safety posters, safety displays, safety incentive scheme- domestic safety and training.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Heinrich.H.W. “Industrial Accident Prevention”, McGraw Hill Company, New York, 1980.
2. John V. Grimaldi and Rollin H. Simonds, “Safety Management” , All India Travellers Book Seller, New Delhi, 1989.
3. E.J.McCormick and M.S. Sanders “Human Factors in Engineering and Design”, TMH, New Delhi, 1982.
4. Hand Book of “Occupational Safety and Health”, National Safety Council, Chicago, 1982.
5. Derek, James, “Fire Prevention Hand Book”, Butter Worths and Company, London, 1986.

**REFERENCES:**

1. Krishnan.N.V. “Safety Management in Industry”, Jaico Publishing House, Bombay, 1997.
2. Lees, F. P. “Loss Prevention in Process Industries”, Butter Worth publications, London, 2nd Edition, 1990.
3. Dan Peterson, “Techniques of Safety Management”, McGraw Hill Company, Tokyo, 1981.
4. “Accident Prevention Manual for Industrial Operations”, N.S.C. Chicago, 1982.
5. Hunter, Gomos, “Engineering Design for Safety”, McGraw Hill Inc., 1992.
6. Encyclopedia of “Occupational Health and Safety” Vol I and II, Published by International Labour Office, Geneva, 1985.
7. Gupta. R.S., “Hand Book of Fire Technology”, Orient Longman, Bombay, 1977.