# ERODE SENGUNTHAR ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University)

PERUNDURAI, ERODE - 638 057

## UG Curriculum and Syllabus

## (1 to 8 Semesters)

## B.E – MECHANICAL ENGINEERING

Choice Based Credit System (CBCS)

**REGULATION 2019**

MECH - 20-21

**ERODE SENGUNTHAR ENGINEERING COLLEGE, ERODE**

**DEPARTMENT OF MECHANICAL ENGINEERING**

**REGULATIONS – 2019**

**CHOICE BASED CREDIT SYSTEM**

**I TO VIII SEMESTERS CURRICULAM**

**(Applicable for the students admitted from 2020-2021 onwards)**

| Induction Program (Mandatory) | 3 weeks duration |
|---|---|
| Induction program for students to be offered right at the start of the first year | • Physical activity<br>• Creative Arts<br>• Universal Human Values<br>• Literary<br>• Proficiency Modules<br>• Lectures by Eminent People<br>• Visits to local Areas<br>• Familiarization to Dept. / Branch & Innovations |

**B.E. MECHANICAL ENGINEERING**

**Total Credits : 163**

**SEMESTER I**

**THEORY**

| Code No | Course | Objective & Outcomes | | | L | T | P | C | Maximum Marks | | | Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PEOs | POs | PSOs | | | | | CA | ES | Total | |
| 19BS101 | Calculus and its Applications | I ,III | 1,2,3 4,12 | - | 3 | 1 | 0 | 4 | 40 | 60 | 100 | BS |
| 19BS102 | Engineering Physics | I ,III | 1,2,4,56, 8,9 | 2 | 2 | 0 | 2 | 3 | 40 | 60 | 100 | BS |
| 19BS103 | Engineering Chemistry | I ,III | 1,2,3,45, 7,12 | 2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | BS |
| 19HS101 | Communicative English | IV | 2,3,6,9, 10,12 | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | HS |
| 19ES103 | Engineering Mechanics | I,II,III | 1,2,6,7,1 2 | 2 | 3 | 1 | 0 | 4 | 40 | 60 | 100 | ES |
| 19TPS01 | Soft Skills- I | IV | 8,9,10, 12 | 3 | 1 | 0 | 1 | 1.5 | 40 | 60 | 100 | EEC |

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| PRACTICAL | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19ES106 | Engineering Graphics | I,II,III | 1,2,3, 5,10, 12 | 1 | 0 | 0 | 4 | 2 | 60 | 40 | 100 | ES |
| 19ES107 | Workshop Practice | II,III | 1,3,9, 12 | 2 | 0 | 0 | 2 | 1 | 60 | 40 | 100 | ES |
| 19BS105 | Chemistry Laboratory | I,III | 1,2,3 4,5, 12 | 2 | 0 | 0 | 4 | 2 | 60 | 40 | 100 | BS |
| TOTAL | | | | | **15** | **02** | **13** | **23.5** | | | | |

| SEMESTER II | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| THEORY | | | | | | | | | | | | |
| **Code No** | **Course** | **Objective & Outcomes** | | | **L** | **T** | **P** | **C** | **Maximum Marks** | | | **Category** |
| | | **PEOs** | **POs** | **PSOs** | | | | | **CA** | **ES** | **Total** | |
| 19BS201 | Vector Calculus and Complex Variables | I ,III | 1,2,3, 4,12 | - | 3 | 1 | 0 | 4 | 40 | 60 | 100 | BS |
| 19BS206 | Engineering Materials | I,III | 1,4,5, 7 | 2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | BS |
| | Language Elective | IV | 9,10, 12 | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | HS |
| 19ES201 | Problem Solving and Python Programming | I,III | 1,2,3, 4,12 | 1 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | ES |
| 19ES204 | Principles of Electrical and Electronics Engineering | I ,III | 1,2,3, 4 | 2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | ES |
| 19MC201 | Environmental Science and Engineering | I ,III | 1,2,3, 4,5,6, 7,8,12 | - | 3 | 0 | 0 | 0 | 40 | 60 | 100 | MC |
| 19TPS02 | Soft skills - II | IV | 8,9, 10,12 | 3 | 1 | 0 | 1 | 1.5 | 40 | 60 | 100 | EEC |
| PRACTICAL | | | | | | | | | | | | |
| 19ES213 | Problem Solving and Python Programming Laboratory | I,III | 1,2,3, 4,5,12 | 1 | 0 | 0 | 2 | 1 | 60 | 40 | 100 | ES |
| 19ES216 | Electrical Engineering | I ,III | 1,2,3, 4,9 | 2 | 0 | 0 | 2 | 1 | 60 | 40 | 100 | ES |

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Laboratory | | | | | | | | | | | |
| Total | | | | | **19** | **01** | **05** | **19.5** | - | | | |

| SEMESTER III | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| THEORY | | | | | | | | | | | | |
| **Code No** | **Course** | **Objective & Outcomes** | | | **L** | **T** | **P** | **C** | **Maximum Marks** | | | **Category** |
| | | **PEOs** | **POs** | **PS Os** | | | | | **CA** | **ES** | **Total** | |
| 19BS303 | Transform Techniques and Partial Differential Equations | I,III | 1,2,3,4 | - | 3 | 1 | 0 | 4 | 40 | 60 | 100 | BS |
| 19ME301 | Engineering Metallurgy | I,II,III | 1,2,6,7 ,12 | 2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PC |
| 19ME302 | Engineering Thermodynamics | I,II,III | 1,2,4,6 7,12 | 2 | 3 | 1 | 0 | 4 | 40 | 60 | 100 | PC |
| 19ME303 | Manufacturing Technology – I | I,II,III | 1,2,5,6 7,12 | 2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PC |
| 19ME304 | Fluid Mechanics and Machinery | I,II,III | 1,2,3,4 6,7,12 | 2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PC |
| 19ME305 | Strength of Materials | I,II,III | 1,2,3,4 6,7, 12 | 2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PC |
| 19TPS03 | Quantitative Aptitude and Logical Reasoning - I | IV | 1,2,9, 10,12 | 3 | 2 | 0 | 0 | 0 | 40 | 60 | 100 | EEC |
| 19MC301 | Indian Constitution | I | 6,8,10,1 1,12 | 3 | 2 | 0 | 0 | 0 | 40 | 60 | 100 | MC |

| PRACTICAL | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19ME306 | Fluid Mechanics and Machinery Laboratory | I,II,III | 1,2,3, 4,6,7, 12 | 2 | 0 | 0 | 2 | 1 | 60 | 40 | 100 | PC |
| 19ME307 | Strength of Materials Laboratory | I,II,III | 1,2,3, 4,6,7, 12 | 2 | 0 | 0 | 2 | 1 | 60 | 40 | 100 | PC |
| 19HS301 | Communication Skills Laboratory | IV | 9, 10,12 | 3 | 0 | 0 | 4 | 2 | 60 | 40 | 100 | HS |
| Total | | | | | **22** | **2** | **08** | **24** | - | | | |

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| SEMESTER IV | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| THEORY | | | | | | | | | | | | |
| Code No | Course | Objective & Outcomes | | | L | T | P | C | Maximum Marks | | | Category |
| | | PEOs | POs | PSOs | | | | | CA | ES | Total | |
| 19BS403 | Numerical Methods and Statistics | I,III | 1,2,3, 4 | - | 3 | 1 | 0 | 4 | 40 | 60 | 100 | BS |
| 19ME401 | Thermal Engineering | I,II,III | 1,2,3, 5,6,7, 12 | 2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PC |
| 19ME402 | Manufacturing Technology –II | I,II,III | 1,2,5, 6,7,12 | 2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PC |
| 19ME403 | Kinematics of Machines | I,II,III | 1,2,3, 4,12 | 2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PC |
| 19TPS04 | Quantitative Aptitude and Logical Reasoning - II | IV | 1,2,9, 10,12 | 3 | 2 | 0 | 0 | 0 | 40 | 60 | 100 | EEC |
| 19HS402 | Universal Human Values 2 : Understanding Harmony | I, II, III, IV | 1, 6, 7, 10,12 | 3 | 2 | 1 | 0 | 3 | 40 | 60 | 100 | HS |
| 19ES406 | Internet of Things | I,II | 1,10, 12 | 3 | 2 | 0 | 2 | 3 | 40 | 60 | 100 | ES |

| PRACTICAL | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19ME404 | Thermal Engineering Laboratory | I,II,III | 1,2,3, 5,6,7, 12 | 2 | 0 | 0 | 2 | 1 | 60 | 40 | 100 | PC |
| 19ME405 | Machine Drawing Laboratory | I,II,III | 1,3,5,9 ,10,12 | 1 | 0 | 0 | 2 | 1 | 60 | 40 | 100 | PC |
| 19ME406 | Manufacturing Technology Laboratory | I,II,III | 1,2,5, 6,7,12 | 2 | 0 | 0 | 2 | 1 | 60 | 40 | 100 | PC |
| | | | | | | | | | | | | |
| Total | | | | | 19 | 1 | 8 | 22 | - | | | |

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| SEMESTER V | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| THEORY | | | | | | | | | | | | | |
| Code No | Course | Objective & Outcomes | | | L | T | P | C | Maximum Marks | | | Category |
| | | PEOs | POs | PSOs | | | | | CA | ES | Total | |
| 19ME501 | Design of Machine Elements | I,II,III | 1,2,3, 5,12 | 2 | 3 | 1 | 0 | 4 | 40 | 60 | 100 | PC |
| 19ME502 | Dynamics of Machines | I,II,III | 1,2,3,4 ,6,12 | 2 | 3 | 1 | 0 | 4 | 40 | 60 | 100 | PC |
| 19ME503 | Engineering Metrology and Measurements | I,II,III | 1,5,12 | 2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PC |
| 19ME504 | Non-Destructive Testing | I,II,III | 1,2, 3,12 | 2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PC |
| | Professional Elective I | - | - | - | - | - | - | 3 | 40 | 60 | 100 | PE |
| | Professional Elective II | - | - | - | - | - | - | 3 | 40 | 60 | 100 | PE |
| 19TPS05 | Quantitative Aptitude and Logical Reasoning - III | I,II,III | 1,2,9, 10,12 | 3 | 2 | 0 | 0 | 0 | 40 | 60 | 100 | EEC |

| PRACTICAL | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19HS501 | Career skills | I,II,III | 2,5,6, 10,12 | 1,2, 3 | 0 | 0 | 2 | 0 | 60 | 40 | 100 | HS |
| 19ME505 | Dynamics & Metrology and Measurements Laboratory | I,II,III | 1,2,3, 4,6,7, 12 | 2 | 0 | 0 | 4 | 2 | 60 | 40 | 100 | PC |
| 19ME506 | Computer Aided Modelling Laboratory | I,II,III | 1,2,5, 6,7,12 | 1 | 0 | 0 | 2 | 1 | 60 | 40 | 100 | PC |
| 19ME507 | Industrial Training / Internship | | 1,2,3, 4,5,6, 7,8,9, 10,11, 12 | 3 | 0 | 0 | 2 | 1 | 100 | 0 | 100 | EEC |
| Total | | | | | **11** | **0** | **10** | **24** | - | | | |

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| SEMESTER VI | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| THEORY | | | | | | | | | | | | |
| Code No | Course | Objective & Outcomes | | | L | T | P | C | Maximum Marks | | | Category |
| | | PEOs | POs | PSOs | | | | | CA | ES | Total | |
| 19ME601 | Design of Transmission Systems | I,II,III | 1,2,3,5,12 | 2 | 3 | 1 | 0 | 4 | 40 | 60 | 100 | PC |
| 19ME602 | Finite Element Analysis | I,II,III | 1,2,3,4,5,12 | 2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PC |
| 19ME603 | Heat and Mass Transfer | I,II,III | 1,2,3,4,6,7,12 | 2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PC |
| | Professional Elective III | - | - | - | - | - | - | 3 | 40 | 60 | 100 | PE |
| | Open Elective I | - | - | - | - | - | - | 3 | 40 | 60 | 100 | OE |
| 19TPS06 | Quantitative Aptitude and Logical Reasoning - IV | I,II,III | 1,9,10,12 | 3 | 2 | 0 | 0 | 0 | 40 | 60 | 100 | EEC |

| PRACTICALS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19ME604 | Computer Aided Analysis Laboratory | I,II,III | 1,2,5,6,7,12 | 1 | 0 | 0 | 2 | 1 | 60 | 40 | 100 | PC |
| 19ME605 | Heat Transfer Laboratory | I,II,III | 1,2,3,4,6,7,12 | 2 | 0 | 0 | 2 | 1 | 60 | 40 | 100 | PC |
| 19ME606 | Mini Project | I,II,III | 1,2,3,4,5,6,7,8,9,10,11,12 | 1,2 | 0 | 0 | 2 | 1 | 100 | 0 | 100 | EEC |
| 19ME607 | Comprehensive Review | I,II,III | 2,5,6,10,12 | - | 0 | 0 | 2 | 0 | 100 | 0 | 100 | EEC |
| Total | | | | | **8** | **0** | **8** | **19** | - | | | |

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| SEMESTER VII | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| THEORY | | | | | | | | | | | | |
| Code No | Course | Objective & Outcomes | | | L | T | P | C | Maximum Marks | | | Category |
| | | PEOs | Pos | PSOs | | | | | CA | ES | Total | |
| 19HS701 | Engineering Economics | II,III | 1,2,6, 10,11 ,12 | 2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | HS |
| 19ME701 | Mechatronics | I,II,III | 1,2,3, 5,6,1 2 | 1 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PC |
| 19ES702 | Research Methodology | I,II,III | 1,2,3, 8,10, 12 | 2 | 3 | 1 | 0 | 4 | 40 | 60 | 100 | ES |
| | Professional Elective IV | - | - | - | - | - | - | 3 | 40 | 60 | 100 | PE |
| | Open Elective II | - | - | - | - | - | - | 3 | 40 | 60 | 100 | OE |
| PRACTICALS | | | | | | | | | | | | |
| 19ME702 | Computer Aided Manufacturing Laboratory | I,II,III | 1,5,9, 10,12 | 1 | 0 | 0 | 2 | 1 | 60 | 40 | 100 | PC |
| 19ME703 | Mechatronics Laboratory | I,II,III | 1,2,3, 5,12 | 1 | 0 | 0 | 2 | 1 | 60 | 40 | 100 | PC |
| 19ME704 | Project Work Phase – I | I,II,III | 1,2,3, 4,5,6, 7,8,9, 10,11 ,12 | 1,2 | 0 | 0 | 2 | 1 | 60 | 40 | 100 | EEC |
| Total | | | | | 9 | 1 | 6 | 19 | - | | | |

| SEMESTER VIII | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| THEORY | | | | | | | | | | | | |
| Code No. | Course | Objective & Outcomes | | | L | T | P | C | Maximum Marks | | | Category |
| | | PEOs | Pos | PSOs | | | | | CA | ES | Total | |
| | Professional Elective V | - | - | - | - | - | - | 3 | 40 | 60 | 100 | PE |
| | Professional Elective VI | - | - | - | - | - | - | 3 | 40 | 60 | 100 | PE |
| PRACTICALS | | | | | | | | | | | | |
| 19ME801 | Project Work | I,II,III | 1,2,3, | 1,2 | - | - | 12 | 6 | 60 | 40 | 100 | EEC |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Phase – II | | 4,5,6, 7,8,9, 10,11, 12 | | | | | | | | | |
| Total | | | | | - | - | 12 | 12 | - | | | |
| **PROFESSIONAL ELECTIVES** | | | | | | | | | | | | |
| **Code No.** | **Course** | **Objective & Outcomes** | | | | | | **L** | **T** | **P** | **C** | |
| | | **PEOs** | **Pos** | | **PSOs** | | | | | | | |
| **PROFESSIONAL ELECTIVE – I** | | | | | | | | | | | | |
| 19MEX01 | Computer Aided Design | I,II,III | 1,2,3,4,5,10, 12 | | 1 | | | 3 | 0 | 0 | 3 | |
| 19MEX02 | Mechanical Vibrations | I,II,III | 1,2,3,4,6,12 | | 2 | | | 3 | 0 | 0 | 3 | |
| 19MEX03 | Applied Hydraulics and Pneumatics | I,II,III | 1,2,3,4,6,7 12 | | 2 | | | 3 | 0 | 0 | 3 | |
| **PROFESSIONAL ELECTIVE – II** | | | | | | | | | | | | |
| 19MEX04 | Composite Materials and Mechanics | I,II,III | 1,2,3,4,5,6, 7,12, | | 2 | | | 3 | 0 | 0 | 3 | |
| 19MEX05 | Welding Technology | I,II,III | 1,2,3,4,5,6, 12 | | 2 | | | 3 | 0 | 0 | 3 | |
| 19MEX06 | Mechanical Behavior of Materials | I,II,III | 1,2,3,4,6,7 , 12 | | 2 | | | 3 | 0 | 0 | 3 | |
| **PROFESSIONAL ELECTIVE – III** | | | | | | | | | | | | |
| 19MEX07 | Automobile Engineering | I,II,III | 1,5,6,7,8,1 2 | | 2 | | | 2 | 0 | 2 | 3 | |
| 19MEX08 | Internal Combustion Engines | I,II,III | 1,5,6,7,8,1 2 | | 2 | | | 3 | 0 | 0 | 3 | |
| 19MEX09 | Refrigeration and Air-Conditioning | I,II,III | 1,2,3,4,5,6, 7,12 | | 2 | | | 3 | 0 | 0 | 3 | |
| **PROFESSIONAL ELECTIVE – IV** | | | | | | | | | | | | |
| 19MEX10 | Fibre Reinforced Plastics | I,II,III | 1,2,3,4,5, 12 | | 2 | | | 3 | 0 | 0 | 3 | |
| 19MEX11 | Process Planning and Cost Estimation | I,II,III | 1,2,3,8,9,1 1,12 | | 2 | | | 3 | 0 | 0 | 3 | |
| 19MEX12 | Statistical Quality Control and Reliability | I,II,III | 1,2,3,4,5,8 | | 2 | | | 3 | 0 | 0 | 3 | |
| **PROFESSIONAL ELECTIVE – V** | | | | | | | | | | | | |
| 19MEX13 | Non – Traditional Machining Processes | I,II,III | 1,2,5,7,12 | | 2 | | | 3 | 0 | 0 | 3 | |
| 19MEX14 | Flexible Manufacturing Systems | I,II,III | 1,2,5,12 | | 2 | | | 3 | 0 | 0 | 3 | |

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| 19MEX15 | Computer Integrated Manufacturing | I,II,III | 1,2,3,5 | 2 | 3 | 0 | 0 | 3 |
| **PROFESSIONAL ELECTIVE – VI** | | | | | | | | |
| 19MEX16 | Industrial Safety Engineering | I,II,III | 1,2,3,5,6,7, 8,9,10,12 | 2 | 3 | 0 | 0 | 3 |
| 19MEX17 | Industrial Robotics | I,II,III | 1,2,3,5,6,1 2 | 2 | 3 | 0 | 0 | 3 |
| 19MEX18 | Total Quality Management | I,II,III | 1,2,3,5,6,7, 8,9,10,11 | 2 | 3 | 0 | 0 | 3 |
| 19MEX19 | Gas Dynamics and Jet Propulsion | I,II,III | 1,2,3,4,6,7, 12 | 2 | 3 | 0 | 0 | 3 |

| **OPEN ELECTIVES** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Code No** | **Course** | **Objective & Outcomes** | | | **L** | **T** | **P** | **C** |
| | | **PEOs** | **Pos** | **PSOs** | | | | |
| 19MEY01 | Additive Manufacturing | I,II,III | 1,2,3,5,12 | 2 | 3 | 0 | 0 | 3 |
| 19MEY02 | Non-Destructive Evaluation For Engineers | I,II,III | 1,2,3,12 | 2 | 3 | 0 | 0 | 3 |
| 19MEY03 | Industrial Safety Engineering | II, III | 1,2,3,5, 6, 7, 8,9 | 2 | 3 | 0 | 0 | 3 |
| 19MEY04 | Maintenance Engineering | II, III | 1,2,3,5, 6, 7 | 2 | 3 | 0 | 0 | 3 |
| 19MEY05 | Renewable Energy Sources | I,II,III | 1,2,7,8 | 2 | 3 | 0 | 0 | 3 |
| 19MEY06 | Power Plant Engineering | I,II,III | 1,2,3,6,7, 11 | 2 | 3 | 0 | 0 | 3 |
| 19MEY07 | Rapid Prototyping | I, II, III | 1,2,5,12 | 2 | 3 | 0 | 0 | 3 |
| 19MEY08 | Nanomaterials Science | I,II,III | 1,2,3,5, 6, 7, 8,9 | 2 | 3 | 0 | 0 | 3 |
| 19MEY09 | Advanced Mechatronics for Engineers | I,II,III | 1,2,3,5,6, 12 | 1 | 3 | 0 | 0 | 3 |
| 19MEY10 | Automobile Engineering | I,II,III | 1,5,6,7,8, 12 | 2 | 3 | 0 | 0 | 3 |
| 19MEY11 | Robotics | I,II,III | 1,2,3,5,6, 12 | 2 | 3 | 0 | 0 | 3 |
| 19MEY12 | Advanced Finite Element Analysis | I,II,III | 1,2,3,4,5, 12 | 2 | 3 | 0 | 0 | 3 |
| 19MEY13 | Entrepreneurship Development | I,II,III | 1,2,3,4,5, | 2 | 3 | 0 | 0 | 3 |

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| | | | 12 | | | | | |
| 19MEY14 | Production Technology of Agricultural Machinery | I,II,III | 1,10,12 | 3 | 3 | 0 | 0 | 3 |

**LANGUAGE ELECTIVES**

| Code No | Course | Objective & Outcomes | | | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| | | PEOs | POs | PSOs | | | | |
| **LANGUAGE ELECTIVE** | | | | | | | | |
| 19HX201 | English for Engineers | I,II,III | 2,3,6,9, 10,12 | 3 | 3 | 0 | 0 | 3 |
| 19HX202 | Hindi | I,II,III | 2,3,6,9, 10,12 | 3 | 3 | 0 | 0 | 3 |
| 19HX203 | Japanese | I,II,III | 2,3,6,9, 10,12 | 3 | 3 | 0 | 0 | 3 |
| 19HX204 | French | I,II,III | 2,3,6,9, 10,12 | 3 | 3 | 0 | 0 | 3 |

**ADDITIONAL ONE CREDIT COURSES**

| Code No. | Course | Objective & Outcomes | | | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| | | PEOs | POs | PSOs | | | | |
| 19MEZ01 | Geometric Dimensioning and Tolerancing | I,II,III | 1,3 | 1 | - | - | - | 1 |
| 19MEZ02 | Lean Manufacturing | I,II,III | 1,3,5 | 2 | - | - | - | 1 |
| 19MEZ03 | Piping Engineering | I,II,III | 1,3 | 2 | - | - | - | 1 |
| 19MEZ04 | Automotive Exhaust System | I,II,III | 1,7 | 2 | - | - | - | 1 |
| 19MEZ05 | Plastics – Design, Processing, Tooling, Assembly and Testing | I,II,III | 1,3,5 | 2 | - | - | - | 1 |
| 19MEZ06 | 5s-Introduction and Implementation | I,II,III | 6 | 3 | - | - | - | 1 |

**VALUE ADDED COURSES**

| Code No. | Course | Objective & Outcomes | | | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| | | PEOs | POs | PSOs | | | | |
| 19MEV01 | Modeling using CATIA v5 | I,II,III | 1,3,5,12 | 1 | - | - | - | - |
| 19MEV02 | Modeling in solid works | I,II,III | 1,3,5,12 | 1 | - | - | - | - |
| 19MEV03 | Core java programming | I,II,III | 1,12 | 1 | - | - | - | - |
| 19MEV04 | Tool design and manufacturing | I,II,III | 1,3,5,12 | 2 | - | - | - | - |
| 19MEV05 | CNC programming and | I,II,III | 1,5,12 | 1 | - | - | - | - |

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| | operations | | | | | | | |
| 19MEV06 | Welding inspection & testing | I,II,III | 1,5,12 | 2 | - | - | - | - |
| 19MEV07 | Pump inspection and testing | I,II,III | 1,5,12 | 2 | - | - | - | - |
| 19MEV08 | Sheet metal tools - design and manufacturing process | I,II,III | 1,3,5,12 | 2 | - | - | - | - |

**MANDATORY COURSES**

| Code No. | Course | Objective & Outcomes | | | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| | | PEOs | POs | PSOs | | | | |
| 19MC201 | Environmental Science and Engineering | I ,III | 1,6,7,8 | - | 3 | 0 | 0 | 0 |
| 19MC301 | Indian Constitution | I,II,III | 6 | 3 | 1 | 0 | 0 | 0 |

**Summary of Credit Distribution**

| S.No. | Category | Credits Per Semester | | | | | | | | Total Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | VII | VIII | |
| 1 | BS | 12 | 7 | 4 | 4 | 0 | 0 | 0 | 0 | 27 |
| 2 | ES | 7 | 8 | 0 | 3 | 0 | 0 | 4 | 0 | 22 |
| 3 | HS | 3 | 3 | 2 | 3 | 0 | 0 | 3 | 0 | 14 |
| 4 | PC | 0 | 0 | 18 | 12 | 17 | 12 | 5 | 0 | 64 |
| 5 | PE | 0 | 0 | 0 | 0 | 6 | 3 | 3 | 6 | 18 |
| 6 | OE | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 6 |
| 7 | EEC | 1.5 | 1.5 | 0 | 0 | 1 | 1 | 1 | 6 | 12 |
| 8 | MC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | 23.5 | 19.5 | 24 | 22 | 24 | 19 | 19 | 12 | 163 |

BS - Basic Sciences
ES - Engineering Sciences
HS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
OE - Open Elective
EEC - Employability Enhancement Course
MC - Mandatory Course
CA - Continuous Assessment
ES - End Semester Examination

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester I | BS |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19BS101 | CALCULUS AND ITS APPLICATIONS | 3 | 1 | 0 | 4 | 60 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To interpret the introductory concepts of Limit and continuity
- To interpret the introductory concepts of calculus, this will enable them to model and analyze physical phenomena involving continuous change of variables
  To find eigen values and eigen vectors which is one of the powerful tools to handle practical problems arising in the field of engineering.
- To summarize and apply the methodologies involved in solving problems related to functions of several variables.
- To develop enough confidence to identify surface and area there by solving using integration

**Course Outcome(s):** At the end of this course, learners will be able to:

- Apply differentiation to solve maxima and minima problems use both the limit definition and rules of differentiation to differentiate functions
- Identify and model the real time problems using first order linear differential equations. Recognize and solve the higher order ordinary differential equations.
- Analyze the characteristics of a linear system with Eigen values and Eigen vectors.
- Characterize the functions of several variables and get the solutions of the same.
- Integrate the functions for evaluating the surface area and volume.

| Unit I | LIMITS AND CONTINUITY | 12 |
|---|---|---|
| Representation of a function-Limit of a function-Continuity-Derivatives-Differentiation rules-Maxima and Minima of one variable | | |

| Unit II | ORDINARY DIFFERENTIAL EQUATIONS | 12 |
|---|---|---|
| Linear differential equations of second and higher order with constant coefficients. Linear differential equations of higher order with variable coefficients: Cauchy"s linear differential equation - Method of variation of parameters for second order differential equations-Vibrating string-Electrical circuits | | |

| Unit III | MULTIVARIABLE CALCULUS | 12 |
|---|---|---|
| Functions of Two Variables - Total Differential - Derivative of implicit functions- Jacobian's- constrained maxima and minima | | |

| Unit IV | MULTIPLE INTEGRALS | 12 |
|---|---|---|
| Double integration with constant and variable limits-Region of integration -Change the order of integration -Area as double integral in cartesian coordinates. Triple integral in Cartesian coordinates. | | |

| Unit V | EIGEN VALUES AND EIGEN VECTORS | 12 |
|---|---|---|
| Eigen Values and Eigen Vectors of a real matrix - Properties of Eigen Values- Cayley - Hamilton Theorem Orthogonal matrix- Diagonalisation-Quadratic form: Reduction of a quadratic form to a canonical form. | | |

**REFERENCE(S):**


| | |
|---|---|
| 1. | Thomas Calculus, 14th Edition by Pearson |
| 2. | Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2015. |
| 3. | Peter V. O Neil , Advanced Engineering Mathematics, Eight Edition , Cengage Learning India Private Limited, 2018 |
| 4. | C. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003. |
| 5. | Glyn James, Advanced Engineering Mathematics, Third Edition, Wiley India, 2014. |


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester I | BS |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19BS102 | ENGINEERING PHYSICS | 2 | 0 | 2 | 3 | 60 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology
- To get the basic knowledge on the properties of matters
- To acquire knowledge in Ultrasonics, Laser and fibers
- To enhance the knowledge in quantum theory
- To understand basic concepts of thermal properties of materials

**Course Outcomes:** At the end of this course, learners will be able to:

- Gain knowledge on the basics of properties of matter and its applications
- Acquire knowledge on the concepts of Ultrasonics and their applications
- Get adequate knowledge on the concepts of fiber & Laser and their applications
- Get knowledge on advanced Physics concepts of quantum theory and its applications in tunneling microscopes and
- Understand knowledge on the concepts of thermal properties of materials and their applications in expansion of joints and heat exchangers

| Unit I | PROPERTIES OF MATTER | 6 |
|---|---|---|

Elasticity – Stress-strain diagram and its uses - torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders.

| Unit II | ULTRASONICS | 6 |
|---|---|---|

Introduction–Classification of Sound- Ultrasonics Production - Magnetostriction generator - Piezo electric generator-cavitations-ultrasonic cleaning-Non Destructive Testing- Pulse echo system through transmission and reflection modes- A, B and C – scan displays- Engineering Applications-Cutting, welding and drilling.

| Unit III | LASER AND FIBRE OPTICS | 6 |
|---|---|---|

Lasers: population of energy levels, Einstein„s A and B coefficients derivation – Semiconductor lasers: homojunction and heterojunction – Industrial applications of laser. Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – fibre optic sensors: pressure and displacement.

| Unit IV | QUANTUM PHYSICS | 6 |
|---|---|---|

Black body radiation – Planck„s theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger„s wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box.

| Unit V | THERMAL PHYSICS | 6 |
|---|---|---|

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity - Lee„s disc method: theory and experiment - conduction through compound media (series and parallel) – applications: heat exchangers, ovens and solar water heaters.

| TEXT BOOK(S): | |
|---|---|
| 1. | Bhattacharya, D.K. & Poonam, T. —Engineering Physicsǁ. Oxford University Press, 2015 |
| 2. | Gaur, R.K. & Gupta, S.L. —Engineering Physicsǁ. Dhanpat Rai Publishers, 2012 |
| 3 | Pandey, B.K. & Chaturvedi, S. —Engineering Physicsǁ. Cengage Learning India, 2012 |

| REFERENCE(S): | |
|---|---|
| 1. | Halliday, D., Resnick, R. & Walker, J. —Principles of Physicsǁ. Wiley, 2015 |
| 2. | Serway, R.A. & Jewett, J.W. —Physics for Scientists and Engineersǁ. Cengage Learning, 2010 |
| 3. | Tipler, P.A. & Mosca, G. - Physics for Scientists and Engineers with Modern Physics„. W.H.Freeman, 2007 |

**List of Experiments - 30 hours**

**PHYSICS (ANY FIVE)**

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young"s modulus by non-uniform bending method
3. Determination of Young"s modulus by uniform bending method
4. Determination of wavelength and particle size using Laser
5. Determination of acceptance angle and numerical aperture in an optical fiber
6. Determination of thermal conductivity of a bad conductor – Lee"s Disc method
7. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
8. Determination of wavelength of mercury spectrum – spectrometer grating
9. Determination of band gap of a semiconductor
10. Determination of thickness of a thin wire – Air wedge method

| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester I | BS |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19BS103 | ENGINEERING CHEMISTRY | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To understand the basic concepts of water characterization and treatment methods.
- To know the fundamental concepts of Electrochemistry and corrosion.
- To understand the principles and generation of energy in Batteries, Solar cells & Nuclear reactors.
- To gain knowledge on nano materials.
- To know the types of fuels and the manufacture of solid, liquid and gaseous fuels.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Make the students conversant with water treatment techniques
- Know the reaction involved in corrosion and corrosion protection methods
- Impart knowledge on renewable energy sources like nuclear, solar and wind and to impart knowledge on energy storage devices
- Impart knowledge on various preparation methods of nano particles and know the applications.
- Impart knowledge on different types of fuels (solid liquid, gas, primary, secondary and synthetic) and about combustion.

| Unit I | WATER CHEMISTRY | 9 |
|---|---|---|

Hardness of water – types – Estimation of hardness of water by EDTA – problems – Domestic water treatment-boiler troubles (scales,sludge,Priming,Foaming,Caustic embrittlememt) – Internal conditioning (Carbonate,phosphate, sodium aluminate and calgon conditioning) external treatment – Demineralization process – Desalination - Reverse Osmosis.

| Unit II | ELECTROCHEMISTRY AND CORROSION | 9 |
|---|---|---|

Electrochemical cell - redox reaction, electrode potential- Nernst equation (derivation and problems).Standard hydrogen electrode-Calomel Electrode- Corrosion-factors- types- chemical, electrochemical corrosion (galvanic, differential aeration)-factors influencing corrosion-corrosion control - sacrificial anode and impressed current cathodic method.

| Unit III | ENERGY SOURCES | 9 |
|---|---|---|

Introduction- nuclear energy- nuclear fission- nuclear fusion- nuclear chain reactions- light water reactor- breeder reactor- solar energy conversion- solar cells- wind energy. Batteries and fuel cells:Types of batteries- alkaline battery- lead storage battery- lithium ion battery- fuel cell $H_2$ -$O_2$ fuel cell.

| Unit IV | NANOCHEMISTRY | 9 |
|---|---|---|

Basics -Nanoparticles: nano cluster, nano rod, nanotube(CNT) and nanowire. Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation; Properties and applications.

| Unit V | FUELS AND COMBUSTION | 9 |
|---|---|---|

Fuel: Introduction- classification of fuels- solid fuels-coal- proximate and ultimate analysis- manufacture of metallurgical coke (Otto Hoffmann method) – Liquid fuels: petroleum- synthetic petrol Fischer-Trophs and Bergius processes- knocking- octane number- cetane number – Gaseous fuels: liquefied petroleum gases(LPG)-water gas- bio diesel. Combustion- flue gas analysis (ORSAT Method).

**TEXT BOOK(S):**


1. Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2010
2. Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2009
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.


**REFERENCE(S):**


1. Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2010
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008.

| REFERENCE(S): | |
|---|---|
| 1. | Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2010 |
| 2. | Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008. |
| 3. | Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014. |
| 4. | Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015. |
| 5. | Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015. |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester I | HS |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19HS101 | COMMUNICATIVE ENGLISH | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective(s):**

- To acquire usage of grammar in English language.
- To develop listening skills which will enable to listen lectures and comprehend different types of texts.
- To enhance the reading skill to comprehend technical writings.
- To improve writing skills to express thoughts freely.
- To develop speaking skills to speak fluently in real contexts.

**Course Outcome(s)**: At the end of this course, learners will be able to:

- Improve their language usage in LSRW skills.
- Develop listening skills to comprehend general / technical talks.
- Acquire the ability to understand different written texts.
- Enhance the writing skills to express the ideas of the learners.
- Communicate fluently in real time context.

| Unit I | LANGUAGE FOCUS | 9 |
|---|---|---|

Parts of speech - Word formation - Sentence types (declarative, imperative, exclamatory & interrogative) - Tense forms - Subject - Verb agreement - Verbs - Adverbs - Adjectives - Framing questions

| Unit II | LISTENING | 9 |
|---|---|---|

Listening for specific information: Short conversations / monologues - Gap filling - Telephone conversations - Telephone etiquette - Note-taking - Listening for gist / interviews - Listening to songs and completing the lyrics - Clear individual sounds - Word stress

| Unit III | READING | 9 |
|---|---|---|

Completing the sentences - Prediction - Skimming for gist - Scanning for specific information - Understanding text and sentence structure - Close reading

| Unit IV | WRITING | 9 |
|---|---|---|

Paragraph writing (descriptive, narrative, expository & persuasive) - Letter (formal and informal) - Dialogue writing - E-mail - Instructions

| Unit V | SPEAKING | 9 |
|---|---|---|

Self-introduction - Giving personal and factual information - Talking about present circumstances, past experiences and future plans - Mini-presentation - Expressing opinions and justifying opinions - Agreement / disagreement - Likes and dislikes

**TEXT BOOK(S):**


1. Communicative English by KN Shoba ,Lourdes Joavani Rayen Publised by Cambridge university 2017.


**REFERENCE(S):**


1. Murphy, Raymond. English Grammar in Use – A Self-Study Reference and Practice Book For Intermediate learners Of English .Ived. United Kingdom: Cambridge University Press. 2012.
2. Seely, John. Oxford Guide to Effective Writing and Speaking. Indian ed. New Delhi: Oxford University Press 2005.
3. Anderson, Kenneth et al. Study Speaking: A Course in Spoken English for Academic Purposes. United Kingdom: Cambridge University Press 1992.
4. Wren and Martin, High school English Grammar and Composition, Publisher: S.Chand. 2019.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester I | ES |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ES106 | ENGINEERING GRAPHICS | 0 | 0 | 4 | 2 | 60 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To learn conventions and use of drawing tools in making engineering drawings.
- To draw orthographic projection of points and lines.
- To draw the projection of planes and simple solids.
- To draw the section of solids and obtain the development of surfaces of given solids.
- To draw the isometric projection of the given solids.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Recognize the conventions and apply construct basic engineering curves.
- Draw the orthographic projection of points and lines.
- Draw the projection of planes and simple solids.
- Draw the section of solid drawings and development of surfaces of given solids.
- Draw the isometric projection of the given objects.

| CONCEPTS AND CONVENTIONS (Not for Examination) | | 01 |
|---|---|---|
| Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. | | |
| **Unit I** | **PLANE CURVES** | **12** |
| Basic Geometrical constructions, Curves used in engineering practice: Conics – Construction of ellipse, parabola and hyperbola by Eccentricity method – Construction of Cycloid – construction of Involutes of triangle, square and circle – Drawing of tangents and normal to the above curves. | | |
| **Unit II** | **PROJECTION OF POINTS AND LINES** | **09** |
| Orthographic projection – principles - Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projection) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method. | | |
| **Unit III** | **PROJECTION OF PLANES & SOLIDS** | **14** |
| Projection of planes (polygonal and circular surfaces) inclined to both the principal planes. Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by Rotating Object method. | | |
| **Unit IV** | **PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES** | **12** |
| Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – prisms, pyramids, cylinders and cones. | | |
| **Unit V** | **ISOMETRIC VIEW / PROJECTION & PERSPECTIVE PROJECTION** | **12** |
| Principles of Isometric view – isometric scale – Isometric projections of simple solids - Prisms, pyramids, cylinders, cones - combination of two solid objects in simple vertical positions. Introduction to Perspective projection. | | |

**TEXT BOOK(S):**


1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2012.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
3. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.


**REFERENCE(S):**


1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester I | ES |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ES103 | ENGINEERING MECHANICS | 3 | 1 | 0 | 4 | 60 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To familiarize basic concepts and force systems in real-world environment.
- To provide knowledge on statics of particles in space with moment & equilibrium of rigid bodies.
- To study the moment of inertia of surfaces and solids.
- To determine the solution for the problems related to kinematics of particles and forces associated with work, energy, impulse and momentum.
- To learn the concepts of static friction & geometric motion of rigid bodies.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Illustrate the scalar and vectorial representation of forces and moments.
- Analyze the rigid bodies in equilibrium.
- Evaluate the properties of surfaces and solids.
- Calculate dynamic forces exerted in rigid bodies.
- Determine the friction characteristics of rigid bodies.

| Unit I | STATICS OF PARTICLES | 12 |
|---|---|---|

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces - Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space (basics).

| Unit II | EQUILIBRIUM OF RIGID BODIES | 12 |
|---|---|---|

Free body diagram – Types of supports – Action and reaction forces – stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force - Equilibrium of Rigid bodies in two dimensions.

| Unit III | PROPERTIES OF SURFACES AND SOLIDS | 12 |
|---|---|---|

Centroids and centre of mass – Centroids of areas - Rectangular, circular, triangular areas by integration – T-section, I-section, Angle section, Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis and Perpendicular axis theorems.

| Unit IV | DYNAMICS OF PARTICLES | 12 |
|---|---|---|

Displacement, velocity and acceleration – Relative motion – Rectilinear & Curvilinear motions – Newton's second law of motion – Work-Energy Equation – Impulse and Momentum – Law of Conservation of Momentum.

| Unit V | FRICTION | 12 |
|---|---|---|

Friction force – Static and Dynamic friction - Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – friction in connected bodies - wedge friction - ladder friction - belt friction - rolling resistance.

**TEXT BOOK(S):**


1. Dr. N. Kottiswaran, "Engineering Mechanics – Statics & Dynamics", Latest Edition, Sri Balaji Publications.
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010).
3. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.


**REFERENCE(S):**


1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).


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| | |
|---|---|
| 4. | N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015. |
| 5. | Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005. |


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester I | ES |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ES107 | WORKSHOP PRACTICES | 0 | 0 | 2 | 1 | 30 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To provide hands-on training in fabrication of components using carpentry, sheet metal and welding equipment / tools.
- To acquire the skill for making fitting joints and household pipe line connections using suitable tools.
- To develop the skill for preparing the green sand mould.
- To provide hands-on training in assembling and dismantling of petrol engines, gear boxes and pumps.
- To develop the skill for making wood/sheet metal models using suitable tools.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Fabricate simple components using carpentry, sheet metal and welding equipment/tools.
- Make fitting joints and household pipe line connections using suitable tools.
- Prepare green sand mould.
- Assemble and dismantle petrol engines, gear boxes and pumps.
- Make simple models using wood and sheet metal.

| Exp. No. | Name of Experiments |
|---|---|
| 1 | Forming of simple object in sheet metal using suitable tools (Example: Dust bin / Tray) |
| 2 | Fabrication of a simple component using thin and thick plates. (Example: Book rack) |
| 3 | Making a simple component using carpentry power tools. (Example: Pen stand/Tool box/ Letter box) |
| 4 | Prepare a "V", Half-round or Square joint from the given mild steel flat plate. |
| 5 | Construct a household pipe line connections using pipes, Tee-joint, Four-way joint, elbow, union, bend, gateway and taps (or) Construct a pipe connection for domestic application (centrifugal pump) using pipes, bend, gate valve, flanges and foot valve. |
| 6 | Prepare a green sand mould using solid pattern/split pattern. |
| 7 | Dismantling and assembly of Centrifugal Gear Pump / Gear box. |
| 8 | Dismantling and assembly of two-stroke and four-stroke petrol engine. |
| 9 | a) Preparation of butt joints, lap joints and T- joints by Electric Arc Welding.<br>b) Gas Welding practice. |
| 10 | Mini-Project (Fabrication of small components). |

| LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS | | |
|---|---|---|
| S.No. | NAME OF THE EQUIPMENT | QUANTITY |
| 1. | Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings | 15 sets |
| 2. | Carpentry Vice (fitted to work bench) | 15 Nos. |
| 3. | Standard woodworking tools | 15 Sets. |
| 4. | Models of industrial trusses, door joints, furniture joints | 5 each |
| 5. | Power Tools: (a) Rotary Hammer | 2 Nos. |
| | (b) Demolition Hammer | 2 Nos. |
| | (c) Circular Saw | 2 Nos. |
| | (d) Planer | 2 Nos. |
| | (e) Hand Drilling Machine | 2 Nos. |
| | (f) Jigsaw | 2 Nos. |
| 6. | Arc welding transformer with cables and holders | 5 Nos. |
| 7. | Welding booth with exhaust facility | 2 Nos. |
| 8. | Welding accessories like welding shield, chipping hammer, wire brush, etc. | 5 Sets. |

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| | | |
|---|---|---|
| 9. | Oxygen and acetylene gas cylinders, blow pipe and other welding outfits | 2 Nos. |
| 10. | Centre lathe | 2 Nos. |
| 11. | Hearth furnace, anvil and smithy tools | 2 Sets. |
| 12. | Moulding table, foundry tools | 2 Sets. |
| 13. | Power Tool: Angle Grinder | 2 Nos. |
| 14. | Study-purpose items: Centrifugal pump, Air-conditioner | One each. |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester I | BS |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19BS105 | CHEMISTRY LABORATORY | 0 | 0 | 4 | 2 | 60 | 100 | |

**Course Objective(s):** The purpose of learning this course is to:

- Determination of total, temporary & permanent hardness of water by EDTA method.
- Determination of chloride content of water sample by argentometric method.
- Estimation of iron content of the given solution using potentiometer.
- Determination of strength of given hydrochloric acid using pH meter.
- Conductometric titration of strong acid vs strong base.

**Course Outcomes:** At the end of this course, learners will be able to:

- Make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis.
- Acquire the knowledge about chloride content in water sample.
- Make the student to acquire practical skills about strength of iron using potentiometric titrations.
- Understand the how to estimate hydrochloric acid in water sample using pH meter.
- Gain the knowledge about conductance of ions.

**List of Experiments**

| Exp No. | Name of Experiments (Any Ten) |
|---|---|
| 1 | Determination of Total, Temporary & Permanent hardness of water by EDTA method. |
| 2 | Determination of chloride content of water sample by Argento metric method. |
| 3 | Determination of Dissolved oxygen content in water sample using Winklers Method |
| 4 | Determination of Alkalinity in Water Sample |
| 5 | Determination of strength of given hydrochloric acid using pH meter. |
| 6 | Determination of strength of acids in a mixture of acids using conductivity meter. |
| 7 | Conductometric titration of Weak acid vs Weak base. |
| 8 | Estimation of iron content of the given solution using potentiometer. |
| 9 | Conductometric titration of strong acid vs strong base. |
| 10 | Determination of Molecular weight of polyvinyl alcohol using Ostwald viscometer |
| 11 | Estimation of iron content of the water sample using spectrophotometer |
| 12 | Estimation of Copper in Brass |

**LIST OF EQUIPMENTS:**

| S.No | Description of Equipment | Quantity required | Quantity available |
|---|---|---|---|
| 01 | Potentiometer | 10 Nos. | 10 Nos. |
| 02 | pH meter | 10 Nos. | 10 Nos. |
| 03 | Conductivity meter | 10 Nos. | 10 Nos. |
| 04 | Spectrophotometer | 2 Nos. | 2 Nos. |
| 05 | Oswald viscometer | 30 Nos. | 30 Nos. |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester I | EEC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours/ Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19TP101 | LIFE SKILLS - I | 1 | 0 | 2 | 0 | 30 | 100 | |

**Course Objective (s):** The purpose of learning this course is

- To develop Inter Personal Skills and be an effective team player.
- To develop professional skills with idealistic, practical and moral values.
- To develop Communication Skills.

**Course Outcomes:** At the end of this course, learners will be able to:

- Have competent knowledge of grammar
- Understand basic rules.
- Speak and write appropriately applying these rules.
- Communicate effectively
- Enhance their interpersonal relationship building skills with renewed self confidence..

**SYLLABUS**

**Effective English – Written and Spoken English**

- Basic rules of Grammar - Parts of Speech – Tenses - Verbs
- Sentence Construction - Vocabulary – Idioms& Phrases – Synonyms – Antonyms.
- Dialogues and Conversations – Writing
- Exercises to practice and improve these skills.

**Art of Communication & the Hidden Data Involved**

- Verbal Communication - Effective Communication - Active listening –Paraphrasing - Feedback
- Non Verbal Communication - Body Language of self and others
- Importance of feelings in communication - dealing with feelings in communication

**World of Teams**

- Self Enhancement - importance of developing assertive skills- developing self confidence – developing emotional intelligence
- Importance of Team work – Team vs. Group - Attributes of a successful team – Barriers involved
- Working with Groups – Dealing with People- Group Decision Making

**TOTAL HOURS: 45 (15 Theory +30 Hours Practical)**

**REFERENCE BOOKS**


1. The Seven Habits of Highly Effective People - Stephen R. Covey.
2. All the books in the "Chicken Soup for the Soul" series.
3. Man□s search for meaning – Viktor Frankl
4. The greatest miracle in the world – OgMandino
5. Goal - EliyahuGoldratt.
6. Working with Emotional Intelligence - David Goleman.


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7. Excel in English – Sundra Samuel, Samuel Publications
8. Developing Communication Skills by Krishna Mohan and Meera Banerji; MacMillan India Ltd., Delhi
9. Essentials of Effective Communication, Ludlow and Panthon; Prentice Hall of India.
10. Effective Presentation Skills (A Fifty-Minute Series Book) by Steve Mandel
11. "Strategic interviewing" byRichaurd Camp, Mary E. Vielhaber and Jack L. Simonetti – Published by Wiley India Pvt. Ltd
12. "Effective Group Discussion: Theory and Practice" by Gloria J. Galanes, Katherine Adams , John K. Brilhart

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester II | BS |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19BS201 | VECTOR CALCULUS AND COMPLEX VARIABLES | 3 | 1 | 0 | 4 | 60 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To summarize and apply the methodologies involved in solving problems related to fundamental principles of Calculus viz: Vector, Vector Differentiation and Vector Integration.
- To implement the Complex Analysis, an elegant method in the study of heat flow, fluid dynamics and electrostatics.
- To develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.
- To defining a complex function and solving through complex integration

**Course Outcome(s):** At the end of this course, learners will be able to:

- Characterize the calculus of vectors.
- Apply the theoretical aspects of vector integral calculus in their core areas.
- Recognize the differentiation properties of complex functions.
- Identify the complex functions and their mapping in certain complex planes.
- Use the concepts of integration to complex functions in certain regions.

| Unit I | DIFFERENTIATION OF VECTORS | 12 |
|---|---|---|

Vector point function- Directional derivative - Gradient -Divergence -Curl - Solenoidal – Irrotational vector fields – Scalar potential

| Unit II | INTEGRATION OF VECTORS | 12 |
|---|---|---|

Work done - Line Integral - Surface integral- Green's theorem in a plane- Stoke's Theorem- Gauss divergence theorem- Applications involving cubes and parallelepiped.

| Unit III | ANALYTIC FUNCTIONS | 12 |
|---|---|---|

Analytic Functions- Necessary and Sufficient conditions of Analytic Function- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method -Applications to the problems of Potential Flow.

| Unit IV | MAPPING OF COMPLEX FUNCTIONS | 12 |
|---|---|---|

Physical interpretation of mapping- Application of transformation: translation, rotation, magnification and inversion of multi valued functions - Linear fractional Transformation (Bilinear transformation).

| Unit V | COMPLEX INTEGRATION | 12 |
|---|---|---|

Cauchy's Fundamental Theorem - Cauchy's Integral Formula - Taylor's and Laurent's series-Classification of Singularities - Cauchy's Residue Theorem.

**TEXT BOOK(S):**


1. Veerarajan, T., Engineering Mathematics I, Tata McGraw Hill Publishing Co., New Delhi, 5th edition, 2006.
2. Kandasamy P, et.al. Engineering Mathematics, Vol.I (4th revised edition), S.Chand &Co., New Delhi,2000.
3. Venkataraman M.K., Engineering Mathematics – First Year (2nd edition), National Publishing Co., Chennai,2000


**REFERENCE(S):**


1. C. Ray Wylie and C. Louis Barrett, Advanced Engineering Mathematics, Tata McGraw-HillPublishing Company Ltd, 2003
2. Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited,New Delhi 2015
3. J. A. Brown and R. V. Churchill, Complex Variables and Applications , Sixth Edition, McGraw Hill,New Delhi, 1996
4. Glyn James, Advanced Engineering Mathematics, Third Edition,Wiley India,2007


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| | |
|---|---|
| 5. | Peter V. O. Neil, Advanced Engineering Mathematics, Seventh Edition ,Cengage Learning India Private Limited, 2012 |

| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester II | BS |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19BS206 | ENGINEERING MATERIALS | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

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

**Course Outcome(s):** At the end of this course, learners will be able to:

- Get knowledge on the various phase diagrams and their applications
- Acquire knowledge on Fe-Fe3C phase diagram, various microstructures and alloys
- Get knowledge on mechanical properties of materials and their measurement
- Gain knowledge on magnetic and dielectric properties of materials
- Understand the basics of ceramics, composites and nanomaterials.

| Unit I | PHASE DIAGRAMS | 9 |
|---|---|---|

Solid solutions - Hume Rothery's rules – the phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions – free energy composition curves for binary systems - microstructural change during cooling.

| Unit II | FERROUS ALLOYS | 9 |
|---|---|---|

The iron-carbon equilibrium diagram - phases, invariant reactions - microstructure of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels - effect of alloying elements on the Fe-C system - diffusion in solids - Fick's laws - phase transformations - T-T-T-diagram for eutectoid steel – pearlitic, baintic and martensitic transformations - tempering of martensite – steels – stainless steels – cast irons.

| Unit III | MAGNETIC MATERIALS | 9 |
|---|---|---|

Magnetism in materials-magnetic field and induction-magnetic permeability and susceptibility -Classification of Magnetic Materials- Dia, Para and Ferro magnetic materials-Ferromagnetism – domain theory – types of energy – hysteresis – hard and soft magnetic materials – Antiferromagnetic Materials- ferrites - Application of Ferrites.

| Unit IV | DIELECTRIC MATERIALS | 9 |
|---|---|---|

Dielectric materials- Dipole moment- Polarization vector- Dielectric Constant- Polar and Non-polar Molecules-Electric Susceptibility-Polarization-Types of polarization – Langevin-Debye equation – frequency effects on polarization – Internal Field- Clausius mosotty equation-dielectric breakdown- Types of dielectric breakdown-Dielectric Loss– Insulating materials – Ferroelectric materials - Applications of Dielectric Materials- Dielectrics in Capacitors- Insulating materials in transformers.

| Unit V | NEW MATERIALS | 9 |
|---|---|---|

Ceramics – types and applications – composites: classification, role of matrix and reinforcement, processing of fiber reinforced plastics – metallic glasses: types , glass forming ability of alloys, melt spinning process, applications - shape memory alloys: NiTi alloy, applications – nanomaterials: preparation (bottom up and top down approaches), properties and applications – carbon nanotubes: structures, preparation and applications.

**TEXT BOOK(S):**


1. Raghavan, V. —Physical Metallurgy: Principles and Practice. PHI Learning, 2015.
2. Balasubramaniam, R. "Callister's Materials Science and Engineering". Wiley India Pvt. Ltd. 2014.
3. Raghavan, V. —Materials Science and Engineering : A First course. PHI Learning, 2015.


**REFERENCE(S):**

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Dept. of Mech Engg. - ESEC

| | |
|---|---|
| 1. | Askeland, D. "Materials Science and Engineering". Brooks/Cole, 2010 |
| 2. | Wahab, M.A. —Solid State Physics: Structure and Properties of Materials.Narosa Publishing House, 2009. |


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester II | ES |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | ours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ES201 | PROBLEM SOLVING AND PYTHON PROGRAMMING | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To understand problem solving concepts.
- To understand why Python is a useful scripting language for developers and to read and write simple Python programs.
- To develop Python programs with conditionals and loops
- To use Python data structures –- lists, tuples, dictionaries.
- To do input/output with files in Python

**Course Outcome(s):** At the end of this course, learners will be able to:

- Apply problems solving techniques to real world problems.
- Recognize and construct common programming idioms: variables, loop, branch, and input/output.
- Design, code, and test Python programs using List, Tuples and Strings
- Write code using dictionaries and functions
- Read and write data from/to files in Python Programs.

| Unit I | COMPUTATIONAL THINKING | 9 |
|---|---|---|

Introduction to Computational Thinking –From abacus to machine – The first Software –First Modern Computer-Information and data - Converting information into data -Data Capacity Problem Solving Techniques: General problem Solving concepts-: Algorithm, Pseudo-code and Flowchart Problem Solving with Sequential Logic Structure - Problem Solving with Decisions - Problem Solving with Loops Case Study: Raptor and Scratch Tools.

| Unit II | INTRODUCTION TO PYTHON | 9 |
|---|---|---|

History- Features - Setting up path - Working with Python - Basic Syntax - Variable and Data Types - Operator - Conditional Statements – Looping – Control Statements

| Unit III | STRING MANIPULATION, LIST AND TUPLES | 9 |
|---|---|---|

Creating String - Accessing Strings - Basic Operations - String slices - Function and Methods – Creating List - Accessing list - Operations on List - Working with lists - Function and Methods – Creating tuple - Tuple Operations – Functions and Methods

| Unit IV | DICTIONARIES AND FUNCTIONS | 9 |
|---|---|---|

Creating Dictionaries - Accessing values in dictionaries - Working with dictionaries - Properties – Functions - Defining a function - Calling a function - Types of functions - Function Arguments - Anonymous functions - Global and local variables

| Unit V | MODULES, FILES AND EXCEPTION HANDLING | 9 |
|---|---|---|

Modules - Importing module - Math module - Random module - Packages - Composition Files - Opening and closing file- File Opening Modes - Reading and writing files – Functions Exception Handling - Exception - Exception Handling - Except clause - Try , finally clause User Defined Exceptions

**TEXT BOOK(S):**


1. David Riley and Kenny Hunt, "Computational Thinking for the Modern Problem Solver", Chapman & Hall/CRC, 2014.
2. M. Sprankle, "Problem Solving and Programming Concepts", 9th Edition, Pearson Education, New Delhi, 2011.


**REFERENCE(S):**

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# ERODE SENGUNTHAR ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University)

PERUNDURAI, ERODE - 638 057

## UG Curriculum and Syllabus

## (1 to 8 Semesters)

## B.E – BIOMEDICAL ENGINEERING

**Choice Based Credit System (CBCS)**

**REGULATION 2019**

| | |
|---|---|
| 1. | Brian Heinold, "Introduction to Programming Using Python",Mount St. Mary s University, 2013. |
| 2. | Michael Dawson ,"Python Programming for the Absolute Beginner" , 3rd Edition, 2010. |
| 3. | Allen Downey, Green Tea Press Needham, "Think Python, How to Think Like a Computer Scientist", Massachusetts. |
| 4. | Cunningham, sams teach yourself python in 24 hours, Second edition Pearson, 2014 |


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester II | ES |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ES204 | PRINCIPLES OF ELECTRICAL AND ELECTRONICS ENGINEERING | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is to

- Understand the basic concepts of electric circuits and magnetic circuits.
- Illustrate the construction and operation of various dc electrical machines.
- Illustrate the construction and operation of various ac electrical machines.
- Illustrate the construction and operation of varioussemiconductor devices.

**Course Outcomes:** At the end of this course, learners will be able to:

- Apply the fundamental laws to electric circuits and compute the different alternating quantities.
- Apply the laws of magnetism for the operation of DC machine.
- Examine the construction and working principle of different AC machines
- Apply the drive for different application and speed control methods of DC and AC motors.
- Analyze the performance characteristics and applications of semiconductor devices.

| Unit I | ELECTRIC CIRCUITS | 9 |
|---|---|---|

Definition of Voltage, Current, Electromotive force, Resistance, Power & Energy, Ohms law and Kirchhoff□s Law & its applications - Series and Parallel circuits - Voltage division and Current division techniques - Generation of alternating emf - RMS value, average value, peak factor and form factor- Definition of real, reactive and apparent power.

| Unit II | DC MACHINES | 9 |
|---|---|---|

Introduction of magnetic circuits - Law of Electromagnetic induction –Principles and operation of DC Machines – EMF equation – Torque equation - Applications.

| Unit III | AC MACHINES | 9 |
|---|---|---|

Single Phase and Three Phase Transformer - Single Phase and Three phase induction motor - Alternator – Constructions - Working Principle - Applications.

| Unit IV | ELECTRICAL DRIVES | 9 |
|---|---|---|

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives - heating and cooling curves – Loading conditions and classes of duty - Speed control methods of dcand ac motors

| Unit V | ELECTRONIC DEVICES AND COMMUNICATION | 9 |
|---|---|---|

Characteristics of PN Junction diode and Zener diode - Half wave and Full wave Rectifiers – BipolarJunction Transistor - Operation of NPN and PNP transistors - Logic gates - Introduction to communication systems.

**TEXT BOOK(S):**


1. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
2. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd., 2010
3. Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics", S. Chand & Co. Ltd., 2008.


**REFERENCE(S):**


1. A. Sudhakar, Shyammohan S Palli, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill, 2010
2. R. S. Sedha, A Textbook of Applied Electronics, S.Chand & Company Ltd, 2013
3. Muthusubramanian & Salivahanan, Basic Electrical and Electronics Engineering and Communication Engineering, Seventh Edition, Tata MCGraw Hill Education Private Limited, 2011
4. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007.
5. John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2006.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester II | MC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MC201 | ENVIRONMENTAL SCIENCE AND ENGINEERING | 3 | 0 | 0 | 0 | 45 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To study the nature and facts about environment.
- To finding and implementing scientific, technological and economic solutions to environmental problems.
- To know the types of natural resources and the individual role in conserving the resources.
- Apply the knowledge to various social issues by understanding the environmental legislation laws.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Extend their knowledge in maintaining ecological balance and make use of their knowledge in the preservation of biodiversity.
- Outline the role of human being in maintaining a clean environment and useful environment for the future generations.
- Explain the constituents of environment, precious resources in the environment and conservation of natural resources.
- Find the role of government and Non-Government organization and explain the various rain water harvesting techniques.
- Develop their awareness about population growth, Family planning programme and HIV/AIDS and extend their knowledge in role of informative technologies in IT and human health.

| Unit I | ECOSYSTEMS AND BIODIVERSITY | 10 |
|---|---|---|

Environment: Scope – importance - need for public awareness -Concepts of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Food chains- food webs - types of ecosystem - structure and functions of forest ecosystem and river ecosystem – Biodiversity - value of biodiversity - consumptive use-productive use - social values - ethical values - aesthetic values - Hotspots of biodiversity -Threats to biodiversity - Habitat loss - poaching of wildlife and man wildlife conflicts-Conservation of biodiversity - In-situ and Ex-situ conservation of biodiversity.

| Unit II | ENVIRONMENTAL POLLUTION | 8 |
|---|---|---|

Pollution: Causes - effects and control measures of Air pollution - Water pollution - Soil pollution and Noise pollution - Solid waste management - Causes - effects -control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Disaster managements - Floods - cyclone- landslides.

| Unit III | INTRODUCTION TO NATURAL RESOURCES | 9 |
|---|---|---|

Forest resources - Use-over exploitation-deforestation - Water resources - use-over utilization of surface and ground water - conflicts over water - Mineral resources - use-exploitation-environmental effects of extracting and using mineral resources - Food resources - world food problems changes caused by agriculture - Effects of modern agriculture - fertilizer- pesticide problems - Energy resources - Renewable energy sources - solar energy - wind energy. Land resources - land degradation - soil erosion - Role of an individual in conservation of natural resources.

| Unit IV | SOCIAL ISSUES AND THE ENVIRONMENT | 9 |
|---|---|---|

Water conservation - rain water harvesting - global warming - acid rain - ozone layer depletion - Environment protection act - Air (Prevention and control of pollution) Act - Water (prevention and control of pollution) Act - Green Chemistry – Principle of Green chemistry – Application of Green chemistry

| Unit V | HUMAN POPULATION AND THE ENVIRONMENT | 9 |
|---|---|---|

Population growth - variation among nations - Population explosion - Family welfare programme - Human rights - HIV/AIDS – Human health and environment - women and child welfare - Role of information technology in environment and human health.

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| TEXT BOOK(S): | |
|---|---|
| 1. | Anubha Kaushik and C.P. Kaushik, Environmental Science and Engineering, New Age International Publishers, New Delhi (2015) |
| 2. | Dr. A. Ravikrishan, Envrionmental Science and Engineering., Sri Krishna Hitech Publishing co. Pt. Ltd., Chennai,12th Edition (2016) |
| 3. | Benny Joseph, „Environmental Science and Engineering□, Tata McGraw-Hill, New Delhi, 2006. |

| REFERENCE(S): | |
|---|---|
| 1. | Masters, Gilbert M, —Introduction to Environmental Engineering and Science ||, Second Edition, Pearson Education, New Delhi (2012). |
| 2. | Santosh Kumar Garg, Rajeshwari garg, smf Ranjni Garg —Ecological and Environmental Studies || Khanna Publishers, Nai Sarak, Delhi (2014). |
| 3. | Dharmendra S. Sengar, „Environmental law□, Prentice hall of India PVT LTD,New Delhi, 2007. |
| 4. | Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad,2015. |
| 5. | Rajagopalan, R, „Environmental Studies-From Crisis to Cure□, Oxford University Press, 2005. |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester II | ES |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ES213 | PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY | 0 | 0 | 2 | 1 | 30 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- To use functions for structuring Python programs.
- To represent compound data using Python lists, tuples, and dictionaries.
- To read and write data from/to files in Python.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

| Exp No. | Name of Experiments |
|---|---|
| 1 | Find the Greatest among three numbers without using third variable |
| 2 | Sum of the Digits of a Number |
| 3 | Generation of Prime Numbers |
| 4 | Implement a sequential search |
| 5 | Create a calculator program |
| 6 | Explore string functions |
| 7 | Implement Selection Sort |
| 8 | Implement Stack |
| 9 | Read and write into a file |
| 10 | Demonstrate usage of basic regular expression |
| 11 | Demonstrate use of advanced regular expressions for data validation. |
| 12 | Demonstrate use of List |
| 13 | Demonstrate use of Dictionaries |
| 14 | Create Comma Separate Files (CSV), Load CSV files into internal Data Structure |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester II | ES |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ES216 | ELECTRICAL ENGINEERING LABORATORY | 0 | 0 | 2 | 1 | 30 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To give a practical knowledge on the working of electrical machines including dc machines, induction motors and synchronous motors
- To impart the basics about design and implementation of small electronic circuits

**Course Outcome(s):** At the end of this course, learners will be able to:

- Test and validate shunt and compound generator.
- Test and Validate series and shunt motor.
- Test and Validate transformer and induction motors.
- Acquire knowledge on working of zener diodes.
- Acquire knowledge on working of rectifiers.

| Exp No. | Name of Experiments |
|---|---|
| 1 | OCC on a dc shunt generator, determination of critical resistance, critical speed, additional resistance required in the field circuit. |
| 2 | Load characteristics of DC Shunt generator |
| 3 | Load characteristics of DC Compound generator. |
| 4 | Load test on DC Series motor |
| 5 | Load test on DC Shunt motor. |
| 6 | Load test on single phase transformer. |
| 7 | Starting of three phase squirrel cage induction motor by star delta switch, load test on three phase squirrel cage induction motor. |
| 8 | Load test on three phase slip ring induction motor. |
| 9 | Load test on single phase induction motor. |
| 10 | OC and SC test on single phase transformer. |
| 11 | V-I Characteristics of diodes and Zener diodes. |
| 12 | Input and output characteristics of CE configuration of BJT S. Determination of β, input resistance and output resistance. |
| 13 | Half wave and full wave rectifiers with and without filters- Observe the waveforms on CRO. |

| LIST OF EQUIPMENTS FOR THE BATCH OF 30 STUDENTS | | |
|---|---|---|
| S.No. | NAME OF THE EQUIPMENT | Qty. |
| 1. | D. C. Motor Generator Set | 2 |
| 2. | D.C. Shunt Motor | 2 |
| 3. | Single Phase Transformer | 2 |
| 4. | Single Phase Induction Motor | 2 |
| 5. | Ammeter A.C and D.C | 20 |
| 6. | Voltmeters A.C and D.C | 20 |
| 7. | Watt meters LPF and UPF | 4 |
| 8. | Resistors & Breadboards | - |
| 9. | Cathode Ray Oscilloscopes | 4 |
| 10. | Dual Regulated power supplies | 6 |

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| | | |
|---|---|---|
| 11. | A.C. Signal Generators | 4 |
| 12. | Transistors (BJT, JFET) | - |

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| Department | COMMON TO ALL BRANCHES | | | | | R 2019 | Semester | II |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours/Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19TP201 | QUANTITATIVE APTITUDE, LOGICAL REASONING AND VERBAL ABILITY -I | 0 | 0 | 2 | 0 | 0 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values.

**Course Outcomes:** At the end of this course, learners will be able to:

- Distinguish the pattern of coding and decoding.
- Differentiate between sequence and series.
- Calculate the percentages and averages.
- Present their views effectively and know how to improve the skills in GD.
- Improve the student's in writing and speaking.

| UNIT 1 | CODING AND DECODING & SEQUENCE AND SERIES | 06 |
|---|---|---|

Introduction - Description of Coding method - Coding patterns - Concepts of Coding and Decoding –Problems involving Coding and Decoding methods.
Introduction - Sequences of real numbers - Number and Alphabet series - Description of Number and Alphabet series - Analogy - Odd man out- Power series

| UNIT 2 | PROBLEM ON AGES & PERCENTAGE | 06 |
|---|---|---|

Introduction- basic concept –Ages, usage of percentage and averages- applications

| UNIT 3 | PRESENTATION SKILLS | 06 |
|---|---|---|

Effective presentation strategies – Story telling – Visual communication.

| UNIT 4 | GROUP DISCUSSION | 06 |
|---|---|---|

Group Discussion – Understanding the objective and skills tested in GD – Types of GD – Roles in a GD – Do's & Don'ts – Video Modules, fundamentals of placement techniques. Interview Skills – Self preparation checklist – Grooming tips (Do's& Don'ts) – Video Modules.

| UNIT 5 | GRAMMAR | 06 |
|---|---|---|

Determiners ,Adjectives-Degrees of comparisons, Prepositions – Idioms & Phrases

**REFERENCE BOOK(S):**


| | |
|---|---|
| 1. | Murphy, Raymond. English in Use - A Self - study Reference and Practice Book for Intermediate Learners of English. IV edition. United Kingdom: Cambridge University Press. 2012. |
| 2. | Lewis, Norman. Word Power Made Easy. New York: Pocket Books.1991. |
| 3. | Baron's The Official Guide for New GMAT Review 2015. New Jersey: John Wiley &Sons, Inc |
| 4. | Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd, 2012 |
| 5. | Arun Sharma, How to prepare for Data Interpretation for the CAT, First Edition, Tata McGraw-Hill Publishing Company Ltd, 2012 |
| 6. | Dr.R S Aggarwal, Quantitative Aptitude, Seventh Revised Edition, S.Chand Publishing Company Ltd, 2013 |
| 7. | Arun Sharma, How to prepare for Quantitative Aptitude for the CAT, Fifth Edition, Tata McGraw-Hill Publishing Company Ltd, 2013 |


Chairman - BoS
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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester III | BS |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19BS301 | TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS | 3 | 1 | 0 | 4 | 60 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To understand the concepts of Fourier series, Transforms and Boundary Conditions, which will enable them to model and analyze the physical phenomena
- To implement the Fourier analysis, an elegant method in the study of heat flow, fluid mechanics and electromagnetic fields.
- To summarize and apply the mathematical aspects that contribute to the solution of one dimensional wave equation
- To develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Recognize the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series.
- Formulate a function in frequency domain whenever the function is defined in time domain.
- Apply the Fourier transform, which converts the time function into a sum of sine waves of different frequencies, each of which represents a frequency component.
- Classify a partial differential equation and able to solve them.
- • Apply and solve the engineering problems in the area of heat, wave equations.

| Unit I | FOURIER SERIES | 10 |
|---|---|---|
| Dirichlet's conditions - General Fourier series - Odd and even functions - Half range cosine and sine series - Root mean square value. | | |
| **Unit II** | **LAPLACE TRANSFORM** | **14** |
| Laplace Transform- Existence Condition -Transforms of Standard Functions - Unit step function, Unit impulse function- Properties- Transforms of Derivatives and Integrals - Initial and Final Value Theorems - Laplace transform of Periodic Functions - Inverse Laplace transforms. | | |
| **Unit III** | **FOURIER TRANSFORM** | **12** |
| Fourier Integral Theorem- Fourier Transform and Inverse Fourier Transform- Sine and Cosine Transforms - Properties - Transforms of Simple Functions - Convolution Theorem - Parseval's Identity. | | |
| **Unit IV** | **PARTIAL DIFFERENTIAL EQUATIONS** | **12** |
| Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of homogeneous types. | | |
| **Unit V** | **APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS** | **12** |
| Classification of Second Order Quasi Linear Partial Differential Equations - Fourier Series Solutions of One Dimensional Wave Equation - One Dimensional Heat Equation - Steady State Solution of Two-Dimensional Heat Equation - Fourier Series Solutions in Cartesian Coordinates. | | |

**TEXT BOOK(S):**


1. Larry.C.Andrews and Bhimsen.K.Shivamoggi, Integral Transforms for Engineers, First Edition, PHI Learning, New Delhi, 2007.
2. Ian.N.Sneddan, The Use of Integral Transforms, Second Edition, McGraw Hill companies, 1972.
3. B.V Ramana.., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.


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| REFERENCE(S): | |
|---|---|
| 1. | E. Kreyszig, Advanced Engineering Mathematics, Eighth Edition, John Wiley and Sons, Inc, Singapore, 2008. |
| 2. | Peter V. O. Neil,Advanced Engineering Mathematics, Seventh Edition, Cenage Learning India Private Ltd, 2012. |
| 3. | C. Ray Wylie and C. Louis Barrett,Advanced Engineering Mathematics, Tata McGraw-Hill Publishing Company Ltd, 2003. |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester III | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME301 | ENGINEERING METALLURGY | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To provide knowledge on physical metallurgy of metals through the study of phase diagrams.
- To study the properties and applications of various metals and alloys used in engineering industries.
- To expose various heat treatment processes of steels.
- To study the properties and applications of polymers and ceramics.
- To impart knowledge on mechanical properties evaluation and testing methods of engineering materials.

**Course Outcomes:** At the end of this course, learners will be able to:

- Explain the phase diagrams of different engineering materials.
- Recognize the properties and applications of various metals and alloys.
- Identify appropriate heat treatment processes for the given applications.
- Apply various nonmetals, its manufacturing techniques and various applications.
- Test the mechanical properties of the given materials for real-time applications.

| Unit I | PHASE DIAGRAMS AND CONSTITUTION OF ALLOYS | 09 |
|---|---|---|
| Alloys, Solid solutions – Phase diagram, phase rule, lever rule, Binary phase diagram –Isomorphous, eutectic, peritectic, eutectoid reactions – Iron-Carbon phase diagram – Metallography, microstructure. | | |
| **Unit II** | **ENGINEERING METALS AND ALLOYS** | **09** |
| Classification of Engineering materials – Ferrous metals –Plain carbon steel (low, medium and high carbon steels), microstructure/composition, properties, applications – Alloy steels, effect of alloying additions on steels – stainless steels, High Strength Low Alloy Steels (HSLA), maraging, tool steels – Cast iron - grey, white, malleable, spheroidal graphite cast iron, microstructure, properties, applications – Non-ferrous metals – Nickel, Copper, Titanium, Aluminium, Magnesium, Zinc alloys, properties and applications – Bearing materials. | | |
| **Unit III** | **HEAT TREATMENT OF STEELS** | **09** |
| Purpose of heat treatment – Annealing (stress relief, recrystallization, spheroidizing) –Normalizing – Hardening and Tempering, Isothermal transformation diagrams (T-T-T diagrams), Cooling curves superimposed on T-T-T diagrams (martensite and bainite phase formation) –Hardenability, Jominy end quench test, Case hardening processes, carburizing, nitriding, carbontiriding, cyaniding, flame hardening, induction hardening | | |
| **Unit IV** | **INTRODUCTION TO POLYMERS AND ENGINEERING CERAMICS** | **09** |
| Polymers - Plastics and elastomers - Thermoplasts and thermosets, properties and applications polyethylene, polypropylene, polyurethane, polystyrene, poly vinylchloride, polymethyl methacrylate, olyethylene terapthalate, polycarbonate, polyamide, acrylonitrile butadiene styrene, polyamide, polyamideimide, olypropyleneoxide, polypropylene sulphide, polyetheretherketone, polytetrafluroethylene, urea formaldehyde, phenol formaldehyde, polyester, nylon, epoxy) – Rubber and its types – Types of Ceramics and applications. | | |
| **Unit V** | **MECHANICAL PROPERTIES AND MATERIALS TESTING** | **09** |
| Elastic and plastic deformation, slip and twinning – Tensile test, stress-strain behavior of ductile and brittle materials – Stress-strain ehavior of elastomers – Viscoelasticity – Compression test – Hardness and testing methods – Impact test – Fatigue test, Stress vs number of cycles (S-N) curve, endurance limit, factors affecting fatigue – Creep test, creep curves –Types of fracture – Fracture toughness – Three crack propagation modes. | | |

| TEXT BOOK(S): | |
|---|---|
| 1. | William D Callister Jr., Materials Science and Engineering: An Introduction, 7th Edition, John Wiley & Sons Inc., New York, 2007. |
| 2. | G. E.Dieter, Mechanical Metallurgy, McGraw Hill, 2007. |

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|---|---|
| 3. | Avner, S.H., "Introduction to Physical Metallurgy", McGraw Hill Book Company,1997. |

| REFERENCE(S): | |
|---|---|
| 1. | V. Raghavan, Materials Science and Engineering, Prentice Hall of India, Delhi, 2009. |
| 2. | William Smith and Javed Hashemi, Foundations of Materials Science and Engineering, 5th Edition, McGraw Hill, New York, 2009. |
| 3. | G. Murray, C. White and W. Weise, Introduction to Engineering Materials, 2nd Edition, Chemical Rubber Company (CRC) Press, Taylor & Francis Group, Florida, 2007. |
| 4. | C.P.Sharma, Engineering Materials-Properties and Applications of Metals and Alloys, Prentice Hall of India, New Delhi, 2004. |
| 5. | U.C.Jindal : Material Science and Metallurgy, "Engineering Materials and Metallurgy", First Edition, Dorling Kindersley, 2012 |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester III | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME302 | ENGINEERING THERMODYNAMICS | 3 | 1 | 0 | 4 | 60 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To study the fundamentals of thermodynamics and zeroth law.
- To provide the knowledge on first law of thermodynamics.
- To impart the knowledge on second law of thermodynamics and entropy.
- To study the thermodynamic properties of pure substances and its phase change processes
- To learn about properties of gas mixtures, psychrometric processes.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Exemplify the basic concepts and zeroth law of thermodynamics.
- Apply the first law of thermodynamics to closed and open systems.
- Solve the problems related to cycles and cyclic devices using second law of thermodynamics.
- Determine the thermodynamic properties of pure substances and its phase change processes.
- Evaluate the properties of gas mixtures, psychrometry using psychrometric chart

| Unit I | INTRODUCTION AND ZEROTH LAW OF THERMODYNAMICS | 12 |
|---|---|---|

Macroscopic and Microscopic approaches, Definitions and concepts- heat, work, thermodynamic equilibrium, system and types, surroundings, Properties- intensive and extensive properties, Path and point functions, Energy- macroscopic and microscopic modes of energy, Thermodynamic processes and cycle, State postulate, Zeroth law of thermodynamics- temperature scale, perfect gas scale.

| Unit II | FIRST LAW OF THERMODYNAMICS | 12 |
|---|---|---|

First law of thermodynamics, I law for Closed systems - constant pressure process, constant volume process, constant temperature process, adiabatic process, polytropic process, throttling process. I law for open systems - Steady state flow processes, Steady flow energy equation (SFEE), Application of SFEE-turbines and compressors, nozzles and diffusers, throttling valves, heat exchangers.

| Unit III | SECOND LAW OF THERMODYNAMICS | 12 |
|---|---|---|

Limitations of I law of thermodynamics, Second law of thermodynamics- Kelvin - Planck and Clausius statements, Heat Engine, heat pump and refrigerator, Reversibility and irreversibility- irreversible and reversible processes, Carnot's principles, Carnot cycle, Carnot engine, Thermodynamic temperature scale, Clausius inequality, Entropy- principle of entropy increase, Availability & irreversibility.

| Unit IV | PROPERTIES OF PURE SUBSTANCES | 12 |
|---|---|---|

Thermodynamic properties of fluids. Pure substance-phases - Phase change processes, Property diagrams - pressure-volume (P-v), pressure-temperature (P-T), temperature volume (T-v), temperature-entropy (T-s) and enthalpy-entropy (h-s) diagrams. Steam tables - Problems on flow and non-flow processes. Ideal gas - equation of state, Van derWaals equation and compressibility chart.

| Unit V | GAS MIXTURES AND PSYCHROMETRY | 12 |
|---|---|---|

Thermodynamics of ideal gas mixture- mixture of ideal gas, mixture of perfect gases, Dalton's law of partial pressure, Amagat's law, Thermodynamics properties, Psychrometric properties and processes - Psychrometric chart.

**TEXT BOOK(S):**


1. P.K.Nag, Engineering Thermodynamics, Tata McGraw-Hill, New Delhi, 2007.
2. R.K. Rajput, Engineering Thermodynamics, Laxmi Publications Pvt.Ltd., New Delhi,2011.
3. R.S.Khurmi, Steam table with Psychometric chart,S.Chand Publications, New Delhi,2009.


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| REFERENCE(S): | |
|---|---|
| 1. | Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2016. |
| 2. | J.P.Holman, Thermodynamics, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi,2002. |
| 3. | Borgnakke & Sonnatag, "Fundamental of Thermodynamics", 8th Edition , 2016. |
| 4. | C.P.Arora, Thermodynamics, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi,2003. |
| 5. | Y. Cengel and Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi,2003. |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester III | ME |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME303 | MANUFACTURING TECHNOLOGY - I | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To study the sand and special casting processes sand casting processes and practice mould preparation
- To learn various metal joining processes and gain welding skills.
- To provide the knowledge on various bulk deformation processes and its applications.
- To expose knowledge on sheet metal forming processes and special forming processes and to make small sheet metal parts.
- To learn about the various plastics moulding and forming processes and to make simple plastic part.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Understand sand casting and special casting processes and produce castings.
- Select the suitable metal joining process for the given materials and its applications.
- Select the suitable bulk deformation processes for the given materials and its applications.
- Understand the sheet metal and special forming processes and prepare simple sheet metal components.
- Identify the suitable moulding and forming processes of plastics for the given applications.

| Unit I | CASTING PROCESSES | 09 |
|---|---|---|

Introduction to production processes and its classifications - Pattern - Types, Materials and Allowances. Moulding sand - Types, Properties and Testing. Moulding machines and its types. Melting furnaces - Cupola and Induction. Fettling and cleaning. Sand casting defects. Special casting processes - Shell moulding, Die casting, Centrifugal casting and Investment casting.

| Unit II | METAL JOINING PROCESSES | 09 |
|---|---|---|

Introduction to welding processes and its classifications - Principle of Gas welding and its flames - Principle of arc welding - Electrodes, Fluxes and filler materials. Principle of Resistance welding - Spot, butt and seam. Principle of Gas metal arc welding, Submerged arc welding, Tungsten Inert Gas welding, Plasma arc welding, Thermit welding, Electron beam welding and Friction welding - Weld defects - Brazing and soldering.

| Unit III | BULK DEFORMATION PROCESSES | 09 |
|---|---|---|

Introduction - Hot and cold working of metals - Forging processes - Open and close die forging, Forging equipment and operations. Rolling - Types of Rolling mills, shape rolling operations, Tube piercing and Defects. Principle of Extrusion and its types. Principle of rod and wire drawing.

| Unit IV | SHEET METAL FORMING AND SPECIAL FORMING PROCESSES | 09 |
|---|---|---|

Introduction - Shearing, bending and drawing operations - Stretch forming operations - Principle of special forming processes - Hydro forming, Rubber pad forming, Metal spinning, Explosive forming, Magnetic pulse forming, Peen forming and Super plastic forming.

| Unit V | MOULDING AND FORMING OF PLASTICS | 09 |
|---|---|---|

Introduction to plastics - Moulding of Thermoplastics - Principle and applications of Injection moulding and its types, Blow moulding, Rotational moulding, Thermoforming and Extrusion. Moulding of Thermosets -Principle and applications of Compression moulding and Transfer moulding - Bonding of Thermoplastics - Fusion and solvent methods.

**TEXT BOOK(S):**


1. P. N. Rao, Manufacturing Technology vol. I, Tata McGraw-Hill Publishing Company Private Limited, New Delhi, 2010.
2. Serope Kalpakjian, Steven R. Schmid, Manufacturing Engineering and Technology,Pearson Education Limited,New Delhi, 2013.
3. Gowri P. Hariharan, A.Suresh Babu, "Manufacturing Technology I", Pearson Education, 2008


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| REFERENCE(S): | |
|---|---|
| 1. | J. P. Kaushish, Manufacturing Processes, Prentice Hall of India Learning Private Limited, New Delhi, 2013. |
| 2. | P.C. Sharma, Manufacturing Technology – I, S Chand and Company Private Limited,New Delhi,2010. |
| 3. | S K Hajra Choudhury, Elements of Workshop Technology – Vol. I, Media Promoters & Publishers Private Limited, Mumbai,2013 |
| 4. | Roy. A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2006 |
| 5. | Paul Degarma E, Black J.T and Ronald A. Kosher, "Materials and Processes, in Manufacturing" Eight Edition, Prentice – Hall of India, 1997. |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester III | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME304 | FLUID MECHANICS AND MACHINERY | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To study the fluid laws, properties and measurements.
- To expose various fluid flow measuring devices and calculate the flow losses in pipes.
- To learn the concept of boundary layer theory over bodies and perform dimensional analysis.
- To impart knowledge on various types of hydraulic turbines and performance curves.
- To gain knowledge on working principles and performance analysis of fluid pumps.

**Course Outcomes:** At the end of this course, learners will be able to:

- Estimate the flow properties and pressure head using fundamental laws of fluid mechanics.
- Evaluate the discharge and loss of energy in flow through pipes.
- Illustrate the impact of boundary layer over bodies and model the fluid structures using Reynolds and Froudes Model law.
- Analyze the performance of hydraulic turbine for a given application.
- Analyze the performance of hydraulic pumps for a given application.

| Unit I | INTRODUCTION TO FLUID AND FLUID MOTION | 9 |
|---|---|---|

Fluid- Fluid mechanics -Laws of Fluid Mechanics-Properties of fluid and its application-Types of fluid Types of fluid flow-Measurement of pressure-U-tube and differential manometer- Measurement of velocity using Discharge Actual discharge-Flow pattern-law of conservation of Mass, Energy, Momentum -continuity equation.

| Unit II | FLUID DYNAMICS AND FLUID FLOW OVER CONDUITS | 9 |
|---|---|---|

Forces acting on a fluid element- Eulers and Bernoulli theorem Application in internal and external flows measuring instruments - Momentum equation applications for bend in pipes Major losses and Minor losses in pipes using standard charts and tables pipes in series and pipes in parallel. Identification of laminar and turbulent flow in closed conduits, flow in circular pipe - Darcy Weisbach equation.

| Unit III | EXTERNAL FLOW OVER BODIES AND DIMENSIONAL ANALYSIS | 9 |
|---|---|---|

Fluid flow over Bodies: Boundary layer theory-Boundary layer development on a flat plate -Lift and drag of an aero foil. Need for dimensional analysis dimensional analysis using Buckingham pi theorem - Similitude types of similitude - Dimensionless parameters- application of dimensionless parameters Model analysis through Reynolds and Froudes Model law.

| Unit IV | HYDRAULIC TURBINES | 9 |
|---|---|---|

Definition of turbine Classification -Types of head and efficiencies of turbine-Impulse turbine - Reaction turbine-Francis turbine, Kaplan turbine - working principles and velocity triangle- Work done by water on the runner pecific speed - unit quantities performance curves.

| Unit V | HYDRAULIC PUMPS | 9 |
|---|---|---|

Definition -Centrifugal pump Classification Construction working principle and velocity Triangle Definition of heads-Losses and efficiencies-Multistage Centrifugal pump-Specific speed Priming and cavitation effects of centrifugal pump. Reciprocating pump Classification Working Principle Coefficient of discharge and slip-Indicator diagram (Descriptive treatment only).

**TEXT BOOK(S):**


1. R.K.Bansal, A Textbook of Fluid Mechanics and Machinery, Laxmi Publications (P) Ltd., New Delhi, Revised Ninth edition, 2014.
2. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2013.
3. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2016.


**REFERENCE(S):**


1. Bruce R Munson , Donald F Young, Theodore H Okiishi and Wade W. Huebsch, Fundamentals of Fluid Mechanics, John Wiley & Sons, Sixth edition 2009.
2. Pijush K Kundu and Ira M Cohen, Fluid Machines, Academic Press, Burlington, United states of merica, 2010.


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|---|---|
| **3.** | Yunus Cengel and John Cimbala, Fluid Mechanics Fundamentals and Application, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi 2009. |
| **4.** | Robert and W Fox, Introduction to Fluid Machines, John Wiley Eastern Pvt. Ltd., New Delhi, 6th edition ,2006. |
| **5.** | Victor L. Streeter, K.W. Bedford and Wylie E. Benjamin , Fluid Mechanics, Tata McGraw Hill Publishing Company Pvt Ltd., New York, Revised Ninth Edition 1997. |


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester III | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME305 | STRENGTH OF MATERIALS | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To study and estimate the mechanical properties of materials and its deformations under different loading conditions through experiments.
- To learn two dimensional stress systems and stresses in thin cylinders and spherical shells.
- To gain knowledge on shear force and bending stress distribution in different beams under various loads.
- To impart knowledge on finding slope and deflection of beams and buckling of columns for various boundary conditions.
- To learn the deformation of shaft under torsion and deflection of closed helical springs.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Evaluate the stresses and strains in regular and composite structures subjected to axial loads.
- Examine the stresses in two dimensional systems and thin cylinders.
- Examine the shear force, bending moment and shear stress of various beams under different loading conditions
- Evaluate the slope and deflection of beams and buckling loads of columns with different boundary conditions.
- Examine the stresses induced in shaft and closed coil helical springs subjected to torsion.

| Unit I | STRESS, STRAIN AND DEFORMATION OF SOLIDS | 09 |
|---|---|---|
| Introduction to material properties. Stresses and strains due to axial force, shear force, impact force and thermal effect-stepped and composite bars-uniformly varying cross section. Stress-strain curve for ductile and brittle materials-Hooke-law-Factor of safety Poisson-ratio. Elastic constants and their relationship. | | |
| **Unit II** | **ANALYSIS OF STRESSES IN TWO DIMENSIONS** | **09** |
| State of stresses at a point-Normal and shear stresses on inclined planes-Principal planes and stresses- Plane of maximum shear stress-Mohr's-circle for bi-axial stress with shear stress. Hoop and longitudinal stresses in thin cylindrical and spherical shells-Changes in dimensions and volume. | | |
| **Unit III** | **LOADS AND STRESSES IN BEAMS** | **09** |
| Types of beams-Supports and Loads, Shear force and Bending Moment in beams, Cantilever, simply supported and overhanging beams-Point of contra flexure. Theory of simple bending-bending and shear stress-stress variation along the length and section of the beam, Section modulus. | | |
| **Unit IV** | **DEFLECTION OF BEAMS AND COLUMNS** | **09** |
| Slope and Deflection of cantilever, simply supported and overhanging beams- Double integration method and Macaulay's method. Columns-types-Equivalent length Euler and Rankine formulae- Slenderness. | | |
| **Unit V** | **TORSION IN SHAFT AND HELICAL SPRING** | **09** |
| Analysis of torsion of circular solid and hollow shafts-stepped shaft-compound shaft-Shear stress distribution, angle of twist and torsional stiffness. Closed coil helical spring-stresses and deflection under axial load-Maximum shear stress in spring section including Wahl's Factor problems, applications. | | |

**TEXT BOOK(S):**


1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India Learning Pvt. Ltd, New Delhi, 2010.
2. S.S.Rattan, Strength of Materials, Tata McGraw Hill, Delhi, Second Edition, 2011.
3. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016


**REFERENCE(S):**


1. D. K. Singh, Mechanics of Solids, Pearson Education New Delhi, 2006.


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|---|---|
| 2. | W.A. Nash, Theory and problems in Strength of Materials, Schaum Outline Series, McGraw- Hill Book Co., New York,1995. |
| 3. | F. P. Beer and R. Johnston, Mechanics of Materials, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, Third edition,2002. |
| 4. | B. K. Sarkar, Strength of Materials, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, Second Reprint, 2007. |
| 5. | Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013 |


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester III | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME306 | FLUID MECHANICS AND MACHINERY LABORATORY | 0 | 0 | 2 | 1 | 30 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

To demonstrate the principles of fluid mechanics.
To measure the energy losses in a pipe flow.
To perform characteristic study on impulse, reaction and axial flow turbines.
To perform characteristic study on positive displacement pumps.
To perform characteristic study on non-positive displacement pumps.

**Course Outcomes:** At the end of this course, learners will be able to:

- Examine the fluid flow and coefficient of discharge in fluid flow devices.
- Measure the major and minor losses associated in a pipe flow.
- Interpret the characteristic study on impulse, reaction and axial flow turbine.
- Evaluate the performance of positive displacement pumps.
- Evaluate the performance of non-positive displacement pumps

| Exp No. | Name of Experiments |
|---|---|
| 1 | Experimental verification of Bernoullis theorem in a pipe flow and visualize the flow using Reynolds apparatus. |
| 2 | Measurement of flow rate using venturimeter and orificemeter and calculate the coefficient of discharge. |
| 3 | Determination of loss of head in different pipes (major loss) and fittings (minor loss) for various flow rates. |
| 4 | Performance test on tangiantial flow impulse (Pelton wheel) turbine against constant head. |
| 5 | Performance test on Francis turbine against constant head. |
| 6 | Performance test on reaction (Kaplan) turbine. |
| 7 | Performance characteristics of a reciprocating pump. |
| 8 | Performance characteristics of a gear pump. |
| 9 | Performance test on centrifugal pump. |
| 10 | Performance test on submersible pump |

| LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS | | |
|---|---|---|
| S. NO. | NAME OF THE EQUIPMENT | Qty. |
| 1 | Orifice meter setup | 1 |
| 2 | Venturi meter setup | 1 |
| 3 | Rotameter setup | 1 |
| 4 | Pipe Flow analysis setup | 1 |
| 5 | Centrifugal pump/submergible pump setup | 1 |
| 6 | Reciprocating pump setup | 1 |
| 7 | Gear pump setup | 1 |
| 8 | Pelton wheel setup | 1 |
| 9 | Francis turbine setup | 1 |
| 10 | Kaplan turbine setup | 1 |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester III | EEC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours/Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19TP301 | QUANTITATIVE APTITUDE, LOGICAL REASONING AND VERBAL ABILITY -II | 0 | 0 | 2 | 0 | 30 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To expose the undergraduate students on methods and practices that helps to develop their Knowledge in Basic Grammar, effective communication, Verbal ability and logical Reasoning.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Plot the diagrams based on direction.
- Perform arithmetical operations with complex numbers and Data analysis.
- Evaluate critically the real life situations by resorting and analyzing analytical reasoning of key issues and factors.
- Improve the performance in receptive skills while listening and reading.
- Develop the student's productive skills in writing and speaking.

| UNIT 1 | SIMPLIFICATIONS & DIRECTION | 06 |
|---|---|---|

Introduction - Basic concepts - Arithmetic operations - Equation solving methods – Puzzles. Introduction to Direction Sense test - Overview of the wide variety of Direction problems – Direction – Plotting diagrams

| UNIT 2 | NUMBER SYSTEMS & DATA INTERPRETATION | 06 |
|---|---|---|

Introduction - Definition- Classification on Numbers -Power cycles and remainders - Short cut process - Concept of highest common factor - Concept of least common multiple - Divisibility - Number of zeros in an expression. Data Interpretation – To analyze the data from various applications.

| UNIT 3 | LISTENING AND READING (RECEPTIVE SKILLS) | 06 |
|---|---|---|

Listening for writing short answers - Filling gaps in sentences - Identifying topic, context and function - Identify different functions of language in business situations - Identify prompts - Identify paraphrases of required information - Scanning - Reading for gist - Understanding sentence structure - Error identification - Identify paraphrases - Cohesive words and phrases - Understand the importance of analyzing the distracters - Identify grammatical and semantic relationships.

| UNIT 4 | WRITING AND SPEAKING (PRODUCTIVE SKILLS) | 06 |
|---|---|---|

Business Emails - Notes - Memos to colleagues or friends - Giving instructions - Explaining a development - asking for comments - Requesting information - Agreeing to requests - Explaining - Apologizing - Reassuring - complaining - Describing - Summrizing - Recommending - Persuading Turn-taking - Sustaining interaction - initiating - Responding - Giving personal information - Talking about present circumstances, past experiences and future plans - Expressing opinion - Speculating - Organizing a larger unit of discourse - Giving information - expressing and justifying opinions - Speculating - Comparing and contrasting - Agreeing and disagreeing.

| UNIT 5 | LEADERSHIP SKILLS | 06 |
|---|---|---|

Team work – Importance of team work – Leadership skills - Attributes of a successful team – Barriers involved dealing with people- Group decision making.

**REFERENCE(S):**


1. Whitehead, Russell and Michael Black. Pass Cambridge BEC Vantage Self-Study Practice Tests with Key, Heinle,a part of Cengage Learning, Delhi, 2003.
2. Murphy, Raymond. English in Use - A Self - study Reference and Practice Book for Intermediate Learners of English.IVed. United Kingdom: Cambridge University Press. 2012.
3. Lewis, Norman.Word Power Made Easy. New York: Pocket Books.1991.
4. Baron's The Official Guide for New GMAT Review 2015. New Jersey: John Wiley &Sons, Inc.
5. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd, 2012
6. Arun Sharma, How to prepare for Data Interpretation for the CAT, First Edition, Tata McGraw-Hill Publishing Company Ltd, 2012.
7. Dr.R S Aggarwal, Quantitative Aptitude, Seventh Revised Edition, S.Chand Publishing Company Ltd, 2013.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester III | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| 19ME307 | STRENGTH OF MATERILAS LABORATORY | L | T | P | C | | | |
| | | 0 | 0 | 2 | 1 | 30 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To study the mechanical properties of materials when subjected to different types of loading.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Perform Tension and Shear stress test on Solid materials.
- Perform Torsion and impact test on Solid materials.
- Perform Hardness test on Solid materials.
- Perform Deformation test on Beams.
- Perform Compression and Tension test on Helical springs.

| Exp No. | Name 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 Hardness Number. |
| 6 | Hardness test on metals - Rockwell Hardness Number. |
| 7 | Hardness test on metals – Vicker's Hardness Number. |
| 8 | Deflection test on beam. |
| 9 | Compression test on helical spring. |
| 10 | Tension test on helical spring. |

| LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS | | |
|---|---|---|
| S. No | NAME OF THE EQUIPMENT | Qty. |
| 1 | Universal Tensile Testing machine with double 1 shear attachment – 40 Ton Capacity | 1 No. |
| 2 | Torsion Testing Machine (60 NM Capacity) | 1 No. |
| 3 | Impact Testing Machine (300 J Capacity) | 1 No |
| 4 | Brinell Hardness Testing Machine | 1 No. |
| 5 | Rockwell Hardness Testing Machine | 1 No. |
| 6 | Vicker's Hardness Testing Machine | |
| 7 | Spring Testing Machine for tensile and compressive loads (2500 N) | 1 No. |

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8. Arun Sharma, How to prepare for Quantitative Aptitude for the CAT, Fifth Edition, Tata McGraw-Hill Publishing Company Ltd, 2013

| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | III |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19HS301 | COMMUNICATION SKILLS LABORATORY | 0 | 0 | 4 | 2 | 30 | 100 | |

**Course Objective (s):** The purpose of learning this course is

- To involve the students in effective listening activities.
- To improve the oral communication skills in proper manner.
- To focus the effective reading of general and technical text.
- To enhance and comprehend the written text.
- To integrate LSRW skills.

**Course Outcomes:** At the end of this course, learners will be able to:

1. Understand the technical talks.
2. Communicate to his peer group properly.
3. Comprehend the general and technical text.
4. Write the reports and job application in clear manner.
5. Integrate LSRW skills.

| | | |
|---|---|---|
| **Unit I** | **LISTENING** | **6** |

Listening and its importance –Listening strategies - Listen to a process information - give information, as part of a simple explanation - Being an active listener: giving verbal and non-verbal feedback - taking lecture notes

| | | |
|---|---|---|
| **Unit II** | **SPEAKING** | **6** |

Give personal information - ask for personal information - express ability - ask for clarification - pronunciation basics - pronunciation practice - conversation starters: Pep talk - stressing syllables and speaking clearly - summarizing academic readings and lectures

| | | |
|---|---|---|
| **Unit III** | **READING** | **6** |

Strategies for effective reading - Read and recognize different types of texts - Predicting content using photos and title - Read for details - Use of graphic organizers to review and aid comprehension - Understanding pronoun reference and use of connectors in a passage- speed reading techniques

| | | |
|---|---|---|
| **Unit IV** | **WRITING** | **6** |

Plan before writing - Develop a paragraph: topic sentence, supporting sentences, concluding sentence –Write a descriptive paragraph – Write a paragraph with reasons and examples - Write an opinion paragraph – E-mail writing - Types of essays-descriptive-narrative- issue-based-argumentative-analytical

| | | |
|---|---|---|
| **Unit V** | **INTEGRATION OF LSRW** | **6** |

Task based Instruction : watching a video –Listing, Sorting, ordering, comparing and analyzing the ideas – Reading a newspaper and creating topic based videos

**TEXT BOOK(S):**


1. Gramer F. Margot and Colin S. Ward Reading and Writing (Level 3) Oxford University Press: Oxford, 2011
2. Brooks,Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011


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| | |
|---|---|
| 3 | Richards,C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010 |
| **REFERENCE(S):** | |
| **1.** | Davis, Jason and Rhonda LIss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006. |
| **2.** | E. Suresh Kumar and et al. Enriching Speaking and Writing Skills. Second Edition. Orient Black swan: |
| **3.** | Anderson, Kenneth et al. Study Speaking: A Course in Spoken English for Academic Purposes. United Kingdom:<br>Cambridge University Press 1992. |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester IV | BS |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19BS403 | NUMERICAL METHODS AND STATISTICS | 3 | 1 | 0 | 4 | 60 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To understand the methods to solve polynomial equations and Implement the mathematical ideas for interpolation numerically
- To summarize and apply the methodologies involved in solving problems related to ordinary and partial differential equations
- To apply the concepts testing of hypothesis in their core areas
- To develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment

**Course Outcome(s):** At the end of this course, learners will be able to:

- Classify the equations into algebraic, transcendental or simultaneous and apply the techniques to solve them numerically
- Demonstrate and obtain the differentiation and integration of functions using the numerical techniques
- Obtain the solutions of all types of differential equations, numerically.
- Apply basic statistical inference techniques, including confidence intervals, hypothesis testing to science/engineering problems.
- Design an experiment for an appropriate situation using ANOVA technique.

| Unit I | SOLUTION OF EQUATIONS | 12 |
|---|---|---|

Solution of algebraic and transcendental equations: Newton- Raphson method - Solution of system of linear equations: Gauss elimination method - Inverse of a matrix: Gauss-Jordan method- Eigen values of a matrix by Power method.

| Unit II | NUMERICAL DIFFERENTIATION AND INTEGRATION | 12 |
|---|---|---|

Interpolation: Newton's forward and backward interpolation formulae - Numerical differentiation: Newton's forward and backward interpolation formulae. Numerical integration: Trapezoidal rule- Simpson's1/3 rule for single integrals- Two point Gaussian quadrature formula.

| Unit III | NUMERICAL SOLUTIONS OF DIFFERENTIAL EQUATIONS | 12 |
|---|---|---|

Solution of first order ordinary differential equations: Fourth order Runge- Kutta method - Solution of partial differential equations: Elliptic equations: Poissons equation- Parabolic equations by Crank Nicholson method- Hyperbolic equations by explicit finite difference method

| Unit IV | CORRELATION AND REGRESSION | 12 |
|---|---|---|

Correlation- Multiple correlation –Regression – Multiple Regression-Linear fit- Quadratic fit

| Unit V | DESIGN OF EXPERIMENTS | 12 |
|---|---|---|

Completely randomized design - Randomized block design - Latin square design.

**Text Books(S):**


1. Sankara Rao. K, Numerical Methods for Scientists and Engineers, Third Edition, Eastern Economy Edition, 2009
2. Jain M.K, Iyangar S.R.K and Jain R.K, Numerical Methods For Scientific and Engineering Computation, New Age International ( P ) Ltd , New Delhi , 2005.
3. Burden R. L and Douglas Faires J, Numerical Analysis Theory and Applications, CengageLearning, Ninth Edition, 2005.


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| REFERENCE(S): | |
|---|---|
| 1. | Steven Chapra , Numerical Methods for Engineers , Tata McGraw Hill seventh Edition, 2015. |
| 2. | Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2012. |
| 3. | Gerald C. F and Wheatley P.O, Applied Numerical Analysis, Seventh Edition, Pearson Education, New Delhi, 2004. |
| 4. | Johnson R.A, Miller and Freund, Applied Probability and Statistics for Engineers, Seventh Edition, Prentice Hall of India, New Delhi, 2005. |
| 5. | Walpole R.E, Myers R.H, Myers R.S.L and Ye K, Probability and Statistics for Engineers and Scientists, Seventh Edition, Pearsons Education, Delhi, 2002 |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester IV | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| 19ME401 | ENGINEERING METROLOGY AND MEASUREMENTS | L | T | P | C | | | |
| | | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To study the concepts of measurement and characteristics of instruments.
- To learn the procedure for various linear and angular measurements.
- To provide knowledge on measurement of gear and thread terminologies using suitable instruments.
- To study the use of laser and advances in metrology for linear geometric dimensions.
- To expose the measuring procedure to measure the mechanical parameters using suitable instruments.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Explain the basic concept of measurement and characteristics of measuring instruments
- Practice the appropriate linear and angular dimensions using precision measuring instruments
- Examine the major terminologies for the gear, screw thread and roundness measurement
- Apply the advanced techniques in metrology to calculate the geometric dimensions.
- Explain the suitable type of instrument used to measure the mechanical parameters

| Unit I | CONCEPT OF MEASUREMENT | 07 |
|---|---|---|

Introduction: Definition, Objectives, Elements of Measuring System, Accuracy and Precision – Units and Standards - Characteristics of measuring instrument: Sensitivity, Stability, Interchangeability, Range of accuracy, Readability, Reliability, Backlash, Repeatability and Reproducibility – Calibration - Errors in Measurement: Static and dynamic errors - Care of Measuring Instruments.

| Unit II | LINEAR AND ANGULAR MEASUREMENTS | 09 |
|---|---|---|

Linear Measurements: Vernier Caliper, Vernier Height and Depth Gauges, Micrometer and depth micrometer, Slip gauge, limit gauge and its classification - Comparator: Mechanical, Pneumatic and Electrical types - Angular Measurements: Bevel protractor, Sine bar, Angle Decker, Autocollimator.

| Unit III | FORM MEASUREMENT | 11 |
|---|---|---|

Thread Measurement: Terminologies, Errors - External Thread Measurement: Pitch Gauge, Tool Maker's microscope, Floating Carriage micrometer with One, Two and Three wires - Internal Thread Measurement: Taper Parallels and Rollers method. Gear Measurement: Terminologies, Errors, Gear Tooth Vernier caliper, Profile Projector, Base pitch measuring instrument, David Brown Tangent Comparator, Involutes tester, Parkinson Gear Tester - External and Internal Radius measurements - Roundness measurement: Circumferential confining gauge, Assessment using V block and Rotating centers.

| Unit IV | LASER AND ADVANCES IN METROLOGY | 09 |
|---|---|---|

Interferometer: NPL Flatness, Laser, Michelson - Computer Aided Inspection - Digital Devices - Machine Vision System - Coordinate Measuring Machine: Basic concept, Types, Constructional features, Probes, Accessories - Surface Roughness Measurement - Straightness Measurement - Squareness Measurement - Machine Tool Metrology.

| Unit V | MEASUREMENT OF MECHANICAL PARAMETERS | 09 |
|---|---|---|

Measurement of Force - Principle, analytical balance, platform balance, proving ring. Torque – Prony brake, hydraulic dynamometer. Measurement of Power: Linear and Rotational - Pressure Measurement: Principle, use of elastic members, Bridgeman gauge, Mcleod gauge, Pirani gauge - Temperature Measurement: bimetallic strip, thermocouples, metal resistance thermometer, pyrometers.

**TEXT BOOK(S):**

1. Bewoor, Vinay Kulkarni, Metrology & Measurement, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2009.

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|---|---|
| 2. | Alan S. Morris, The Essence of Measurement, Prentice Hall of India, New Delhi,2001. |
| 3. | Raghavendra ,Krishnamurthy "Engineering Metrology & Measurements", Oxford Univ. Press, 2013. |

| **REFERENCE(S):** | |
|---|---|
| 1. | R. K. Jain, Engineering Metrology, Khanna Publishers, New Delhi, 2009. |
| 2. | A. K. Jayal, Instrumentation and Mechanical Measurements, Galgotia Publications, New Delhi 2000. |
| 3. | T. G. Beckwith, N. Lewis Buck, Mechanical Measurements, Addison Wesley, New Delhi 2008. |
| 4. | Charles Reginald Shotbolt, "Metrology for Engineers", 5th edition, Cengage Learning EMEA,1990. |
| 5. | Donald Peckman, "Industrial Instrumentation", Wiley Eastern, 2004. |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester IV | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME402 | THERMAL ENGINEERING | 3 | 1 | 0 | 3 | 60 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To learn the concept of Brayton cycle and Rankine cycle.
- To study the components, systems and performance of internal combustion engines
- To provide knowledge on steam nozzles and steam turbines.
- To impart knowledge on working principles and performance of air compressors.
- To study the working principle and applications of refrigeration and air conditioning systems.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Understand the applications of Brayton cycle and Rankine cycle.
- Recognize the components and compute the performance of internal combustion engines.
- Resolve the problems involving steam nozzles and steam turbines.
- Understand the classification, working and performance of air compressors.
- Estimate the cooling load and select suitable refrigeration and air conditioning system.

| Unit I | AIR STANDARD AND POWER PLANT CYCLES | 12 |
|---|---|---|
| Air standard cycles – otto, diesel and dual cycles, Gas turbine power plant cycle, Brayton cycle, expression for efficiency, work ratio. Modifications of Brayton cycle with intercooler, reheater and regenerator. Steam power plant cycle - Rankine cycle, modifications with reheater and regenerator. Problem solving using Mollier chart. | | |
| **Unit II** | **INTERNAL COMBUSTION ENGINES** | **12** |
| Internal combustion engines - Classification - Components and functions - Comparison. Valve timing diagram and port timing diagram - Fuel supply systems - Ignition Systems Lubrication system and cooling system. Performance calculation, Heat balance sheet preparation- Air-fuel ratio calculation- Knocking and detonation. | | |
| **Unit III** | **STEAM NOZZLES AND TURBINES** | **12** |
| Flow of steam through nozzles-Shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and reaction principles- Compounding of Turbines - velocity diagrams for simple and multistage turbines- Speed regulations- Governors. | | |
| **Unit IV** | **AIR COMPRESSOR** | **12** |
| Classification and working principle-Work of compression with and without clearance, volumetric efficiency, Isothermal efficiency and isentropic efficiency of reciprocating air compressors. Multistage air compressor and inter cooling, Work of multistage air compressor. Rotary compressors- Centrifugal, vane and roots blowers. | | |
| **Unit V** | **REFRIGERATION AND AIR-CONDITIONING** | **12** |
| Vapour compression refrigeration cycle Effect of superheat, sub cooling of refrigerant, performance calculations. Working principle of vapour absorption system- Ammonia, water, Lithium bromide water systems (Elementary treatment only), and comparison between vapour compression and absorption systems. Cooling load calculations, Concept of RSHF, GSHF, ESHF, Air conditioning systems. | | |

**TEXT BOOK(S):**


1. Kothandaraman.C.P., Domkundwar.S. and A.V.Domkundwar., A course in Thermal Engineering, Dhanpat Rai & Sons, Fifth edition, 2002.
2. Arora .C.P., "Refrigeration and Air Conditioning", Tata Mc Graw Hill, 2008
3. R. S. Khurmi & J. K. Gupta, Refrigeration Tables with Chart, S Chand & Company Limited, New Delhi, 2008.


**REFERENCE(S):**


1. Ballaney. P.L ." Thermal Engineering", Khanna publishers, 24th Edition 2012


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|---|---|
| 2. | Yunus A. Cengel, Michael A. Boles, Thermodynamics An Engineering Approach, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2008. |
| 3. | Mahesh M. Rathore, Thermal Engineering, Tata McGraw - Hill Education Private Limited, New Delhi, 2011. |
| 4. | J. P. Holman, Thermodynamics, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2007. |
| 5. | C. P. Kothandaraman, Steam Tables, New Age International Private limited, 2007. |


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester IV | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME403 | MANUFACTURING TECHNOLOGY -II | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To learn the metal cutting theory and calculate the forces involved in it.
- To study construction, working and operations of centre, semi-automatic and automatic lathes.
- To provide the knowledge on construction, working of milling and gear cutting machines.
- To impart knowledge on construction, working and operations of reciprocating, drilling and boring machines.
- To provide knowledge on construction, working of broaching, grinding and few fine finishing processes.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Apply the metal cutting theory, calculate the various cutting forces, application of cutting tools and cutting fluids.
- Select the suitable type of lathe machine for machining operations and explain its working.
- Explain the working of milling and gear cutting machine and identify the suitable machines based on the applications.
- Choose the suitable reciprocating machine and explain its working.
- Illustrate the working of broaching, grinding & fine finishing processes and identify the suitable finishing process based on the application.

| Unit I | METAL CUTTING THEORY | 10 |
|---|---|---|
| Introduction - Orthogonal, Oblique Cutting and types of chip formation. Mechanisms of metal cutting - Shear plane, Stress, Strain and cutting forces. Merchants Circle - Deriving the forces, calculations. Cutting tool - Properties, materials, wear, single point tool nomenclature, tool life and its calculations. cutting fluids - Types and its properties. | | |
| **Unit II** | **LATHE, SEMI AUTOMATS AND AUTOMATS** | **10** |
| Introduction - Types- Centre Lathe - Construction, specification, operations. Mechanisms – Head stock driven using all geared type and thread cutting. Work holding devices - Centres, chucks, carrier with catch plate and face plates. Calculation of machining time - Capstan and turret lathes - Introduction, turret indexing and bar feeding mechanism. Automats - single spindle, multi spindle and their types. | | |
| **Unit III** | **MILLING MACHINE AND GEAR CUTTING MACHINES** | **08** |
| Milling - Introduction, types, up milling, down milling, operations, and nomenclature of plain milling cutter. Indexing - simple and differential indexing methods. Gear cutting-gear milling, gear shaper and gear hobbing machine. | | |
| **Unit IV** | **RECIPROCATING MACHINES, DRILLING AND BORING MACHINES** | **10** |
| Shaper, Planer and Slotter - Introduction, types, specification and quick return mechanisms. Drilling - Introduction, types, construction of universal drilling machine, specification, types of drills and nomenclature of twist drill. Introduction to horizontal boring machine. | | |
| **Unit V** | **BROACHING AND FINISHING PROCESSES** | **07** |
| Broaching - Introduction, types and tool nomenclature. Finishing processes - Grinding -Introduction, types, grinding wheel- specification, selection, glazing, loading, dressing and truing. Fine finishing processes - Honing, lapping, polishing, buffing and super finishing. | | |

**TEXT BOOK(S):**


1. J. P. Kaushish, Manufacturing Processes, Prentice Hall India Learning Private Limited., New Delhi, 2013.
2. Serope Kalpakjian and Steven R Schmid, Manufacturing Engineering and Technology, Pearson Education Limited., New Delhi, 2013.
3. HMT, "Production Technology", Tata McGraw Hill, 1998.


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| REFERENCE(S): | |
|---|---|
| 1. | P. N. Rao, Manufacturing Technology- Metal Cutting and Machine Tools, Tata McGraw Hill Publishing Company Private Limited., New Delhi, 2013 |
| 2. | S. K. Hajra Choudhury, Elements of Workshop Technology. Vol. II, Media Promoters & Publishers Private Limited., Mumbai, 2013. |
| 3. | P.C Sharma, Manufacturing Technology - II, S.Chand & Company Limited. New Delhi,2012. |
| 4. | Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J.White "Machine Tool Practices", Prentice Hall of India, 1998 |
| 5. | Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", Mc Graw Hill, 1984 |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester IV | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| 19ME404 | KINEMATICS OF MACHINES | L | T | P | C | 60 | 100 | |
| | | 3 | 1 | 0 | 3 | | | |

**Course Objective(s):** The purpose of learning this course is:

- To impart the knowledge on the concept of simple mechanisms.
- To provide knowledge on kinematic analysis of simple mechanisms.
- To study and construct the cam profile for the various types of follower motion.
- To learn the kinematics terminologies of spur gear and calculate speed ratio of various types of gear train.
- To introduce the concept of friction drives in kinematic of machines.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Identify the simple mechanisms based on given application.
- Find velocity and acceleration of simple mechanisms.
- Construct the cam profile for different types of follower motion.
- Identify the kinematic terminologies of spur gear and calculate speed ratio of various types of gear train.
- Estimate the amount of power transmitted by friction drive.

| Unit I | FUNDAMENTALS OF MECHANISMS | 12 |
|---|---|---|
| Basic Terminology - Kinematic link, Pair, joints, Structure, Machine, Degree of freedom, Grubler & Kutzbach Criterion - Inversions of four bar mechanism, Mechanical advantage - Transmission Angle , Inversion of single slider and double slider crank mechanisms. Common Mechanisms - Straight line mechanism, Dwell mechanism. | | |
| **Unit II** | **KINEMATIC ANALYSIS OF MECHANISMS** | **12** |
| Relative velocity of kinematic link, Rubbing Velocity of kinematic pair, Construction of velocity and acceleration diagram by graphical method (Relative Velocity Method), Four bar mechanism, slider crank mechanisms and complex mechanism. | | |
| **Unit III** | **CAM AND FOLLOWER MECHANISMS** | **12** |
| Introduction - Terminology, Classifications, Types of follower motion - Uniform velocity Motion, Simple Harmonic Motion, Uniform Acceleration and Retardation Motion and Cycloidal Motion- Construction of cam profile - Knife edge follower, Roller and flat faced follower. | | |
| **Unit IV** | **GEAR AND GEAR TRAIN** | **12** |
| Gears - Terminology, Law of gearing, Length of path of contact, Length of arc of contact, contact ratio- Interference and undercutting. Gear trains- Speed ratio, train value. Simple gear train, compound gear train, Epicyclic gear train- speed calculation by tabular method. | | |
| **Unit V** | **FRICTION DRIVES** | **12** |
| Introduction-Friction clutch, types -single plate, Multi plate and cone clutch. Flat Belt Drives Velocity, slip, creep and Centrifugal effect of belt, length of open and cross belt drives, Maximum power transmitted, ratio of driving tension in flat belt drives - V Belt drives. | | |


| TEXT BOOK(S): | |
|---|---|
| 1. | S. S. Rattan, Theory of Machines, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2014 |
| 2. | Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006. |
| 3. | F.B. Sayyad, "Kinematics of Machinery", MacMillan Publishers Pvt Ltd., Tech-max Educational resources, 2011 |
| **REFERENCE(S):** | |
| 1. | Ballaney P L, Theory of Machines and Mechanisms, Khanna Publishers, New Delhi, 2005. |
| 2. | Sadhu Singh, Theory of Machines, Pearson Education, Second Edition, 2012. |
| 3. | Rao J S and Dukkipati, Mechanism and Machine Theory, Wiley- Eastern Ltd., New Delhi, 2006. |


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|---|---|
| **4.** | Beven T, Theory of Machines, Third Edition, CBS Publishers and Distributors, New Delhi, 2010. |
| **5.** | .J. J. Uicker, G. R. Pennock and J. E. Shigley, Theory of Machines and Mechanisms, Oxford University Press, New York, 2011. |


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester IV | ME |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| 19ME405 | THERMAL ENGINEERING LABORATORY | L | T | P | C | | | |
| | | 0 | 0 | 2 | 1 | 30 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

To learn the port timing and valve timing diagram of internal combustion engines.
To impart the knowledge on flash point, fire point, calorific value and viscosity of the fuel sample.
To study the performance, retardation and emission characteristics of internal combustion engines.
To provide the knowledge on working of two stage reciprocating air compressor.
To study the performance of refrigeration and air conditioning systems.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Draw the port timing and valve timing diagram of two stroke and four stroke internal combustion engines.
- Measure the flash point, fire point, calorific value, viscosity and calculate the performance with emission characteristics of IC engines.
- Evaluate the performance of IC engine on retardation.
- Evaluate the performance of two stage reciprocating air compressor.
- Calculate the COP of refrigeration and air conditioning systems.

| Exp No. | Name of Experiments |
|---|---|
| 1 | Experimental study on port timing and valve timing diagram of IC engines. |
| 2 | Measure the flash point, fire point, calorific value and viscosity of the given oil sample. |
| 3 | Experimental study of performance test on 4-Stroke Petrol engine. |
| 4 | Experimental study of performance and emission characteristics on 4-Stroke diesel engine. |
| 5 | Heat balance test on 4-Stroke diesel engine. |
| 6 | Morse test on multi-cylinder petrol engine. |
| 7 | Retardation test on 4-Stroke diesel engine. |
| 8 | Experimental study on performance of two stage reciprocating air compressor. |
| 9 | Experimental study on determination of Coefficient of Performance of refrigeration system. |
| 10 | Experimental study on determination of Coefficient of Performance of Air-conditioning system. |

| LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS | | |
|---|---|---|
| S. No | NAME OF THE EQUIPMENT | Qty. |
| 1 | I.C Engine – 2 stroke and 4 stroke model | 1 set |
| 2 | Apparatus for Flash and Fire Point | 1 No. |
| 3 | 4-stroke Diesel Engine with mechanical loading. | 1 No |
| 4 | 4-stroke Diesel Engine with hydraulic loading. | 1 No. |
| 5 | 4-stroke Diesel Engine with electrical loading. | 1 No. |
| 6 | Multi-cylinder Petrol Engine | 1 No. |
| 7 | Single cylinder Petrol Engine | 1 No. |
| 8 | Data Acquisition system with any one of the above engines | 1 No. |
| 9 | Steam Boiler with turbine setup | 1 No. |
| 10 | Single/two stage reciprocating air compressor | 1 No. |
| 11 | Refrigeration test rig | 1 No. |
| 12 | Air-conditioning test rig | 1 No. |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester IV | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME406 | MACHINE DRAWING LABORATORY | 0 | 0 | 2 | 1 | 30 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To use limits, fits and tolerances in real world problems.
- To apply different sectional views in drawings.
- To recognize the drawing notations of standard machine elements.
- To draw the assembly drawing.
- To draw the detailed drawing of given components.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Use limits, fits and tolerances in real world problems.
- Sketch the sectional views of simple elements.
- Select and draw the standard mechanical elements like bolt,nut,screw etc.
- Select the assembly drawing of automobile components.
- Sketch the detailed drawing of automobile components.

| Unit I | LIMITS, FITS AND TOLERANCES | 05 |
|---|---|---|

Limit System- Tolerance, Limits, Deviation, Actual Deviation, Upper Deviation, Lower Deviation, Allowance, Basic Size, Design Size, Actual Size. Fits- Types, Tolerances of Form and Position- Form and Position Variation, eometrical Tolerance, Tolerance Zone, Indicating Geometrical Tolerances. Indication of Surface Roughness, Standard Abbreviations and Symbols used in industries.

| Unit II | SECTIONAL VIEWS | 05 |
|---|---|---|

Sections- Hatching of Sections, Cutting Planes, Revolved or Removed Section, Sectional Views- Full Section, Half Sections and Auxiliary Sections- Conventional Representation-One-view, Two-view and three view drawings.

| Unit III | INTRODUCTION TO MACHINE ELEMENT DRAWINGS | 05 |
|---|---|---|

Drawing standards and Designation of Bolts, nuts, screws, keys, pins, Rivets, Welded Joints- Dimensioning of Welds, Belt Driven Pulleys, Chain and Gears Drives.

| Unit IV | ASSEMBLY DRAWINGS AND SECTIONAL VIEWS | 08 |
|---|---|---|

Preparation of manual parts drawing and assembled sectional views from orthographic part drawings, Automobile components - stuffing box, Machine Tool Parts plummer block, Joints knuckle joints, Couplings Protected type flanged coupling, Bearings swivel bearing, Preparation of Bill of materials and tolerance data sheet.

| Unit V | REAL PRODUCTS TO MACHINE DRAWING CONVERSION | 07 |
|---|---|---|

Preparation of manual parts drawing and assembled sectional views from real time products- Internal combustion engine parts, connecting rod, couplings - universal coupling, machine tool parts - tailstock, Automobile components screw jack, stuffing box - Commercial products - Preparation of Bill of materials and tolerance data sheet.

**TEXT BOOK(S):**


1. N.D. Bhatt, Machine Drawing, Charotar Publishing House Pvt. Ltd., 2014
2. P.S.Gill, A Textbook of Machine Drawing, Katson books, 2013


**REFERENCE(S):**


1. R.K.Dhawan, A Textbook of Machine Drawing,S.Chand,2012
2. K.C. John, Textbook of Machine Drawing, PHI Learning Pvt. Ltd.,2009


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester IV | ME |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME407 | MANUFACTURING TECHNOLOGY LABORATORY | 0 | 0 | 2 | 1 | 30 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To learn the basic machining operations using lathe machine.
- To know the grinding machine operations.
- To provide training on machining operations through milling, gear hobbing and slotting.
- To develop skill on drilling operations.
- To develop skill for making a product using various machining operations.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Produce components as per the given drawing using lathe machine.
- Perform surface finish operation using grinding machines.
- Make components using milling, gear hobbing and slotting machines.
- Perform operations using drilling machines.
- Make a product using machining operations.

| Exp No. | Name of Experiments |
|---|---|
| 1 | Exercise on turning, threading, taper turning and boring. |
| 2 | Exercise on surface grinding, cylindrical grinding and internal grinding. |
| 3 | Exercise on milling, gear hobbing and Slotting. |
| 4 | Exercise on drilling, tapping and reaming. |
| 5 | To make one of the following product: gear box/direct indexing/pump/press tool/progressive die/screw jack/single cavity mould. |

| LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS | | |
|---|---|---|
| S. No | NAME OF THE EQUIPMENT | Qty. |
| 1 | Turret and Capstan Lathes | 1 No each |
| 2 | Horizontal Milling Machine | 1 No. |
| 3 | Vertical Milling Machine | 1 No |
| 4 | Surface Grinding Machine | 1 No. |
| 5 | Cylinderical Grinding Machine | 1 No. |
| 6 | Radial Drilling Machine | 1 No. |
| 7 | lathe Tool Dynamometer | 1 No. |
| 8 | Milling Tool Dynamometer | 1 No. |
| 9 | Gear Hobbing Machine | 1 No. |
| 10 | Tool Makers Microscope | 1 No. |
| 11 | CNC Lathe | 1 No. |
| 12 | CNC Milling machine | 1 No. |
| 13 | Gear Shaping machine | 1 No. |
| 14 | Centerless grinding machine | 1 No. |
| 15 | Tool and cutter grinder | 1 No. |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester IV | EEC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours/Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19TP401 | QUANTITATIVE APTITUDE, LOGICAL REASONING AND VERBAL ABILITY - III | 0 | 0 | 2 | 0 | 30 | 100 | |

**Course Objective(s):** The purpose of learning this course is:

- To expose the undergraduate students on methods and practices that helps to develop their Knowledge in Basic Grammar, effective communication, Managerial Skills, Quantitative Aptitude and Verbal ability.

**Course Outcome(s):** At the end of this course, learners will be able to:

- Demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken to solve Aptitude Questions.
- Evaluate critically the real life situations by resorting and analyzing analytical reasoning of key issues and factors.
- To understand the importance of Non-Verbal Communication and its clues.
- To excel in Verbal Communication Skills and being effective in it.
- To know to ways of improving the presentation Skills.

| UNIT 1 | DATA SUFFICIENCY, SIMPLE AND COMPOUND INTEREST | 06 |
|---|---|---|

Introduction to Data Sufficiency - Overview of the wide variety of Data Sufficiency problems – Basic introduction on how to determine what information is sufficient to solve a given problem – Common Pitfalls to avoid. Simple Interest and Compound Interest – Principal – Rate of Interest –Amount – Time Period.

| UNIT 2 | VISUAL REASONING & BLOOD RELATION | 06 |
|---|---|---|

Introduction - Basic concepts - Odd man out - Next series - Mirror image and water image Introduction - Basic concept - Kinds of relation - Tree diagram – Relations

| UNIT 3 | NON-VERBAL COMMUNICATION | 06 |
|---|---|---|

Importance on Non-Verbal Communication – Gesture – Posture – Positive and Negative Non-Verbal Clues.

| UNIT 4 | VERBAL COMMUNICATION | 06 |
|---|---|---|

Importance of Verbal Communication – Tips and Tricks to Improve Verbal Communication – Tips to Overcome from MTI – Tips to avoid filler in Verbal Communication

| UNIT 5 | PRESENTATION SKILLS | 06 |
|---|---|---|

Importance – Effective Presentation Tips – Presentation Exercise.

**REFERENCES:**


1. Murphy, Raymond. English in Use - A Self - study Reference and Practice Book for Intermediate Learners of English.IVed. United Kingdom: Cambridge University Press. 2012.
2. Lewis, Norman.Word Power Made Easy. New York: Pocket Books.1991.
3. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd, 2012.
4. Dr.R S Aggarwal, Quantitative Aptitude, Seventh Revised Edition, S.Chand Publishing Company Ltd, 2013.
5. Arun Sharma, How to prepare for Quantitative Aptitude for the CAT, Fifth Edition, Tata McGraw-Hill Publishing Company Ltd, 2013.
6. The Definitive Book of Body Language by Barbara Pease, Body Language Book by Allan Pease.
7. Speak to Win: How to Present with Power in Any Situation.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester IV | ES |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| 19ES406 | INTERNET OF THINGS | L | T | P | C | | | |
| | | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To understand what internet of thing is.
- To identify the various elements of IoT system
- To understand the various means of communication from Node/Gateway to cloud platforms.
- To understand cloud computing &its relevance in IoT
- To identify types of data analytics and data visualization tools and make students aware of security concerns and challenges while implementing IoT solutions

**Course Outcomes:** At the end of this course, learners will be able to:

- Explain what Internet of things is.
- Describe components of IoT Architecture and platforms of IoT Ecosystem.
- Describe and choose sensors and actuators.
- Describe and implement Edge Network.
- Describe Big data analytics, transform data and draw meaningful conclusions, identify the DIY open source electronic platforms.

| Unit I | INTRODUCTION TO IoT | 7 |
|---|---|---|
| Definition of IoT- Evolution of IoT- IoT and related terms- Business scope. | | |
| **Unit II** | **ELEMENTS OF IoT** | **7** |
| Introduction to Elements of IoT- Basic Architechture of an IoT Application Sensors & Actuators- Edge Networking (WSN) – Gateways- IoT Communication Model- WPAN & LPWA. | | |
| **Unit III** | **COMMUNICATION AND CONNECTIVITY TECHNOLOGIES** | **8** |
| Cloud Computing in IoT- IoT Communication Model- Cloud Connectivity. | | |
| **Unit IV** | **DATA ANALYTICS AND IOT PLATFORMS** | **8** |
| Big Data Analytics- Data Visualization- IoT Platforms. | | |
| **Unit V** | **CONCERNS AND FUTURE TERNDS, HANDS-ON PROJECTS** | **15** |
| Different Players of IoT- Security Concerns and Challenges- Future Trends- Standards Internet of Things(IoT). DIY Kits – IFTTT and other apps. Applications of IOT in Manufacturing, Automotive and Power Industries. | | |

| TEXT BOOK(S): | |
|---|---|
| 1. | "The Internet of Things" by Samuel Greengard |
| 2. | "The Fourth Industrial Revolution" by Klaus Schwab |

| REFERENCE(S): | |
|---|---|
| 1. | "Getting started with Internet of Things" by Cuno Pfister |
| 2. | "Learning Internet of Things" by Peter Waher |
| 3. | "Precision: Principles, Practices and Solutions for the Internet of Things" by Timothy Chou |
| 4. | "The Second Machine Age: Work, Progress and Prosperity in a Time of Brilliant Technologies" by Erik Brynjolfsson and Andrew McAfee |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester V | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME501 | DESIGN OF MACHINE ELEMENTS | 3 | 1 | 0 | 4 | 60 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To learn the design procedure of machine elements subjected to simple and variable loads.
- To study the design procedure of shafts and couplings.
- To provide knowledge on the design of bolted and welded joints.
- To provide knowledge on the design of helical, leaf and torsional springs subjected to constant and variable loads.
- To study the selection procedure of sliding and rolling contact bearings.

**Course Outcomes:** At the end of this course, learners will be able to:

- Design machine elements subjected to simple and variable loads.
- Design shaft and couplings for various engineering applications.
- Design bolted and welded joints subjected to static load.
- Design helical, leaf and torsional springs subjected to constant and variable loads.
- Select suitable bearings for axial and radial loading conditions from manufacturers„catalogue.

| Unit I | STEADY AND VARIABLE STRESSES | 12 |
|---|---|---|
| Introduction to the design process - Design of straight and curved beams - C -frame and Crane hook. Stress concentration - Design for variable loading - Soderberg, Goodman, Gerber methods and combined stresses - Theories of failure. | | |
| **Unit II** | **DESIGN OF SHAFTS AND COUPLINGS** | **12** |
| Design of shafts based on strength, rigidity and critical speed. Design of rigid flange coupling - Design of flexible coupling. | | |
| **Unit III** | **DESIGN OF JOINTS** | **12** |
| Design of bolted joints - stresses due to static loading, eccentrically loading. Design of welded joints - Butt and Fillet welded Joints - Strength of parallel and traverse fillet welded Joints - Eccentrically loaded joints. | | |
| **Unit IV** | **DESIGN OF SPRINGS** | **12** |
| Types, End connections and design parameters. Design of helical springs - Circular and noncircular wire - Concentric springs. Design of leaf and torsional springs under constant and varying loads - Wahl's stress factor. | | |
| **Unit V** | **DESIGN OF BEARINGS** | **12** |
| Types and selection criteria - Design of journal bearings - Design of rolling contact bearing Ball and roller bearing. | | |

**TEXT BOOK(S):**


1. V. B. Bhandari, Design of Machine Elements, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2010.
2. Faculty of Mechanical Engineering, PSG College of Technology, Design Data Book, M/s.Kalai kathir Achchagam, 2013.


**REFERENCE(S):**


1. J. E. Shigley and C. R. Mischke, Mechanical Engineering Design, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2011.
2. R. C. Juvinall and K. M. Marshek, Fundamentals of Machine Component Design, John Wiley & Sons, New Delhi, 2011.
3. R. L. Norton, Design of Machinery, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2004.
4. M. F. Spoutts, T. E. Shoup and I. E. Hornberger, Design of Machine Elements Pearson Education, 2006.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester V | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME502 | DYNAMICS OF MACHINES | 3 | 0 | 0 | 4 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To impart knowledge in dynamic analysis of simple mechanism and design of flywheel.
- To provide knowledge on balancing of rotating and reciprocating masses.
- To study the working principle of governor and gyroscope.
- To learn the concept of free and forced vibration.
- To learn the concept of transverse and torsional vibration.

**Course Outcomes:** At the end of this course, learners will be able to:

- Perform dynamic analysis of simple mechanism and design of flywheel.
- Estimate the balancing mass for rotating and reciprocating masses by using the force and couple polygon.
- Compute the range of speed for governor and gyroscopic effect of ship and aero plane
- Evaluate the natural frequency of single degrees of freedom system subjected to free and forced vibration.
- Calculate the natural frequency of transverse and torsional vibration of single, two and three rotors system.

| Unit I | DYNAMIC FORCE ANALYSIS OF MECHANISMS | 09 |
|---|---|---|
| Principle of superposition, Condition for dynamic analysis, Dynamic analysis of four bar & slider crank mechanism - Engine force analysis. Turning moment diagram for steam & IC Engine. Energy stored in flywheel, Dimension of flywheel rim, Flywheel in punching press. | | |
| **Unit II** | **BALANCING** | **09** |
| Introduction - Static balancing and dynamic balancing, Balancing of Rotating mass several masses in same and different plane. Balancing of reciprocating mass Swaying couple, Tractive force, Hammer Blow. Balancing of coupled locomotives. | | |
| **Unit III** | **GOVERNOR AND GYROSCOPE** | **09** |
| Governor Terminology, Working principle, Types - Watt, Porter and Proell governor, Characteristics of Governor-sensitiveness, Hunting, Ichoronisn, Stability. Gyroscope- Gyroscopic effect, gyroscopic couple, gyroscopic effect on aero planes and naval ships. | | |
| **Unit IV** | **FUNDAMENTAL OF VIBRATION** | **09** |
| Introduction-Terminology, Classification, elements of vibration, free undamped vibration, Free Damped vibration (Viscus Damping) - Damping ratio and logarithmic decrement. Force damped vibration - Magnification factor. Vibration isolation and transmissibility. | | |
| **Unit V** | **TRANSVERSE AND TORSIONAL VIBRATION** | **09** |
| Transverse vibration of shafts and beams Shaft carrying several loads, whirling of shafts. Torsional vibration-effect of inertia on torsional vibration-Torsionally equivalent Shaft, single rotor, two rotor and three rotor system. | | |

**TEXT BOOK(S):**


1. S. S. Rattan, Theory of Machines, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2014.
2. John J Uichker and Joesph E. Shigley, Theory of Machines and Mechanism, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2005.


**REFERENCE(S):**


1. Ashok G Ambekar, Mechanism and Machine Theory, Prentice Hall of India, New Delhi, 2009.
2. R. L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2005.
3. Sadhu Singh, Theory of Machines, Prentice Hall of India, New Delhi, 2007.
4. R. L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2005.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester V | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME503 | HEAT AND MASS TRANSFER | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To impart the knowledge of conduction heat transfer mechanisms.
- To provide the knowledge on the principles of free and forced convection.
- To study the performance of various types of heat exchange.
- To impart the knowledge on black body radiation and grey body radiation.
- To learn about diffusion and convective mass transfer.

**Course Outcomes:** At the end of this course, learners will be able to:

- Apply the heat conduction equation to compute the rate of heat transfer in simple and composite systems
- Assess the convection phenomena and select appropriate correlation to determine the rate of heat transfer in free and forced convection
- Compare the thermal performance of various types of heat exchangers using LMTD and NTU
- approach
- Determine the rate of radiation heat transfer in black and grey bodies.
- Find the mass transfer rate in diffusion and convective mass transfer applications.

| Unit I | CONDUCTION | 11 |
|---|---|---|
| Basic concepts - Mechanism of Heat transfer. Conduction - Fourier's Law, General differential equation in Cartesian and cylindrical coordinates, one dimensional steady state heat conduction, conduction through plane wall, cylinders and spherical systems. Composite Systems. Extended surfaces. Transient heat conduction – Lumped systems, Infinite and semi-infinite solids, Use of Heisler charts. | | |
| **Unit II** | **CONVECTION** | **10** |
| Basic Concepts - Heat transfer coefficients, boundary layer concept. Types of convection – Forced convection, dimensional analysis, non-dimensional numbers, external flow, flow over plates, cylinders and spheres, internal flow, laminar and turbulent flow, combined laminar and turbulent. Free convection - Dimensional Analysis, flow over vertical plate, horizontal plate. | | |
| **Unit III** | **PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS** | **09** |
| Modes of boiling - Nusselt's theory of condensation, types of condensation - correlations in boiling and condensation. Heat exchangers - Types, heat exchanger analysis, fouling factor, LMTD (Logarithmic mean temperature difference) and Effectiveness - NTU (number of transfer units) Method - Overall Heat Transfer Coefficient. | | |
| **Unit IV** | **RADIATION** | **08** |
| Laws of Radiation- Stefan-Boltzmann Law, Kirchhoff's Law - Black body radiation - Grey body radiation - Shape factor algebra - Electrical analogy - Radiation shields. | | |
| **Unit V** | **MASS TRANSFER** | **07** |
| 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. | | |

**TEXT BOOK(S):**


1. R. C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age International private limited, New Delhi, 2010.
2. Yunus A.Cengel, Heat and Mass Transfer: a Practical Approach, Tata McGraw Hill publishing Company private limited, New Delhi, 2007.


**REFERENCE(S):**


1. J. P. Holman, Heat Transfer, Tata McGraw Hill publishing Company private limited, New Delhi, 2009.


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| | |
|---|---|
| 2. | C. P. Kothandaraman and S. Subramanyan, Fundamentals of Heat and Mass Transfer, New Age International private limited, New Delhi, 2014. |
| 3. | Frank P. Incropera, Fundamentals of Heat and Mass Transfer, John Wiley, New Delhi, 2007. |
| 4. | R. K. Rajput, Heat and Mass Transfer, S Chand and Company, New Delhi, 2009. |


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester V | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME504 | NON - DESTRUCTIVE TESTING | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To learn different surface inspection techniques.
- To provide knowledge on magnetic particle testing.
- To impart knowledge on ultrasonic testing method.
- To provide knowledge on radiography testing method.
- To study various special non destructive testing methods.

**Course Outcomes:** At the end of this course, learners will be able to:

- Select appropriate surface inspection techniques for the components to be inspected
- Explain the magnetic particle testing method for ferrous materials.
- Select and explain the suitable testing method for testing internal defects.
- Apply radiography testing methods for different suitable applications.
- Choose the suitable special non-destructive technique for various applications.

| Unit I | SURFACE TECHNIQUES | 09 |
|---|---|---|

Concepts of Non-Destructive testing (NDT) - Discontinuities and Defects in various manufacturing Component- Types of NDT techniques, Introduction to Standards and Specifications (ASME, ASTM, AWS) - Visual or Optical Testing, Direct and remote visual inspection and Aides-Liquid Penetrant Testing (LPT) Principles - Types and properties of liquid penetrants and developers - Preparation of test materials - Advantages and limitations - Application of penetrants to parts - Fluorescent penetrant test.

| Unit II | MAGNETIC PARTICLE TESTING | 09 |
|---|---|---|

Magnetic Particle Testing (MPT) Principles, applications - Magnetization methods, magnetic Particles, - Dry particle technique and Wet fluorescent particle technique, demagnetization, Advantages and limitations - Magnetic Flux Leakage Testing Principle, Instrumentation and applications - Electromagnetic Induction Techniques, Principle - Instrumentation and applications of Eddy Current Testing (ECT)

| Unit III | ULTRASONIC TESTING | 09 |
|---|---|---|

Ultrasonic Testing (UT) Principle, Types and characteristics of Ultrasonic waves, Attenuation, Couplants, Probes - Inspection methods-Pulse echo, Transmission and Phased Array techniques (PAUT) , Types of scanning and displays, Angle beam inspection of welds, Calibration of ASTM Test blocks, International Institute of Welding IIW) reference blocks, Applications.

| Unit IV | RADIOGRAPHY TESTING | 09 |
|---|---|---|

Radiographic testing (RT) Principle, Sources of X-rays and Gamma rays and their characteristics - Absorption, scattering-Filters and screens, imaging modalities - Film radiography and Digital Radiography - Problems in shadow formation, Exposure factors, film handling and storage Inverse square law, Exposure charts, and Radiographic equivalence. Penetrometers, Safety in radiography, Applications.

| Unit V | SPECIAL TECHNIQUES | 09 |
|---|---|---|

Acoustic Emission Testing (AET) Principle - Advantages and limitations - Instrumentation and applications - Infra Red Thermography (IRT), Contact and non-contact inspection methods, Pressure and Leak Testing - Testing Procedure and applications, LASER Shearography - Typical applications- Requirements - advantages and disadvantages.

**TEXT BOOK(S):**

1. Baldev Raj, Jayakumar T, Thavasimuthu M, Practical Non-Destructive Testing, Narosa Publishing, 1997.

**REFERENCE BOOK(S)**

1. Mc Gonnagle,Non-Destructive Testing, McGraw Hill Book Co., 1988
2. Barry Hull and Vernon John, Non Destructive Testing, Macmillan, 1989.
3. V-17, Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, 2001

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| LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS | | |
|---|---|---|
| **S. No** | **NAME OF THE EQUIPMENT** | **Qty.** |
| 1 | Cam follower setup. | 1 No. |
| 2 | Motorised gyroscope. | 1 No. |
| 3 | Governor apparatus - Watt, Porter, Proell and Hartnell governors. | 1 No |
| 4 | Whirling of shaft apparatus. | 1 No. |
| 5 | Dynamic balancing machine. | 1 No. |
| 6 | Two rotor vibration setup. | 1 No. |
| 7 | Spring mass vibration system. | 1 No. |
| 8 | Torsional Vibration of single rotor system setup. | 1 No. |
| 9 | Gear Models | 1 No. |
| 10 | Kinematic Models to study various mechanisms. | 1 No. |
| 11 | Turn table apparatus. | 1 No. |
| 12 | Transverse vibration setup of cantilever | 1 No. |
| 13 | Micrometer | 1 No. |
| 14 | Vernier Caliper | 1 No. |
| 15 | Vernier Height Gauge | 1 No. |
| 16 | Vernier depth Gauge | 1 No. |
| 17 | Slip Gauge Set | 1 No. |
| 18 | Gear Tooth Vernier | 1 No. |
| 19 | Sine Bar | 1 No. |
| 20 | Floating Carriage Micrometer | 1 No. |
| 21 | Profile Projector / Tool Makers Microscope | 1 No. |
| 22 | Mechanical / Electrical / Pneumatic Comparator | 1 No. |
| 23 | Autocollimator | 1 No. |
| 24 | Temperature Measuring Setup | 1 No. |
| 25 | Force Measuring Setup | 1 No. |
| 26 | Torque Measuring Setup | 1 No. |
| 27 | Surface finish measuring equipment | 1 No. |
| 28 | Bore gauge | 1 No. |
| 29 | Telescope gauge | 1 No. |

**Chairman - BoS**
**Dept. of Mech Engg. - ESEC**

| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | V |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME505 | DYNAMICS & METROLOGY AND MEASUREMENTS LABORATORY | 0 | 0 | 4 | 2 | 60 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To impart knowledge in dynamic analysis of simple mechanism and design of flywheel.
- To study the working principle of governor and gyroscope.
- To study the heat transfer phenomena of conduction
- To study the heat transfer phenomena predict the relevant coefficient using implementation
- To study the performance of refrigeration cycle / components

**Course Outcomes:** At the end of this course, learners will be able to:

- Perform dynamic analysis of simple mechanism and design of flywheel.
- Compute the range of speed for governor and gyroscopic effect of ship and aero plane
- Conduct tests on heat conduction apparatus and evaluate thermal conductivity of materials
- Conduct tests on natural and forced convection heat transfer apparatus and radiation apparatus
- Conduct tests to evaluate the performance of refrigeration and air-conditioning test rigs.

| Exp No. | Name of Experiments |
|---|---|
| 1 | Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains. |
| 2 | Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms. |
| 3 | a) Determination of Mass moment of inertia of Fly wheel and Axle system.<br>b)Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.<br>c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum. |
| 4 | Motorized gyroscope – Study of gyroscopic effect and couple. |
| 5 | Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors. |
| 6 | Cams – Cam profile drawing, Motion curves and study of jump phenomenon |
| 7 | a) Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination.<br>b) Multi degree freedom suspension system – Determination of influence coefficient. |
| 8 | a) Determination of torsional natural frequency of single and Double Rotor systems.- Undamped and Damped Natural frequencies.<br>b)Vibration Absorber – Tuned vibration absorber. |
| 9 | Vibration of Equivalent Spring mass system – undamped and damped vibration. |
| 10 | Whirling of shafts – Determination of critical speeds of shafts with concentrated loads. |
| 11 | a) Balancing of rotating masses. (b) Balancing of reciprocating masses |
| 12 | a) Transverse vibration of Free-Free beam – with and without concentrated masses.<br>b) Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.<br>c) Determination of transmissibility ratio using vibrating table. |
| 13 | Calibration and use of measuring instruments – Vernier caliper, micrometer, Vernier height gauge – using gauge blocks. |
| 14 | Calibration and use of measuring instruments – depth micrometer, bore gauge, telescopic gauge. |
| 15 | Measurement of linear dimensions using Comparators. |
| 16 | Measurement of angles using bevel protractor and sine bar. |
| 17 | Measurement of screw thread parameters – Screw thread Micrometers and Three wire method „(floating carriage micrometer). |
| 18 | Measurement of gear parameters – disc micrometers, gear tooth vernier caliper. |
| 19 | Non-contact (Optical) measurement using Toolmaker s microscope / Profile projector and Video measurement system. |
| 20 | Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments. |
| 21 | Machine tool metrology – Level tests using precision level; Testing of straightness of a machine tool guide way using Autocollimator, spindle tests. |
| 22 | Measurement of force, torque and temperature. |

Chairman - BOS
Dept. of Mech Engg. - ESEC

| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | V |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME506 | COMPUTER AIDED MODELLING LABORATORY | 0 | 0 | 2 | 1 | 30 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To provide knowledge and skills to draw orthographic projections of simple components using geometric modelling software.
- To impart knowledge for creating three dimensional assembly models of few automotive and machine components using CAD Software.
- To provide knowledge on generating 3D assembly models of few machine elements using CAD software.
- To provide knowledge on three dimensional model of simple mechanism and animation using CAD software.
- To expose the knowledge to prepare the technical documents for the given components using software.

**Course Outcomes:** At the end of this course, learners will be able to:

- Sketch the orthographic projections of simple components using geometric modeling software.
- Construct three dimensional assembly models of few automotive and machine components using CAD Software.
- Construct the three dimensional assembly models of machine elements using CAD software.
- Create the animation of simple mechanisms using CAD software.
- Prepare the technical documents for the given components using software.

| Exp No. | Name of Experiments |
|---|---|
| 1 | Create an orthographic view of machine components from the given isometric drawings. |
| 2 | Construct a three dimensional assembly model of bearing. |
| 3 | Generate a three dimensional shaft and coupling assembly model by considering tolerance in each Component. |
| 4 | Create a three dimensional assembly model of Piston and Connecting Rod. |
| 5 | Build a three dimensional assembly model of power drive system. |
| 6 | Create a three dimensional assembly model of two wheeler suspension system. |
| 7 | Construct a three dimensional assembly model of control valve. |
| 8 | Generate a three dimensional assembly model of Jig/fixture. |
| 9 | Create a three dimensional assembly model of simple mechanism and animate its working using modeling software. |
| 10 | Prepare technical documents for an I.C. Engine Assembly by using 3D Via software. |

| LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS | | |
|---|---|---|
| S. No | NAME OF THE EQUIPMENT | Qty. |
| 1 | Computer Server | 1 |
| 2 | Computer nodes or systems (High end CPU with atleast 1 GB main memory) networked to the server | 30 |
| 3 | A3 size plotter | 1 |
| 4 | Laser Printer | 1 |
| 5 | Any High end integrated modeling and manufacturing CAD / CAM software | 15 Licenses |
| 6 | Licensed operating system | Adequate |
| 7 | Support for CAPP | Adequate |

Chairman - BoS
Dept. of Mech Engg. - ESEC

| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | V |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours/Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19TP501 | QUANTITATIVE APTITUDE , LOGICAL REASONING & VERBAL ABILITY- IV | 0 | 0 | 2 | 0 | 30 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To develop strategies for vocabulary development.
- To expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values.
- To manage the time during each activity in their career

**Course Outcomes:** At the end of this course, learners will be able to:

- Calculate percentages in real life contexts , find any percentage of a given whole using their knowledge of fraction multiplication and increase / decrease a given whole by a percentage.
- Produce solutions the Ratio, Proportions and Variation.
- Identify the percentage gain or percentage loss.
- Improve their performance in the verbal ability sections of different competitive examinations.
- Manage the time for various activities in day to day life.

| UNIT 1 | PERCENTAGES & AVERAGES | 06 |
|---|---|---|

Introduction - definition and Utility of percentage - importance of base/denominator for percentage calculations - concept of percentage values through additions - fraction to percentage conversion table.
Introduction - average of different groups - addition or removal of items and change in average replacement of some of the items.

| UNIT 2 | RATIO, PROPORTIONS AND VARIATION & PROFIT AND LOSS | 06 |
|---|---|---|

Introduction- Ratio- properties-dividing a given number in the given ratio - comparison of ratios - proportions - useful results on proportion- continued proportion - relation among the quantities more than two – variation. Gain/Loss and percentage gain or percentage loss-multiplying equivalents to find sale price – relation among cost price, sale price, gain/loss and percentage gain or percentage loss - an article sold at two different selling price - two different articles sold at same selling price - percentage gain or percentage loss on selling price - percentage gain or percentage loss on whole property.

| UNIT 3 | TIME MANAGEMENT | 06 |
|---|---|---|

Time Management – Tips and strategies- Time wasters – Procrastination – Advantages of time management.

| UNIT 4 | GRAMMAR | 06 |
|---|---|---|

Passive voice, Reported Speech – Infinitives and Gerund,

| UNIT 5 | VERBAL REASONING – I | 06 |
|---|---|---|

Critical Reasoning - Cloze Test - One Word Substitution - Idioms and Phrases - Text Completion.

**REFERENCES:**


1. Murphy, Raymond. English in Use - A Self - study Reference and Practice Book for Intermediate Learners of English.IVed. United Kingdom: Cambridge University Press. 2012.
2. Lewis, Norman.Word Power Made Easy. New York: Pocket Books.1991.
3. Baron's The Official Guide for New GMAT Review 2015. New Jersey: John Wiley &Sons, Inc.
4. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd, 2012
5. Arun Sharma, How to prepare for Data Interpretation for the CAT, First Edition, Tata McGraw-Hill Publishing Company Ltd, 2012.
6. Dr.R S Aggarwal, Quantitative Aptitude, Seventh Revised Edition, S.Chand Publishing Company Ltd, 2013.
7. Arun Sharma, How to prepare for Quantitative Aptitude for the CAT, Fifth Edition, Tata McGraw-Hill Publishing Company Ltd, 2013


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | V |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19HS501 | CAREER SKILLS | 0 | 0 | 2 | 1 | 30 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To encourage the students to comprehend the knowledge acquired from the first Semester to Sixth Semester of B.E Degree Course through periodic exercise.

**Course Outcomes:** At the end of this course, learners will be able to:

- Understand and comprehend any given problem related to mechanical engineering field.

**METHOD OF EVALUATION:**

The students will be assessed 100% internally through weekly test with objective type questions on all the subject related topics

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | VI |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME601 | DESIGN OF TRANSMISSION SYSTEMS | 3 | 1 | 0 | 4 | 60 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To study the design procedure of belt and rope drives.
- To learn the design procedure of spur and helical gear drives.
- To learn the design procedure of bevel and worm gear drives.
- To study the design procedure of multi stage gear box.
- To familiarize the students for design of I.C engine components.

**Course Outcomes:** At the end of this course, learners will be able to:

- Design of belt and rope drives
- Design of spur and helical gear drives.
  Design of bevel and worm gear drives.
- Draw the kinematic and ray diagrams for multi stage gear boxes.
- Design of Ratchet & Pawl, Geneva mechanisms and I.C. Engine Components.

| Unit I | DESIGN OF FLEXIBLE ELEMENTS | 15 |
|---|---|---|

Need for power transmission - Types and classification of transmission systems, Applications, Limitations. Belt drives - Types, materials and construction, Selection of flat and V-belts from manufacturer's catalogue. Wire Ropes- Construction, Rope lay, Stresses in wire rope, Failure of ropes

| Unit II | DESIGN OF SPUR AND HELICAL GEARS | 10 |
|---|---|---|

Spur and Helical gears- Introduction, Gear design, Force analysis, Tooth stresses - Beam strength calculation - Failure in gears.

| Unit III | DESIGN OF BEVEL AND WORM GEARS | 15 |
|---|---|---|

Bevel Gear- Introduction, Types, Geometry, Angle relations, Basic dimensions, Force analysis. Worm Gear - Introduction, Types, Geometry, Basic dimensions - Forces on worm and worm wheel - Mode of failures - Efficiency - Heat removal calculations.

| Unit IV | DESIGN OF GEAR BOXES | 10 |
|---|---|---|

Gear Box - Geometric progression - Standard step ratio - Ray diagram - Kinematics layout. Design of multi stage gear boxes, Calculation of number of teeth and overlapping speed.

| Unit V | DESIGN OF MECHANISMS AND I.C. ENGINE MACHINE COMPONENTS | 10 |
|---|---|---|

Design of Ratchet & pawl mechanism and Geneva mechanism Design of IC engine components such Geneva as piston, connecting rod and crank shaft.

**TEXT BOOK(S):**


1. V. B. Bhandari, Design of Machine Elements, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, 2010.
2. R. L. Norton, Design of Machinery, Fifth Edition, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2011.


**REFERENCE(S):**


1. B. J. Hamrock, B. Jacobson and S. R. Schmid, Fundamentals of Machine Elements, Third Edition, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2014.
2. T. J. Prabhu, Design of Transmission Elements, Mani Offset, Chennai, 2008.
3. S. G. Kulkarni, Machine Design, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2010.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | VI |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME602 | GAS DYNAMICS AND JET PROPULSION | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To understand the fundamental principles of compressible flow.
- To resolve the problems on isentropic flow through variable area ducts, Fanno flow and Rayleigh flow.
- To understand the effect of flow properties on normal shock.
- To apply the basic gas dynamics theories for aircraft Propulsion systems.
- To describe the working of solid propellant and liquid propellant rocket engines

**Course Outcomes:** At the end of this course, learners will be able to:

- Illustrate the fundamental principles of compressible flow.
- Resolve the problems on isentropic flow through variable area ducts, Fanno flow and Rayleigh flow.
- Interpret the effect of flow properties on normal shock.
- Explain the basic gas dynamics theories for aircraft propulsion systems.
- Demonstrate the working of solid propellant and liquid propellant rocket engines

| Unit I | COMPRESSIBLE FLOW FUNDAMENTALS | 09 |
|---|---|---|

Introduction to compressible flow - Integral and differential forms of conservation equations, velocity of sound, Mach number, various regimes of flow, wave propagation, Mach cone and Mach angle- Stagnation state - stagnation enthalpy, stagnation temperature, stagnation pressure and stagnation density - critical state - reference velocities, reference Mach number. Effect of Mach number on compressibility.

| Unit II | FLOW THROUGH VARIABLE AREA DUCTS | 09 |
|---|---|---|

Isentropic flow through variable area ducts - effect of area change on flow parameters, area ratio as a function of Mach number, impulse function, mass flow rate equations, chocking flow, effect of back pressure on performance of convergent and De lavel nozzle.

| Unit III | FLOW THROUGH CONSTANT AREA DUCTS | 09 |
|---|---|---|

Flow in constant area ducts with friction (Fanno flow) Governing equations, fanno curves and Fanno flow equations, variation of flow properties, variation of Mach number with duct length. Flow in constant area ducts with simple stagnation temperature change (Rayleigh Flow) - Governing equations,Rayleigh line and Rayleigh flow equation, variation of flow properties, maximum heat ransfer in Rayleigh flow.

| Unit iV | FLOW WITH NORMAL SHOCK | 09 |
|---|---|---|

Governing equations - variation of flow properties like static pressure, static temperature, density, stagnation pressure and entropy across the normal shock - Prandtl equation - Rankine Hugonoit equation. Impossibility of shock in subsonic flows, flow in convergent and divergent nozzle with normal shock - normal shock in Fanno and Rayleigh flows.

| Unit V | AIRCRAFT AND ROCKET PROPULSION | 09 |
|---|---|---|

Aircraft propulsion - types of jet engines, energy flow through jet engines. Performance of turbo jet engines - thrust, thrust power, propulsive and overall efficiencies - thrust augmentation in turbo jet engine. Ram jet, Scram jet and Pulse jet engines. Rocket Propulsion - Classification of rocket engines. Propellants - solid, liquid and hybrid propellants, rocket engines thrust equation, effective jet velocity,specific impulse. Rocket engine performance.

**TEXT BOOK(S):**


1. Patrick H. Oosthuizen and William E. Carscallen, Introduction to Compressible Fluid Flow, 2nd edition, CRC Press, Taylor & Francis Group, Florida, 2013.
2. Robert D. Zucker, Fundamentals of Gas Dynamics, 2nd edition, John Wiley & Sons Inc., New York, 2002.


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| REFERENCE(S): | |
|---|---|
| 1. | H.I.H. Saravanamuttoo, G.F.C. Rogers, H. Cohen and P.V. Straznicky, Gas Turbine Theory, 6th edition, Pearson Education, 2009. |
| 2. | George P. Sutton and Oscar Biblarz, Rocket Propulsion Elements, 8th edition, John Wiley & Sons Inc., New York, 2010. |
| 3. | S. M. Yahya, Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion, 4th edition, New Age International private Limited, 2014. |
| 4. | E. Rathakrishnan, Gas Dynamics, 5th edition, PHI Learning Private Limited, 2013. |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester VI | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME603 | FINITE ELEMENT ANALYSIS | 3 | 0 | 0 | 3 | 60 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To impart basic knowledge in finite element method.
- To provide knowledge in 1D elements.
- To provide knowledge in 2D elements.
- To study heat conduction problems using finite element method.
- To provide knowledge on higher order and iso parametric elements.

**Course Outcomes:** At the end of this course, learners will be able to:

- Apply the numerical methods to formulate the simple finite element problems.
- Apply one dimensional finite element method to solve bar, beam and truss type problems.
- Apply finite element method for plane stress, plane strain and axisymmetric conditions.
- Determine temperature distribution of one and two dimensional heat transfer problems using one and two
- dimensional finite elements.
- Apply the numerical methods to formulate the higher order and isoperimetric problems.

| Unit I | INTRODUCTION | 09 |
|---|---|---|
| Relevance and scope of finite element methods - strain vs displacement relations - stresses and equilibrium - natural and essential boundary conditions - Rayleigh Ritz - Galerkin method- FEM procedure - Discretisation of domain-element shapes, types, size, location and numbers. | | |
| **Unit II** | **ONE-DIMENSIONAL (1D) ELEMENTS** | **09** |
| Coordinate system types-global, local and natural. shape function of 1D bar element -Finite element formulation - stiffness matrix, load vector, boundry condition and assembly of global equation-1D bar element and two node truss element- problems in 2D truss. Introduction to beam element. | | |
| **Unit III** | **TWO-DIMENSIONAL (2D) ELEMENTS** | **09** |
| Shape function for linear triangular element-Finite element formulation- Constant Strain Triangular (CST) element -plane stress, plane strain - axisymmetric elements - problems. | | |
| **Unit IV** | **HEAT TRANSFER APPLICATIONS** | **09** |
| Shape function for 1D and 2D triangular element heat conduction - stiffness matrix, load vector and assembly of global equation for 1D and 2D triangular element heat conduction, heat generation with convective boundary conditions for linear element. | | |
| **Unit V** | **HIGHER ORDER AND ISOPARAMETRIC ELEMENT** | **09** |
| Selection of order of polynomial-linear, simplex, complex and multiplex elements. Mesh refinement methods and convergence requirements. Iso, Sub and Super parametric element. Shape functions for a 2-D four nodded and eight nodded Isoparametric rectangular element using natural coordinate system - problems. Gaussian quadrature method-problems. | | |

**REFERENCE(S):**


1. S. S. Rao, Finite Element Method in Engineering, Elsevier India, 2005.
2. David V. Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi,2005.
3. Robert D. Cook, s. David , Malkucs Michael E. Plesha, Concepts and Applications of Finite Element Analysis, John Wiley, New Delhi,2007
4. T. R. Chandrupatla and A. D. Belegundu, Introduction to Finite Elements Engineering, Pearson Education, New Delhi, 2002.
5. S. S. Bhavikati, Finite Element Analysis, New Age International Publishers, 2015.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester VI | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME604 | COMPUTER AIDED ANALYSIS LABORATORY | 0 | 0 | 2 | 1 | 30 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To introduce knowledge on the FEA software as a tool for truss and beam analysis
- To provide knowledge on applications having plane stress, plane strain and axisymetric conditions using FEA software.
- To impart knowledge in dynamic analysis using FEA software.
- To learn about temperature distribution for heat conduction using FEA software.
- To impart knowledge on coupled field analysis using FEA software.

**Course Outcomes:** At the end of this course, learners will be able to:

- Analysis of trusses and beams using FEA software.
- Apply plane stress, plane strain and axisymetric conditions using FEA software.
- Dynamic analysis of simple structure using FEA software.
- Find temperature distribution for heat conduction using FEA software.
- Thermo-mechanical analysis of simple structure using FEA software.

| Exp No. | Name of Experiments |
|---|---|
| 1 | Structural analysis of simple and composite trusses. |
| 2 | Structural analysis of cantilever beam, simply supported beam and fixed beam under different boundary conditions. |
| 3 | Stress analysis of a simple machine element. |
| 4 | Stress analysis under plane strain condition. |
| 5 | Stress analysis of pressure vessel subjected to an internal pressure |
| 6 | Dynamic analysis of a rotating shaft subjected to twisting moment. |
| 7 | Modal analysis of Cantilever, Simply supported and Fixed beams under different boundary conditions. |
| 8 | Harmonic analysis of Cantilever, Simply supported and Fixed beams under different boundary conditions. |
| 9 | Heat transfer analysis of 2D and 3D components under different boundary conditions. |
| 10 | Coupled field analysis. |

| LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS | | |
|---|---|---|
| S. No | NAME OF THE EQUIPMENT | Qty. |
| 1 | Computer Work Station | 15 |
| 2 | Color Desk Jet Printer | 01 |
| 3 | Multibody Dynamic Software Suitable for Mechanism simulation and analysis | 15 licenses |
| 4 | C / MATLAB | 5 licenses |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester VI | PC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME605 | HEAT TRANSFER LABORATORY | 0 | 0 | 2 | 1 | 30 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To study the heat transfer phenomena of conduction
- To study the heat transfer phenomena predict the relevant coefficient using implementation
- To study the performance of refrigeration cycle / components

**Course Outcomes:** At the end of this course, learners will be able to:

- Conduct tests on heat conduction apparatus and evaluate thermal conductivity of materials
- Conduct tests on natural and forced convection heat transfer apparatus and radiation apparatus
- Conduct tests to evaluate the performance of refrigeration and air-conditioning test rigs

| Exp No. | Name of Experiments |
|---|---|
| 1 | Guarded plate apparatus |
| 2 | Lagged pipe apparatus |
| 3 | Natural convection-vertical cylinder apparatus |
| 4 | Forced convection inside tube apparatus |
| 5 | Composite wall apparatus |
| 6 | Thermal conductivity of insulating powder apparatus |
| 7 | Pin-fin apparatus |
| 8 | Stefan-Boltzmann apparatus |
| 9 | Emissivity measurement apparatus |
| 10 | Parallel/counter flow heat exchanger apparatus |

| LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS | | |
|---|---|---|
| S. No | NAME OF THE EQUIPMENT | Qty. |
| 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 | Composite wall apparatus | 1 No. |
| 6 | Thermal conductivity of insulating powder apparatus | 1 No. |
| 7 | Pin-fin apparatus | 1 No. |
| 8 | Stefan-Boltzmann apparatus | 1 No. |
| 9 | Emissivity measurement apparatus | 1 No. |
| 10 | Parallel/counter flow heat exchanger apparatus | 1 No. |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester VI | EEC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME606 | MINI PROJECT | 0 | 0 | 2 | 1 | 30 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To develop skills to formulate a technical project.
- To give guidance on the various tasks of the project and standard procedures.
- To teach use of new tools, algorithms and techniques required to carry out the projects.
- To give guidance on the various procedures for validation of the product and analyse the cost effectiveness
- To provide guidelines to prepare technical report of the project.

**Course Outcomes:** At the end of this course, learners will be able to:

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies.
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- Design and Fabricate the prototype and analysis the cost- effectiveness.
- Prepare report and present oral demonstrations

**Methodology of the Project work:**

- The student will identify and select a problem based on comprehensive literature survey.
- The student should submit a proposal and get it approved by the Head of the department.
- Three reviews will be conducted by Project review committee.
- Students will be evaluated by the committee during the review and suggestions will be offered by members.

The report for Mini-project has to be submitted by the students at the end of the semester for assessment.

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester VI | EEC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME607 | COMPREHENSIVE REVIEW | 0 | 0 | 2 | 0 | 30 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To encourage the students to comprehend the knowledge acquired from the first Semester to Sixth Semester of B.E Degree Course through periodic exercise.

**Course Outcomes:** At the end of this course, learners will be able to:

- Understand and comprehend any given problem related to mechanical engineering field.

**METHOD OF EVALUATION:**
The students will be assessed 100% internally through weekly test with objective type questions on all the subject related topics

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester VI | EEC |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours/Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19TP601 | QUATITAIVE APTITUDE ,LOGICAL REASONING AND RECRUITMENT PROCESS | 0 | 0 | 2 | 0 | 30 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To read and understand the unseen passages with appropriate speed.
- To effectively deal with different kinds of structures
- To expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values.

**Course Outcomes:** At the end of this course, learners will be able to:

- Demonstrate the situations like motion in as straight line , Boats and Streams , Trains, Races and clocks
- Differentiate Pipes and Cisterns
- Evaluate the Counting techniques, Permutation and Combination, Recursion and generating functions
- Categorize the distributions of probability with respect to the random variables
- Improve the vocabulary and the way of communication.
- Handle and manage the different difficult situations.

| UNIT I | TIME AND WORK & PERMUTATION AND COMBINATION | 06 |
|---|---|---|

Introduction - Basic concepts -Concepts on working with different efficiency - Pipes and Cisterns – Work Equivalence (Man Days) -Alternative approach. Definition - Fundamental rules - Theorems on Permutation - Theorems on Combination.

| UNIT II | TIME, SPEED AND DISTANCE & PROBABILITY | 06 |
|---|---|---|

Definition - Basics of Time, Speed and Distance - Relative speed - Problems based on Trains? Problems based on Boats and Streams -Problems based on Races - time taken with two difference modes of transport - time and distance between two moving bodies. Concept and importance of probability - underlying factors for Real-Life estimation of probability - Basic facts about probability - some important consideration while defining event.

| UNIT III | MANAGEMENT SKILLS | 06 |
|---|---|---|

Stress management – Management of various forms of fear (examination fear, stage fear and public speaking fear).

| UNIT IV | GRAMMAR – SENTENCES | 06 |
|---|---|---|

Sentence Formation - Sentence Correction - Sentence Improvement - Completing Statements - Sequencing of Sentences

| UNIT V | VERBAL REASONING – II | 06 |
|---|---|---|

Paragraph Formation - Instructions - Change of Voice - Change of Speech - Reading Comprehension - Sentence Equivalence

**REFERENCES:**


1. Murphy, Raymond. English in Use - A Self - study Reference and Practice Book for Intermediate Learners of English.IVed. United Kingdom: Cambridge University Press. 2012.
2. Lewis, Norman.Word Power Made Easy. New York: Pocket Books.1991.
3. Baron's The Official Guide for New GMAT Review 2015. New Jersey: John Wiley &Sons, Inc.
4. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd, 2012
5. Arun Sharma, How to prepare for Data Interpretation for the CAT, First Edition, Tata McGraw-Hill Publishing Company Ltd, 2012.
6. Dr.R S Aggarwal, Quantitative Aptitude, Seventh Revised Edition, S.Chand Publishing Company Ltd, 2013.
7. Arun Sharma, How to prepare for Quantitative Aptitude for the CAT, Fifth Edition, Tata McGraw-Hill Publishing Company Ltd, 2013


Chairman - BoS
Dept. of Mech Engg. - ESEC

| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | VII |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ES701 | ENGINEERING ECONOMICS | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To introduce the concepts of micro, macroeconomic systems and business decisions in organizations.
- To acquire knowledge on laws of demand & supply and methods of forecasting the demand
- To emphasis the systematic evaluation of the costs, breakeven point for return on economics and diseconomies
- To acquaint in pricing methods, payback and competition in modern market structure
- To obtain knowledge on macro economics, various taxes and financial accounting procedures

**Course Outcomes:** At the end of this course, learners will be able to:

- Explain the micro economic environment for creating a favourable business environment.
- Make use of the major concepts and techniques of engineering economic analysis in real time applications.
- Compare the cost of multiple projects by using the methods learned, and make a quantitative decision between alternate facilities and/or systems.
- Apply the appropriate engineering economics analysis method(s) for problem solving: present worth, annual cost, rate-of-return, payback, break-even, benefit-cost ratio.
- Examine and evaluate the issues in macro-economic analysis.

| Unit I | INTRODUCTION | 09 |
|---|---|---|
| Introduction to Micro and Macro economics - Kinds of Economic Systems - Production Possibility Frontier - Opportunity Cost - Objective of Organizations - Kinds of Organization | | |
| **Unit II** | **DEMAND AND SUPPLY** | **09** |
| Functions of Demand and Supply - Law of diminishing Marginal Utility - Law of Demand and Supply - Elasticity of Demand - Demand Forecasting Methods - Indifference curve. | | |
| **Unit III** | **PRODUCTION AND COST** | **09** |
| Production Function - Returns to Scale - Law of Variable Proportion - Cost and Revenue concepts and Cost Curves - Revenue curves - Economies and Dis-economies of scale - Break Even point. | | |
| **Unit IV** | **MARKET STRUCTURE** | **09** |
| Market Structure - Perfect Competition - Monopoly - Monopolistic - Oligopoly - Components of Pricing - Methods of Pricing - Capital Budgeting IRR - ARR - NPV - Return on Investment – Payback Period. | | |
| **Unit V** | **INTRODUCTION TO MACRO ECONOMICS AND FINANCIAL ACCOUNTING** | **09** |
| National Income - Calculation Methods - Problems - Inflation - Deflation - Business Cycle - Taxes - Direct and Indirect Taxes - Fiscal and monetary policies. | | |

**TEXT BOOK(S):**


1. A Ramachandra Aryasri and V V Ramana Murthy, Engineering Economics and Financial Accounting, Tata McGraw Hill Publishing Company Limited, New Delhi, 2006.
2. V L Samuel Paul and G S Gupta,Managerial Economics Concepts and Cases, Tata McGraw Hill Publishing Company Limited, New Delhi, 1981.


**REFERENCE(S):**


1. R Kesavan, C Elanchezhian and T Sunder Selwyn, Engineering Economics and Financial Accounting, Laxmi Publication (P) Ltd, New Delhi, 2005.
2. S N Maheswari, Financial and Management Accounting, Sultan Chand Publications
3. V L Samuel Paul and G S Gupta, Managerial Economics-Concepts and Cases


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | VII |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME701 | MECHATRONICS | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To introduce the concept and working of sensors used in mechatronic system.
- To study different types of actuators used in mechatronic system.
- To provide knowledge on feedback mechanism for improving the reliability of mechatronic system.
- To impart knowledge on working of microcontroller in mechatronic systems
- To learn the Programmable Logic Controller (PLC) used in mechatronic systems

**Course Outcomes:** At the end of this course, learners will be able to:

- Select the different types of sensor for various mechatronics applications.
- Identify suitable actuator used in mechatronic system.
- Design a feedback controller for mechatronics system.
- Develop a controller using the microcontroller for mechatronic system.
- Write a program for PLC used in mechatronic systems

| Unit I | SENSORS | 08 |
|---|---|---|
| Components of mechatronics system, Sensor - terminology and Mathematical equation - Potentiometer, Linear Variable differential transformer, strain gauge, Piezoelectric sensor, Optical encoder, Hall effect sensor, Thermistor, Thermo-couple, Light sensor. | | |
| **Unit II** | **ACTUATOR** | **10** |
| Terminology, mathematical equation of Mechanical Actuation system - cam, gear, belt & chain, Ball screw, Mechanical aspects of motor selection. Pneumatic & hydraulic Actuation system. Electrical actuation system -lay & solenoid, working & control of Brush & brushless DC motor, working &control of Stepper & servo motor. | | |
| **Unit III** | **FEEDBACK CONTROL** | **11** |
| Transfer Function, Mathematical Modeling of Mechanical & Electrical system, Electrical analogy, Electro-mechanical system, First order system, second order system, Proportional control, derivative control, Integral control, PID control, Controller tuning, Concept of stability. | | |
| **Unit IV** | **MICROCONTROLLER** | **09** |
| Architecture of 8051- I/O Pins, Ports and Circuits, memory, counter, Timer, Interrupt, Instruction set- Moving data, Logical , arithmetic operation, Jump & call instruction, LCD & Keyboard Interfacing. Examples -Windscreen wiper motion, Car engine management. | | |
| **Unit V** | **PROGRAMMABLE LOGIC CONTROLLER** | **07** |
| Basic Structure - Input / Output Processing - Programming - Mnemonics - Timers, Internal relays and counters - Shift Registers - Master and Jump Controls - Data Handling - Analogue Input / Output - Selection of PLC. Examples -Pick and place robot. Car park barrier system. | | |

**TEXT BOOK(S):**


1. W. Bolton, Mechatronics, Pearson Education, New Delhi, 2012.
2. Godfrey Onwubolu, Mechatronics: Principles and Applications Butterworth-Heinemann Ltd, 2005.


**REFERENCE(S):**


1. Nitaigour Premchand Mahalik, Mechatronics : Principles, Concepts and Applications, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2008
2. Krishna Kant, Microprocessors & Microcontrollers, Prentice Hall of India, 2007.
3. K. P. Ramachandran, G. K. Vijayaraghavan, and M. S. Bala-Sundram, Mechatronics: Integrated Mechanical Electronic Systems, Wiley India Pvt. Ltd., New Delhi 2008.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | VII |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ES702 | RESEARCH METHODOLOGY | 2 | 2 | 0 | 4 | 60 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To impart scientific, statistical and analytical knowledge for carrying out research work effectively.

**Course Outcomes:** At the end of this course, learners will be able to:

- Get knowledge about the purpose, need and techniques of research.
- Get knowledge about the experimental design concepts.
- Get knowledge about the various method of data collection.
- Get knowledge about the statistical techniques.
- Get knowledge about the report writing of research work.

| Unit I | INTRODUCTION TO RESEARCH | 12 |
|---|---|---|

The hallmarks of scientific research – Building blocks of science in research – Concept of Applied and Basic research – Quantitative and Qualitative Research Techniques – Need for theoretical frame work – Hypothesis development – Hypothesis testing with quantitative data. Research design – Purpose of the study: Exploratory, Descriptive, Hypothesis Testing.

| Unit II | EXPERIMENTAL DESIGN | 12 |
|---|---|---|

Laboratory and the Field Experiment – Internal and External Validity – Factors affecting Internal validity. Measurement of variables – Scales and measurements of variables. Developing scales – Rating scale and attitudinal scales – Validity testing of scales – Reliability concept in scales being developed – Stability Measures.

| Unit III | DATA COLLECTION METHODS | 12 |
|---|---|---|

Interviewing, Questionnaires, etc. Secondary sources of data collection. Guidelines for Questionnaire Design – Electronic Questionnaire Design and Surveys. Special Data Sources: Focus Groups, Static and Dynamic panels. Review of Advantages and Disadvantages of various Data-Collection Methods and their utility. Sampling Techniques – Probabilistic and nonprobabilistic samples. Issues of Precision and Confidence in determining Sample Size. Hypothesis testing, Determination of Optimal sample size

| Unit IV | MULTIVARIATE STATISTICAL TECHNIQUES | 12 |
|---|---|---|

Data Analysis – Factor Analysis – Culster Analysis -Discriminant Analysis – Multiple Regression and Correlation – Canonical Correlation – Application of Statistical(SPSS) Software Package in Research.

| Unit V | RESEARCH REPORT | 12 |
|---|---|---|

Purpose of the written report – Concept of audience – Basics of written reports. Integral parts of a report – Title of a report, Table of contents, Abstract, Synopsis, Introduction, Body of a report – Experimental, Results and Discussion – Recommendations and Implementation section – Conclusions and Scope for future work.

**REFERENCE(S):**


1. C.R.Kothari, Research Methodology, WishvaPrakashan, New Delhi, 2001.
2. Donald H.McBurney, Research Methods, Thomson Asia Pvt. Ltd. Singapore, 2002


**REFERENCE(S):**


1. Donald R. Cooper and Ramela S. Schindler, Business Research Methods, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2000
2. G.W.Ticehurst and A.J.Veal, Business Research Methods, Longman, 1999.
3. Ranjit Kumar, Research Methodology, Sage Publications, London, New Delhi, 1999.
4. Raymond-Alain Thiet tart, et.al., Doing Management Research, Sage Publications, London, 1999


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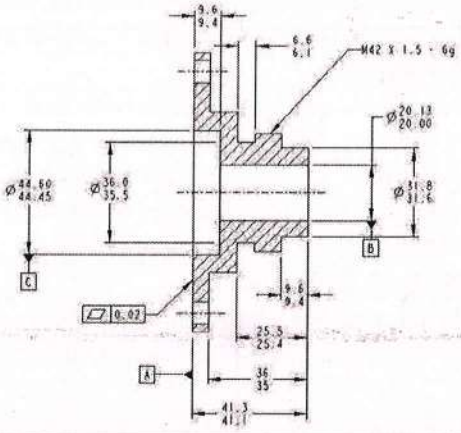
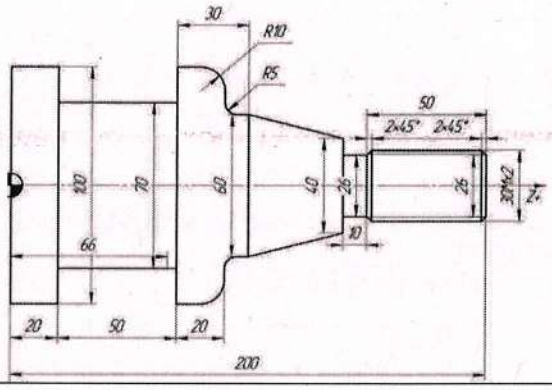
| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | VII |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME702 | COMPUTER AIDED MANUFACTURING LABORATORY | 0 | 0 | 2 | 1 | 30 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To provide knowledge on modeling and creating tool path of machine components using computer aided manufacturing software.
- To impart part programming knowledge on CNC lathe.
- To expose part programming knowledge on CNC milling machine.
- To study the working of wire cut EDM for cutting various shapes.
- To impart knowledge on developing the prototype by additive manufacturing process.

**Course Outcomes:** At the end of this course, learners will be able to:

- Formulate the tool path for circular and prismatic parts using machining programs.
- Create the part program for the machining component using CNC lathe.
- Create the part program for the machining component using CNC milling.
- Demonstrate the the wire cut EDM for producing intricate shapes.
- Demonstrate the component using additive manufacturing process.

| Exp No. | Name of Experiments |
|---|---|
| 1. | To make a protected type fanged coupling to transmit the power from dia20mm shaft.  |
| 2. | To manufacture a following component as shown below.  |

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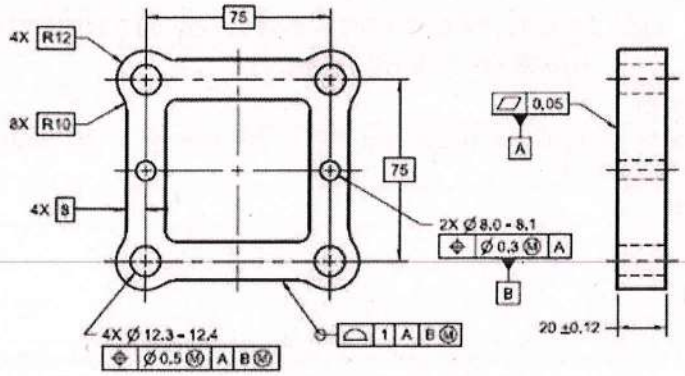
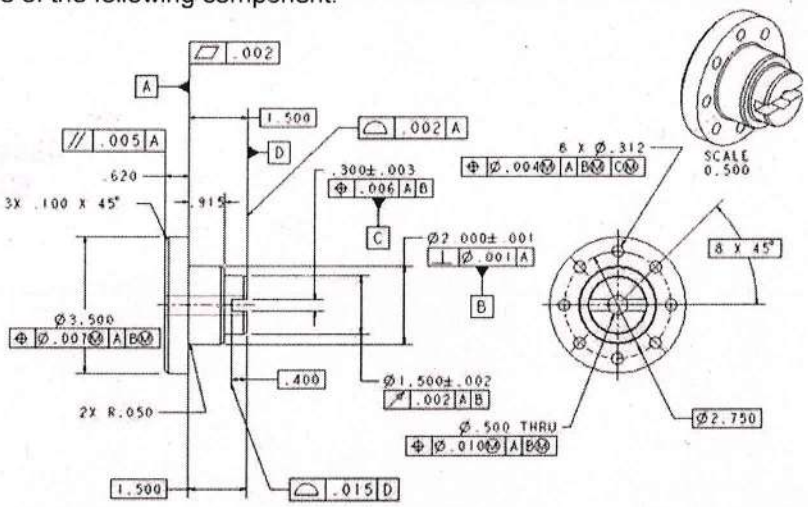
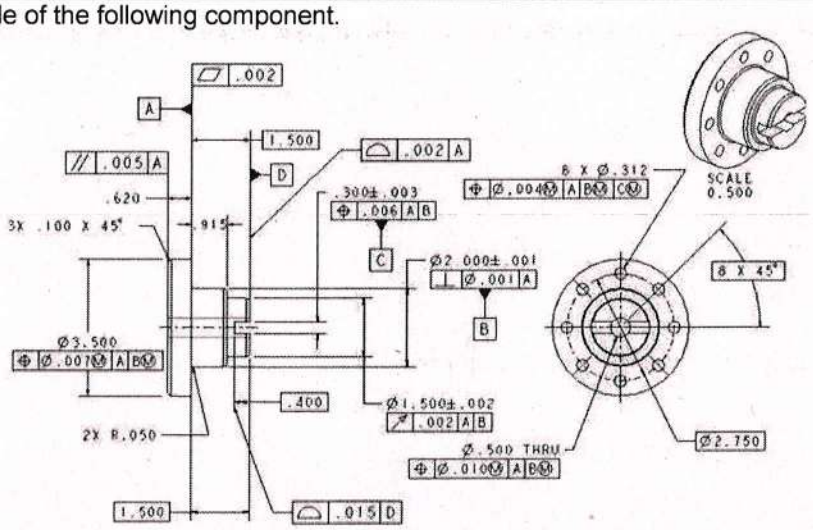
| | |
|---|---|
| 3. | To fabricate a stand as shown in figure.<br>  <br> |
| 4. | To machine a logo of Erode Sengunthar Engineering College. |
| 5. | To make a profile of the following component.<br>  <br> |
| 6. | To make a profile of the following component.<br>  <br> |
| 7. | Exercise on reverse engineering of pump impeller using 3D scanner and printer |

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| | |
|---|---|
| 8. | Redesign and make an extruder assembly of a 3D printer to hold three filaments using design for Additive manufacturing principles. |

| LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS | | |
|---|---|---|
| **S. No** | **NAME OF THE EQUIPMENT** | **Qty.** |
| 1 | Computer Server | 1 |
| 2 | Computer nodes or systems (High end CPU with atleast 1 GB main memory) networked to the server | 30 |
| 3 | A3 size plotter | 1 |
| 4 | Laser Printer | 1 |
| 5 | CNC Lathe | 1 |
| 6 | CNC milling machine | 1 |
| 7 | Any High end integrated modeling and manufacturing CAD / CAM software | 15 Licenses |
| 8 | CAM Software for machining centre and turning centre | 15 Licenses |
| 9 | Licensed operating system | Adequate |
| 10 | Support for CAPP | Adequate |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | VII |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME703 | MECHATRONICS LABORATORY | 0 | 0 | 2 | 1 | 30 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To impart knowledge on modeling and simulation of mechatronics system.
- To provide knowledge on design of fluid power circuit in mechatronic system.
- To understand the working of microcontroller and PLC in mechatronic systems through Experiments.
- To expose knowledge on force, acceleration and displacement measurements.
- To gain the knowledge for controlling the position, velocity and force in mechatronics system.

**Course Outcomes:** At the end of this course, learners will be able to:

- Developmathematical model of mechatronics system.
- Simulate fluid power circuit using Simulation software.
- Develop mechatronics system using microcontroller & PLC.
- Measure the force, acceleration and displacement of a system using microcontroller program.
- Control the position, velocity and force of mechatronics system.

| Exp No. | Name of Experiments |
|---|---|
| 1 | Modeling and simulation of mechatronics system using MATLAB. |
| 2 | Modeling and design of PID controller for Mechatronics system. |
| 3 | Study and simulation of various hydraulic and pneumatic components using FLUIDSIM software. |
| 4 | Design and testing of fluid power circuits for automatic opening and closing for doors and to control its velocity and direction. |
| 5 | Position and speed control of DC Motor using Microcontroller Board |
| 6 | Speed control of Stepper Motor using Microcontroller Interface Board |
| 7 | Measurement of force, acceleration and displacement using Virtual instrumentation. |
| 8 | Design of Programmable logic Controller based timer controller for multiple pneumatic cylinder Sequencing in assembly operations. |
| 9 | Position and velocity control of pick and place robot arm for loading and unloading Application using Robot Programming language. |
| 10 | Measurement and control of temperature of an application using Virtual instrumentation |

| REFERENCE(S): | |
|---|---|
| 1. | W. Bolton, Mechatronics, Pearson Education, New Delhi, 2012. |
| 2. | Godfrey Onwubolu, Mechatronics: Principles and Applications Butterworth-Heinemann Ltd,2005. |

| REFERENCE(S): | |
|---|---|
| 1. | Nitaigour Premchand Mahalik, Mechatronics : Principles, Concepts and Applications, TataMcGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2008 |
| 2. | Krishna Kant, Microprocessors & Microcontrollers, Prentice Hall of India, 2007. |
| 3. | K. P. Ramachandran, G. K. Vijayaraghavan, and M. S. Bala-Sundram, Mechatronics: Integrated Mechanical Electronic Systems, Wiley India Pvt. Ltd., New Delhi 2008. |

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| LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS | | |
|---|---|---|
| **S. No** | **NAME OF THE EQUIPMENT** | **Qty.** |
| 1 | Basic Pneumatic Trainer Kit with manual and electrical controls/ PLC Control each | 1 |
| 2 | Basic Hydraulic Trainer Kit | 1 |
| 3 | Hydraulics and Pneumatics Systems Simulation Software | 10 |
| 4 | 8051 - Microcontroller kit with stepper motor and drive circuit sets | 2 |
| 5 | Image processing system with hardware & software | 1 |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | VII |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME704 | PROJECT WORK PHASE I | 0 | 0 | 2 | 1 | 30 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To develop skills to formulate a technical project.
- To give guidance on the various tasks of the project and standard procedures.
- To teach use of new tools, algorithms and techniques required to carry out the projects.
- To give guidance on the various procedures for validation of the product and analyse the cost effectiveness.
- To provide guidelines to prepare technical report of the project.

**Course Outcomes:** At the end of this course, learners will be able to:

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies.
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
- Prepare technical report and oral presentations.

**Methodology of the Project work:**

- The student will identify and select a problem based on comprehensive literature survey.
- The student should submit a proposal and get it approved by the Head of the department.
- Three reviews will be conducted by Project review committee.
- Students will be evaluated by the committee during the review and suggestions will be offered by members.

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | VIII |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19ME801 | PROJECT WORK PHASE II | 0 | 0 | 0 | 6 | 90 | 100 | |

**Course Objective (s):** The purpose of learning this course is

- To develop skills to formulate a technical project.
- To give guidance on the various tasks of the project and standard procedures.
- To teach use of new tools, algorithms and techniques required to carry out the projects.
- To give guidance on the various procedures for validation of the product and analyse the cost effectiveness.
- To provide guidelines to prepare technical report of the project.

**Course Outcomes:** At the end of this course, learners will be able to:

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies.
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
- Prepare technical report and oral presentations.

**Methodology of the Project work:**

- The student will identify and select a problem based on comprehensive literature survey.
- The student should submit a proposal and get it approved by the Head of the department.
- Three reviews will be conducted by Project review committee.
- Students will be evaluated by the committee during the review and suggestions will be offered by members.

The report for PHASE - I should be submitted by the students at the end of course.

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester II | HS |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19HX201 | ENGLISH FOR ENGINEERS | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):**

- To acquire the usage of grammar in English language.
- To develop listening skills which will enable to listen lectures and comprehend different types of texts.
- To enhance the reading skill to comprehend technical writings.
- To improve writing skills to express thoughts freely.
- To develop speaking skills to speak fluently in real contexts.

**Course Outcomes**: At the end of this course, learners will be able to:

1. Improve their language usage in LSRW skills.
2. Develop listening skills to understand sentence stress and intonations.
3. Acquire the ability to understand different written texts.
4. Enhance the writing skills to express the ideas of the learners.
5. Communicate fluently in pair / team.

| | | |
|---|---|---|
| **Unit I** | **LANGUAGE FOCUS** | 9 |
| Voice(Active & Passive) - Reported speech - Conditionals - Collocations - Discourse markers - One word substitution - Phrasal verbs - Error identification | | |
| **Unit II** | **LISTENING** | 9 |
| Listening for specific information – Identifying sentence stress - Rhythm - Intonation | | |
| **Unit III** | **READING** | 9 |
| Reading graphs and charts - Skimming and scanning texts – Identifying topic sentences - Understanding the structure of a text | | |
| **Unit IV** | **WRITING** | 9 |
| Job Application, Letter and Resume - Recommendations - Report writing (accident and survey) - Writing review ( book and movie) - Transcoding (interpreting charts & diagrams) | | |
| **Unit V** | **SPEAKING** | 9 |
| Collaborative task - Turn taking (initiating and responding appropriately) - Negotiating - Exchanging - Language Functions: suggesting - comparing and contrasting - Expressing - finding out facts, attitudes and opinions | | |

**TEXT BOOK(S):**


1. Communicative English by KN Shoba ,Lourdes Joavani Rayen Published by Cambridge university Revised Edition 2018


**REFERENCE(S):**


1. Jeremy Comfort, Pamela Rogerson, Trish Stott, and Derek Utley, Speaking Effectively and Developing Speaking Skills for Business English, Cambridge: Cambridge University Press, 2002.
2. Eric H. Glendinning and Beverly Holmstrom, Study Reading: A Course In Reading for Academic Purposes. United Kingdom: Cambridge University Press, 2004.
3. rphy, Raymond. English Grammar in Use – A Self-Study Reference and Practice Book For Intermediate rners Of English .Ived. United Kingdom: Cambridge University Press. 2012.
4. Seely, John. Oxford Guide to Effective Writing and Speaking. Indian ed. New Delhi: Oxford University Press. 2005.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester II | HS |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19HX202 | HINDI | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is to

- To help students to acquire the basics of Hindi
- To teach them how to converse in Hindi on various occasions
- To help learners acquire the ability to understand a simple technical text in Hindi

**Course Outcomes**: At the end of this course, learners will be able to:

1. An ability to communicate effectively with: (a) Improved fluency in Hindi (b) Clarity on the basic sounds of the Hindi language (c) Proper vocabulary

| Unit I | HINDI ALPHABET | 9 |
|---|---|---|

Genders (Masculine & Feminine Nouns ending in a ,e,i,o, u,)- Masculine & Feminine - Reading Exercises. Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu&Visarg -Table of Alphabet -Vocabulary.

| Unit II | NOUNS IN HINDI | 9 |
|---|---|---|

Genders (Masculine & Feminine Nouns ending in a ,e,i,o, u,)- Masculine & Feminine - Reading Exercises.

| Unit III | PRONOUNS AND TENSES | 9 |
|---|---|---|

Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

| Unit IV | CLASSIFIED VOCABULARY | 9 |
|---|---|---|

Parts of body - Relatives - Spices- Eatables- Fruit & Vegetables - Clothes - Directions-Seasons - Professions.

| Unit V | SPEAKING | 9 |
|---|---|---|

Model Sentences - Speaking practice for various occasions.

**TEXT BOOK(S):**


1. Elementary Hindi: Learn to Communicate in Everyday Situations by Richard Delacy Tuttle Publication 2013
2. Colloquial Hindi: The Complete Course for Beginners by Tej K. Bhatia


**REFERENCE(S):**


1. B. R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People, Vee Kumar Publications (P) Ltd., New Delhi, 2009
2. Syed, PrayojanMulak Hindi, RahamathullahVaniPrakasan, New Delhi, 2002.
3. Ramdev, VyakaranPradeep, SaraswathiPrakasan, Varanasi, 2004.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester II | HS |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19HX203 | JAPANESE | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is to

- To help students acquire the basics of Japanese language
- To teach them how to converse in Japanese in various occasions
- **To teach the students the Japanese cultural facets and social etiquette**

**Course Outcomes**: At the end of this course, learners will be able to communicate effectively with:

1. Improved fluency in Japanese
2. Clarity on the basic sounds of the Japanese language
3. Proper vocabulary

| Unit I | Introduction | 9 |
|---|---|---|

Introduction to Japanese - Japanese script - Pronunciation of Japanese(Hiragana) - Long vowels - Pronunciation of in,tsu,ga - Letters combined with ya,yu,yo - Daily Greetings and Expressions Numerals. N1 wa N2 des - N1 wa N2 ja arimasen - S ka - N1mo - N1 no N2 - .san - Kanji - Technical Japanese Vocabulary (25 Numbers) - Phonetic and semantic resemblances between Tamil and Japanese

| Unit II | Vocabulary & Grammar 語彙と文法 | 9 |
|---|---|---|

Introduction - Kore - Sore - are - Kono N1 - Sono N1 - ano N1 - so des - so ja arimasen - S1 ka - S2 ka - N1 no N1 - so des ka ' koko - soko - asoko - kochira - sochira - achira - N1 wa N2 (Place) des - dhoko-N1 no N2 - Kanji-10 - ima-.ji-fun des - Introduction of verb - V mas - V masen - V mashitha-V masen deshitha - N1(Time) ne V - N1 kara N2 des - N1 tho N2 / S ne Kanji-10 - Technical Japanese Vocabulary (25 Numbers) - Dictionary Usage.

| Unit III | Noun & Types 名詞とタイプ | 9 |
|---|---|---|

N1(Place) ye ikimas - ki mas - kayerimasu - Dhoko ye mo ikimasen - ikimasendheshitha - N1(vehicle) de ikimasu - kimasu - kayerimasu - N1(Personal or Animal) tho V ithsu - S yo. - N1 wo V (Transitive) - N1 wo shimus - Nani wo shimasu ka - Nan & Nani - N1(Place) de V - V masen ka - V masho - Oo. Kanji-10 , N1( tool - means ) de V - Word / Sentence wa go nan des ka - N1( Person ) ne agemus - N1( Person ) ne moraimus - mo V shimashitha - , Kanji-10 - Japanese Typewriting using JWPCE Software, Technical Japanese Vocabulary (25 Numbers)

| Unit IV | Vocabulary & Grammar 語彙と文法 | 9 |
|---|---|---|

Introduction to Adjectives - N1wanaadj des. N1 wa ii adj des - naadjna N1 - ii adj ii N1 - Thothemo - amari - N1 wadho des ka - N1 wadhonna N2 des ka - S1 ka S2 - dhore - N1 gaarimasu - wakarimasu - N1 ga suki masu - N1 gakiraimasu - jozu des - hetha des - dhonna N1 - Usages of yoku - dhaithai - thakusan - sukoshi - amari - zenzen - S1 kara S2 - dhoshithe, N1 gaarimasu - imasuN1(Place) ne N2 gaarimasu - iimasu - N1 wa N2(Place) ne arimasu - iimasu - N1(Person,Place,or Thing ) no N2 (Position) - N1 ya N2, Kanji-10 - Japanese Dictionary usage using JWPCE Software, Technical Japanese Vocabulary (25 Numbers)

| Unit V | Root Word & Vocabulary 語彙と語彙 | 9 |
|---|---|---|

Saying Numbers , Counter Suffixes , Usages of Quantifiers -Interrogatives - Dhonokurai - gurai - Quantifier-(Period ) ne -.kai V - Quantifier dhake / N1 dhake Kanji - Past tense of Noun sentences and na Adjective sentences - Past tense of ii-adj sentences - N1 wa N2 yoriadj des - N1 tho N2 tho Dhochiragaadj des ka and its answering method - N1 [ no naka ] de {nani/dhoko/dhare/ithsu} ga ichiban adj des ka - answering -N1 gahoshi des - V1 mas form dhake mas - N1 (Place ) ye V masu form ne ikimasu/kimasu/kayerimasu - N1 ne V/N1 wo V - Dhokoka - Nanika - gojumo - Technical Japanese Vocabulary (25 Numbers)

**TEXT BOOK(S):**

| | |
|---|---|
| 1. | Modern Japanese Vocabulary: A Guide for 21st Century Students \| Edward P. Trimnell Publisher: Beechmont Crest Publishing (April 28 |
| 2 | Japanese Verbs & Essentials of Grammar" \| Rita Lampkin Passport Books , 2013 |

**REFERENCE(S):**

| | |
|---|---|
| 1 | Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007. |
| 2 | Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers and Distributors Pvt. Ltd.,Delhi, 2007 |

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| Department | ENGLISH | | | | | R 2019 | Semester | I |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19HX204 | FRENCH | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is to

- To help students acquire the basics of French language
- To teach them how to converse in French in various occasions

**Course Outcomes**: At the end of this course, learners will be able to:

1. The students will become familiar with the basics of French language and start conversing in French.

| Unit I | Alphabet Français | 6 |
|---|---|---|

Alphabet Français (alphabets) - Les Accents Français (the accents in French) - aigu - grave - circonflexe - tréma cédille - écrire son nom dans le français (spellingone -sname in French) - Les noms de jours de la semaine (Days of the week)

| Unit II | Numbers, month & year ( Nombre, mois et année) | 6 |
|---|---|---|

Les noms de mois de l'année (Months) - Numéro 1 à 100 (Numbers 1 to 100) GRAMMAIRE :Conjugaison

| Unit III | Language Skills & Grammar (Compétences linguistiques et grammaire) | 10 |
|---|---|---|

Moyens de transport (Transport) - Noms de Professions (Professions) - Noms d'endroits communs (Places) - Nationalités (Nationalities) ECOUTER : (Listening) Écouter l - alphabet associéà des prénoms français - Écouter et répondre PARLER (Speaking)Présntation - même /Présentez - Vous (Introducingoneself)LIRE :Lireles phrases simples

| Unit IV | Grammar (et grammaire) | 12 |
|---|---|---|

Pronoms (Pronouns) - Noms communs masculins et de femme (Common masculine and Femininenouns) - Verbes communs (Common verbs)COUTER :couter et crier les prnoms - Observer les dessins et couter les dialogues LIRE : Lire les profils d'utilisateurs d'interlingua (alter ego)PARLER :Parler de sa ville - Parler de sa profession

| Unit V | Speaking & Writing (Parler et écrire) | 11 |
|---|---|---|

Narration de son nom et l'endroit où on vit - Son âge et date de naissance - Numéro de téléphone et'dresse -Narration du temps - La France en Europe PARLER :Conversation entre deux amis - Jouer la scène ÉCOUTER :Ecouter les conversations (CD alter ego)ÉCRIRE :Écrireune carte postale

**TEXT BOOK(S):**

| | |
|---|---|
| 1. | Le Bon Usage by M. Grevisse Publisher- Duculot 14 edition (25 January 2001) |
| 2 | Advanced French by Monique L'Huillier, Cambridge University Press,2013 |

**REFERENCE(S):**

| | |
|---|---|
| 1 | Alter ego+ Niveau a1 |
| 2 | Grammaire Progressive du Français |
| 3 | Collins Easy Learning French Verbs& Practice |
| 4 | Français Linguaphone |
| 5 | FrançaisI.Harrisonburg: The Rosetta Stone: Fairfield Language Technologies |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | V |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX01 | COMPUTER AIDED DESIGN | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To provide knowledge on fundamentals of CAD and geometric transformations.
- To understand the various geometric modeling concepts.
- To identify the common visual realism algorithms.
- To impart the knowledge on parts assembly logics and consideration factors.
- To study the available data exchange formats for CAD model transportation.

**Course Outcomes:** At the end of this course, learners will be able to:

- Explain the fundamentals of CAD and geometric transformations concepts.
- Describe the various representation of geometric curves,surfaces and solids.
- Identify the importance of visual realism algorithms.
- Identify the significant factors in computer aided assembly.
- Explain the geometrical model data exchanging formats to transfer CAD Models between various platforms.

| Unit I | FUNDAMENTALS | 09 |
|---|---|---|
| Product cycle, Sequential and Concurrent Engineering, CAD - Architecture, Tools, applications - Coordinate systems - Two and Three dimensional Transformations - Translation - Scaling – Reflection - Rotation, Windowing - clipping and Viewing. | | |
| **Unit II** | **GEOMETRIC MODELING** | **09** |
| Representation of curves - Hermite, Bezier, B-Spline and rational curves - Surface Modeling – surface patch -Bezier and B spline surface. Solid Modelling - Boundary representation and Constructive Solid Geometry. | | |
| **Unit III** | **VISUAL REALISM** | **09** |
| Coherence - types. Hidden line removal algorithm - Priority and Area oriented algorithms. Hidden Surface removal algorithm - Depth buffer and Warnock's algorithms. Hidden solid removal algorithm, Ray Tracing algorithm, shading and Coloring - types. Computer Animation. | | |
| **Unit IV** | **ASSEMBLY OF PARTS** | **09** |
| Assembly modeling - Interference of Positions and orientations - CAD Tolerance Analysis - geometrical Mass Properties - degree of freedom - Constraints and Simulation concepts. | | |
| **Unit V** | **DATA EXCHANGE FORMATS** | **09** |
| Database Management System - CAD Standards File types - IGES, PDES, PARASOLID, ACIS, Data - Database - Structures - Types, DXF, STL and STEP Files. Communication Standards - File Transfer between CAD and CAM package. | | |

**REFERENCE(S):**


1. Ibrahim Zied, CAD/CAM-Theory and Practice, Tata McGraw Hall Publishing Company Pvt.Ltd., New Delhi, 2009.
2. P.Radhakrishnan, CAD-CAM-CIM, New Age International Publishers, New Delhi 2000.
3. Donald Hearn, M. Pauline Baker, Computer Graphics, Prentice Hall of India, New Delhi, 2005.
4. Donald Hearn, M. Pauline Baker, Computer Graphics, Prentice Hall of India, New Delhi, 2005.
5. William M. Neumann, Robert F. Sproul, Principles of Computer Graphics, Tata McGraw Hall Publishing Company Pvt Ltd., New Delhi, 2005.
6. Mikell P. Groover, Emory W. Zimmers, CAD/CAM Computer-Aided Design and Manufacturing, Prentice Hall of India, New Delhi, 2007.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | V |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX02 | MECHANICAL VIBRATIONS | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To study the fundamental concept of vibration of single degree of freedom (DOF) system.
- To provide knowledge on vibration of Two DOF system.
- To impart knowledge on vibration of Multi- DOF system.
- To learn the governing equation of vibration of continuous systems.
- To study various instruments and control methods used in vibration analysis.

**Course Outcomes:** At the end of this course, learners will be able to:

- Explain basic elements of vibration of single DOF system.
- Calculate the natural frequency of vibration of Two DOF system.
- Estimate the natural frequency of vibration of Multi DOF system.
- Perform vibration analysis for vibration of continuous systems.
- Select suitable instruments and control method for measurement and control of vibration.

| Unit I | FUNDAMENTALS OF VIBRATION | 09 |
|---|---|---|
| Basic concepts - One degree of freedom - Free vibration -undamped and viscous damping system. Forced vibration - harmonically excited vibration - Equation of motion, Response of damped system under harmonic force, Response of Damped system under base excitation and rotating unbalance - Duhamels Integral - Impulse response function. | | |
| **Unit II** | **TWO DEGREE FREEDOM SYSTEM** | **09** |
| Equation of motion - Free and Forced vibration Analysis- Coordinate Couplings and Principal Coordinates - Transfer function approach - Lagranges equation. | | |
| **Unit III** | **MULTI-DEGREE FREEDOM SYSTEM** | **09** |
| Influence Coefficients and stiffness coefficients- Flexibility Matrix and Stiffness Matrix - Eigen Values and Eigen Vectors-Matrix Method, Matrix Iteration Method -Approximate Methods: Dunkerley, Rayleighs and Holzer Method. | | |
| **Unit IV** | **VIBRATION OF CONTINUOUS SYSTEMS** | **09** |
| Introduction- Transverse vibration of string- Longitudinal vibration of shaft - torsional vibration of shaft- lateral vibration of beam- Rayleigh Method, Rayleigh - Ritz method. | | |
| **Unit V** | **VIBRATION MEASUREMENT AND CONTROL** | **09** |
| Transducer - Vibration Pickups - Frequency Measuring Instruments - Vibration exciter - dynamic Testing Machine - Machine Condition Monitoring and diagnosis. Control of vibration- control of Natural frequencies - Introduction to damping - vibration Isolation - Vibration Absorber | | |

**REFERENCE(S):**


1. S.S.Rao, Mechanical Vibrations, Pearson Education, 2011.
2. Thomson W.T. Theory of Vibration with Applications, CBS Publishers and Distributors, New Delhi, 2006.
3. A.K. Mallik, Principles of Vibration Control, Affiliated East-West Press Pvt. Ltd, 2004.
4. R.N. Iyengar , Elements of Mechanical Vibration, I K International Publishing House Pvt.Ltd, New Delhi, 2007
5. S.Graham Kelly and Shashidar K.Kudari, Mechanical Vibrations, Tata McGraw-Hill Publishing Company Ltd New Delhi, 2007.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | V |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX03 | APPLIED HYDRAULICS AND PNEUMATICS | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To impart knowledge on various types of hydraulic pumps and actuators.
- To learn about various hydraulic components and its functions.
- To provide knowledge about the selection of hydraulic components.
- To study about various types of pneumatic components and servo systems.
- To learn fluid power circuit design methods and its applications.

**Course Outcomes:** At the end of this course, learners will be able to:

- Identify suitable hydraulic pumps and actuators for different applications.
- Choose the suitable hydraulic components for various applications.
- Select the suitable fluid power components for various applications.
- Choose the suitable pneumatic components for different applications.
- Design fluid power circuit for given applications

| Unit I | HYDRAULIC PUMPS AND ACTUATORS | 09 |
|---|---|---|

Introduction to fluid power system- Applications of Pascal's Law- Hydraulic pumps - Pumping theory, classification - Gear pump, Vane pump, piston pump, lobe pump, construction and working principles - Fluid power Actuators-Single acting, Double acting, cushioning and telescopic cylinder, construction and working principles. Gear Motors, Vane motors.

| Unit II | HYDRAULIC COMPONENTS | 09 |
|---|---|---|

Direction control valve - check valve, shuttle valve, 3/2 , 4/2 and 4/3 way valve and solenoid valve - Actuation methods. Pressure control valves-pressure relief valve, compound pressure relief valve, pressure reducing valve, unloading valve, sequence valve, counterbalance valve. Flow control valves- types. Accumulators and intensifier - Types.

| Unit III | SELECTION OF HYDRAULIC COMPONENTS | 09 |
|---|---|---|

Selection factors-Selection of pumps. Actuators- cylinders, motors versus load-Piston rod buckling. Selection of Hydraulic pipe and hoses, valves, reservoir, filters, Accumulators and intensifiers

| Unit IV | PNEUMATIC COMPONENTS | 09 |
|---|---|---|

Compressors- Filter, Regulator, Lubricator (FRL) unit, mufflers. Valves- direction control valves - shuttle valve, two way air piloted valve, push button valve, quick exhaust valve, lever control valve and solenoid valve - Pneumatic actuators. Servo system - Hydro mechanical, Electro hydraulic and proportional valve.

| Unit V | DESIGN OF FLUID POWER CIRCUIT | 09 |
|---|---|---|

Fluid power circuits- Speed control circuits, synchronizing circuit, sequential circuit and design for simple application using cascade and stepper sequencer method. Application of Accumulator and Intensifier circuit.

**REFERENCE(S):**


1. Anthony Esposito, Fluid power with applications, Pearson Education, New Delhi, 2011
2. S.R Majumdar, Oil hydraulics, Tata McGraw Hill publishing company Pvt. Ltd. New Delhi,2004
3. S.R.Majumdar, Pneumatic systems-Principles and maintenance, Tata McGraw Hill publishing company Pvt. Ltd., New Delhi, 2008.
4. S.Ilango Introduction to Hydraulics and Pneumatics, Prentice Hall of India Pvt. Ltd., New Delhi, 2007.
5. Andrew Parr, Hydraulics and Pneumatics, Jaico Publishing House, 2006.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | V |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX04 | COMPOSITE MATERIALS AND MECHANICS | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To provide fundamental knowledge in reinforcement and matrix materials.
- To impart knowledge on polymer matrix composites.
- To expose the characteristics and different fabrication techniques of metal matrix composites.
- To impart knowledge on ceramic matrix composites.
- To provide knowledge on advanced composites.

**Course Outcomes:** At the end of this course, learners will be able to:

- Identify suitable reinforcement and matrix materials for different applications
- Select appropriate fabrication technique for specific application of polymer matrix composite.
- Select suitable processing method for the fabrication of metal matrix composites
- Select suitable fabrication method for specific application of ceramic matrix composite.
- Identify the advanced composites for appropriate applications.

| Unit I | INTRODUCTION TO COMPOSITES | 09 |
|---|---|---|
| Fundamentals of composites, characteristics, need for composites, Enhancement of properties, Reinforcements - glass fibers, boron fibers, carbon fibers, organic fibers, aramid fibers, ceramic fibers, oxide and nonoxide fibers, Forms of reinforcements - Roving, Woven fabrics, Non woven, random mats, whiskers, Matrix materials - Polymers - Thermosetting resins, thermoplastic resins , Metals, Ceramic materials | | |
| **Unit II** | **POLYMER MATRIX COMPOSITES** | **09** |
| Processing of polymer matrix composites- hand lay-up, Spray lay-up processes, Compression molding- SMC Reinforced reaction injection molding, Resin transfer molding, Pultrusion, Filamentwinding, Applications of polymer matrix composites | | |
| **Unit III** | **METAL MATRIX COMPOSITES** | **09** |
| Characteristics of MMCs, Various types of Metal matrix composites, Advantages and limitations of MMCs, Effect of reinforcements on properties-Volume fraction - Rule of mixtures, Processing of MMCs - Liquid state processing- stir casting, squeeze casting, infiltration, solid state processing - Powder metallurgy, Diffusion bonding, In-situ processes, applications of MMCs. | | |
| **Unit IV** | **CERAMIC MATRIX COMPOSITES** | **09** |
| Need for CMCs, Processing of CMCs- cold pressing and sintering, hot pressing, infiltration, chemical vapor deposition and chemical vapor impregnation, sol-gel and polymer pyrolysis, high temperature synthesis properties and applications in aerospace and space fields. | | |
| **Unit V** | **ADVANCES IN COMPOSITES** | **09** |
| Carbon fiber composites - properties, chemical vapor deposition - oxidative etching, liquid phase oxidation carbon/carbon composites - properties and applications of C/C Composites, future scope of c-c composites, multi-filament superconducting composites. | | |

**REFERENCE(S):**


1. P.K. Mallick, Fiber Reinforced Composites Materials, Manufacturing and Design, Marcel Dekker Inc, 2003.
2. K. Autar Kaw, Mechanics of Composite Materials, CRC Press, 2006.
3. B.D. Agarwal and L.J. Broutman, Analysis and Performance of Fiber Composites, John Wiley and Sons, New York, 2000.
4. Ronald Gibson, Principles of Composite Material Mechanics, Tata McGraw Hill, 2004.
5. K.K. Chawla, Composite materials, Springer Verlag, 2007.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | V |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX05 | WELDING TECHNOLOGY | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To study working principle of welding processes and its parameters.
- To provide knowledge on special welding processes.
- To study the welding metallurgy and design of weldments.
- To know about automation in welding processes.
- To learn about the welding defects, inspection and testing.

**Course Outcomes:** At the end of this course, learners will be able to:

- Explain the construction and working of welding process and its parameters.
- Assess the suitable special welding techniques for industrial requirements.
- Select the welding symbol, welding metallurgy and weld ability of special metals.
- Implement the welding automation techniques in the real time applications.
- Select the suitable inspection and testing methods to test the welded components.

| Unit I | BASICS AND PRINCIPLES OF WELDING PROCES | 09 |
|---|---|---|

Classification - Weld joints, Position, edge preparation, fluxes, filler rod- safety aspects in welding - Fusion welding - Gas Tungsten Arc Welding, gas metal arc welding, submerged arc welding. Resistance welding- spot, seam, projection, percussion, flash. Atomic hydrogen arc welding, Thermit welding

| Unit II | SPECIAL WELDING PROCESSES | 09 |
|---|---|---|

Electron beam and Laser beam welding - plasma arc welding - stud welding - friction welding - explosive welding - ultrasonic welding - roll bonding-diffusion bonding - cold welding - welding of plastics- Underwater welding.

| Unit III | WELD DESIGN AND METALLURGY | 09 |
|---|---|---|

Welding symbols, welding dimension, No. of examination, area of examination, Nondestructive testing symbol- welding design, selection of joint, selection of weld type- allowable strengths of welding, fatigue strengths of welds. Welding Metallurgy of steel, solidification of weld metal, gas metal reaction, slag metal reaction. Weldability of cast iron, steel, stainless steel, aluminum alloys.

| Unit IV | WELDING AUTOMATION | 09 |
|---|---|---|

Automation - welding operation, structure analysis, and classification - Introduction to robotic welding system, types, and selection mechanics - Design of welding robots - Joint tracking system. Welding fixtures.

| Unit V | WELD DEFECTS AND INSPECTION AND TESTING OF WELDING | 09 |
|---|---|---|

Weld defect - Surface and subsurface defects - Sources of weld defect - Inspection and testing of welds. Destructive Testing - Tensile Tests, Impact Tests, Bend Tests. Non-destructive Testing - Liquid Penetrant Testing, Magnetic Particle Testing, Eddy Current Testing, Radio-Graphic Testing, Ultrasonic Testing. Tightness test - Testing of pipe, plate, boiler, drum, tank. Acceptance levels of arc welding defects

**REFERENCE(S):**


1. Little, Welding technology, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi,200
2. R. S. Parmer, Welding Processes & Technology, Khanna Publishers, New Delhi, 2008.
3. O. P. Khanna, A text book of Welding Technology, Dhanpatrai publications, Second Edition - New Delhi, 2002.
4. Metals Hand Book, Volume 6, American Society for Metals, 2005.
5. Sindokou, Welding metallurgy, A Jhon wiley & sons,Inc. Publication, Second Edition-New Jersey, 2003.
6. www.weldingtypes.net


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | V |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX06 | MECHANICAL BEHAVIOUR OF MATERIALS | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To provide knowledge on deformation mechanisms in materials.
- To learn high temperature deformation phenomena.
- To impart knowledge on various fracture mechanism.
- To provide knowledge on the various strengthening mechanisms in materials.
- To impart knowledge on fatigue failure for different cyclic loading conditions.

**Course Outcomes:** At the end of this course, learners will be able to:

- Explain the deformation mechanisms of different materials.
- Describe the phenomenon of high temperature deformation & failure
- E xplain the types of fracture modes and its mechanisms.
- Express the concept of different strengthening mechanisms and its advantages
- Describe about fatigue failure and its characteristics

| Unit I | BASIC CONCEPT OF MATERIAL BEHAVIOR | 09 |
|---|---|---|
| Deformation - Types - Elastic deformation - Elastic modulus, linear elastic deformation- Rubber elasticity, Elasticity -Plastic deformation, Yield strength of a perfect crystal, Dislocations - Edge, Screw and Mixed dislocation, Slip and Twinning, Interaction of moving dislocations | | |
| **Unit II** | **HIGH TEMPERATURE DEFORMATION** | **09** |
| Creep mechanism - Dislocation glide at low temperature, Differential flow creep mechanisms - Creep in two phase alloys - Independent and sequential process -Deformation mechanism maps - Engineering aspects of creep design -Introduction to Super plasticity, Hot working of metals,Dynamic Recovery and recrystallization. | | |
| **Unit III** | **TENSILE FRACTURE AT LOW TEMPERATURE AND EMBRITTLEMENT** | **09** |
| Theoretical strength of a crystalline solid - Types of low temperature tensile fracture (Mode I, Mode II, Mode III Brittle fracture) - Ductile fracture, Introduction to Embrittlement fracture and types - Characteristics of Liquid Metal Embrittlement (LME), Solid Metal Embrittlement (SME), Hydrogen Embrittlement (HE) and Stress Corrosion Cracking (SCC). | | |
| **Unit IV** | **STRENGTHENING MECHANISMS** | **09** |
| Strengthening Mechanism-Types-Work hardening, Boundary strengthening, solid solution strengthening, Particle hardening- Deformation of two phase aggregates- Precipitation hardening in aluminum alloys, Patented steel wire, Martensite, Ausforming, TRIP (Transformed induced plasticity) steel, Maraging steel. | | |
| **Unit V** | **FRACTURE MECHANICS AND FATIGUE** | **09** |
| Importance of Fracture Mechanics, Griffith Fracture Theory-Crack Driving Force & Energy Release Rate-Stress intensity factors - Fracture Toughness - Crack initiation and propagation- Material design for fracture toughness- Characteristics of fatigue fracture - Fatigue crack growth rates - Paris Law - Cyclic stress-strain behavior - Design and evaluation of materials against fatigue. | | |

**REFERENCE(S):**


1. Thomas H Courtney, Mechanical Behavior Materials, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2000
2. R. W. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, John Wiley & Sons, New Delhi, 2000.
3. M. A. Meyers and K. Chawla, Mechanical Behavior of Materials, Prentice Hall of India, New Delhi, 2001.
4. George E. Dieter, Mechanical Metallurgy, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2007.
5. F. A. Mcclintock, and A. S. Argon, Mechanical Behavior of Materials, Mass, New Delhi, 1966.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | VI |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX07 | AUTOMOBILE ENGINEERING | 2 | 0 | 2 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To impart knowledge on the constructional details and principle of operation of various automobile components.
- To provide knowledge on the working of fuel supply system in various automobiles.
- To learn the function of various components in transmission and drive lines of a vehicle.
- To study the concept and working of steering, brakes and suspension systems in automobile.
- To impart knowledge on electrical and electronic systems of automobiles.

**Course Outcomes:** At the end of this course, learners will be able to:

- Demonstrate the operating principles and constructional details of various automobile components.
- Classify two main types of fuel supply systems and explain its working.
- Explain the function of components in transmission and drive lines of a vehicle.
- Identify and explain the types of steering system, suspension system and braking system.
- Interpret the functioning of electrical and electronic systems in automobiles

| Unit I | VEHICLE STRUCTURE AND ENGINES | 09 |
|---|---|---|
| Types of Automobiles - vehicle construction, chassis, frame and body. Engines Supercharger, turbo chargers, engine emission control by 3 Way catalytic controller.Alternative energy resources Liquefied petroleum gas, Bio Diesel. | | |
| **Unit II** | **FUEL SUPPLY SYSTEMS** | **09** |
| Spark ignition engine Carburetor-Types simple carburettor, solex carburettor, carter carburetor. Electronic fuel injection system, mono-point and multi Point injection systems.Compression iginition engine-Inline fuel injection system, Common rail direct fuel injection system. | | |
| **Unit III** | **TRANSMISSION AND DRIVE LINES** | **09** |
| Clutch types single plate clutch, multi plate clutch.Gearbox synchromesh gear box, sliding mesh gear box, constant mesh gear box. Fluid flywheel, torque convertors, propeller shaft, slip joint, universal Joints,differential and rear axle hotchkiss drive and torque tube drive | | |
| **Unit IV** | **STEERING, BRAKES AND SUSPENSION** | **09** |
| Wheels and Tyres Construction. Steering geometry and types of steering gearbox rack and pinion steering gear, recirculating ball type gear and Power steering construction and working principle. Suspension systems types rear suspension and front suspension. Braking systems-types disc brake, drum brake, hydraulic brake and air brake. | | |
| **Unit V** | **ELECTRICAL AND ELECTRONIC SYSTEMS** | **09** |
| Electrical systems, battery types, construction and working principle of lead acid battery. Generator, starting motor and drives. lighting, ignition (Battery, Magneto Coil and Electronic type), regulators, cut outs. Common rail direct fuel injection system.Different electronic control unit used in the engine management, block diagram of the engine management system.. | | |

**REFERENCE(S):**


1. Kirpal Singh, Automobile Engineering Volume.1 and 2, Standard Publishers, New Delhi,2009.
2. Crouse and Anglin, Automotive Mechanism, Tata McGraw Hill Publishing Company PVT Ltd, New Delhi, 2003.
3. Newton, Steeds and Garet, Motor vehicles, Butterworth Publishers, 2000.
4. S. Srinivasan, Automotive Mechanics, Tata McGraw Hill Publishing Company Pvt Ltd New Delhi, 2003.
5. Joseph Heitner, Automotive Mechanics, East-West Press, 2006.
6. H. M. Sethi, Automobile Technology, Tata McGraw Hill Publishing Company Private Limited, New Delhi, 2007.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | VI |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX08 | INTERNAL COMBUSTION ENGINES | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To learn about the combustion phenomenon in spark ignition engines.
- To learn about the combustion phenomenon in compression ignition engines.
- To study the causes, effects and control of pollutants from an Internal Combustion engine.
- To provide the knowledge of alternate fuels in Internal Combustion engines.
- To impart the knowledge on recent developments in Internal Combustion engines.

**Course Outcomes:** At the end of this course, learners will be able to:

- Examine the combustion phenomenon in spark ignition engines.
- Examine the combustion phenomenon in compression ignition engines.
- Distinguish the causes,effects and control of pollutants from an IC engine.
- Identify the uses of alternate fuels in Internal Combustion engines.
- Illustrate the recent developments in Internal Combustion engines.

| Unit I | SPARK IGNITION ENGINES | 09 |
|---|---|---|
| Spark ignition engine- Mixture requirements, carburetors, fuel injection systems, mono point and multipoint injection, stages of combustion, normal and abnormal combustion, factors affecting knocking-combustion chambers. | | |
| **Unit II** | **COMPRESSION IGNITION ENGINES** | **09** |
| States of combustion in Compression Ignition Engine - combustion knock in compression ignition engines, methods of controlling knock. Direct and indirect injection systems. Combustion chambers. Fuel spray behaviour-spray structure, spray penetration and evaporation. Air motion-turbocharging | | |
| **Unit III** | **POLLUTANT FORMATION AND CONTROL** | **09** |
| Pollutant -formation of Oxides of Nitrogen in spark ignition and compression ignition engines, hydrocarbon emission - carbon monoxide formation - particulate emissions. Measurement of exhaust emissions- Non dispersive infrared gas analyzer, gas chromatography, chemiluminescent analyser and flame ionization detector, smoke meters. Methods of controlling emissions- Catalytic converters and particulate traps. Exhaust gas recirculation and Selective catalytic Reduction | | |
| **Unit IV** | **ALTERNATIVE FUELS** | **09** |
| Bio-fuels, alcohol, hydrogen, natural gas and liquefied petroleum gas, bio gas, properties, suitability, engine modifications, merits and demerits as fuels. | | |
| **Unit V** | **RECENT TRENDS** | **09** |
| Lean Burn Engines - stratified charge engines, homogeneous charge compression ignition, plasma Ignition. Variable valve timing, multi-valving, tuned manifolding, camless valve gearing, Variable compression ratio engines | | |

**REFERENCE(S):**


1. V. Ganesan, Internal Combustion Engines, Tata McGraw Hill Publishing Company Private limited., New Delhi, 2012
2. John B. Heywood, Internal Combustion Engine Fundamentals, Tata McGraw Hill Publishing Company Private limited., New Delhi,2008
3. R. B. Mathur and R. P. Sharmal Internal Combustion Engines, Dhanpat Rai Publications, 2008.
4. B.P.Pundir, Internal combustion Engines Combustion and Emissions, Narosa Publishing House Private limited, New Delhi, 2010.
5. W.W. Pulkrabek, Engineering Fundamentals of the Internal Combustion Engine, Prentice Hall, 2006


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX09 | REFRIGERATION AND AIR-CONDITIONING | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To provide the knowledge on air refrigeration systems.
- To study the working of single and multistage vapour compression refrigeration systems.
- To learn the operation of vapour absorption and other refrigeration systems.
- To impart the knowledge about Psychometrics and its applications.
- To learn the parameters involved in design of air conditioning systems.

**Course Outcomes:** At the end of this course, learners will be able to:

- Illustrate the principle of operation of air refrigeration systems.
- Explain the components and working of vapor compression refrigeration systems.
- Demonstrate the working of vapour absorption and other refrigeration systems.
- Resolve the psychometric problems in various applications.
- Determine the parameters involved in design of air conditioning systems

| Unit I | INTRODUCTION | 09 |
|---|---|---|

Recapitulation of Thermodynamics- Thermodynamics processes pertaining to refrigeration and air conditioning. First and Second law of thermodynamics applied to refrigerating machines, Carnot principles, unit of refrigeration, co-efficient of performance, Air refrigeration cycle. Reversed Carnot cycle, Bell-Coleman cycle. Air refrigeration systems- Types, thermodynamic processes, priority criteria, and suitability.

| Unit II | VAPOR COMPRESSION SYSTEM | 09 |
|---|---|---|

Need for modification of Carnot cycle, Thermodynamic processes in vapour compression cycle. Simple vapour compression system, various conditions of vapour refrigerant in the system, improvement in simple system. Flash chamber, Flash inter cooler. Compound vapor compression system- Need for compound compression, two stage compression and various arrangements for improvement in coefficient of performance. Refrigerants. Desirable properties of refrigerants - R-12, R-22, R-717, R-134, Butane. Recent substitute for refrigerants.

| Unit III | VAPOUR ABSORPTION AND OTHER REFRIGERATION SYSTEMS | 09 |
|---|---|---|

Vapor absorption system -System components, representation of system on various charts, steam ejector system, representation on T-s and P-v plane, applications and limitations, co- efficient of performance-Thermo-electric and vortex refrigeration systems. Cascade refrigeration system.

| Unit IV | APPLIED PSYCHROMETRY | 09 |
|---|---|---|

Principle and properties of psychrometry, Representation of various psychometric processes on psychometric chart and their analysis, by-pass factor, sensible heat factor, room sensible heat factor, equipment sensible heat factor, grand sensible heat factor, apparatus dew point, ventilation and infiltration, energy efficiency ratio. Use of psychometric charts. Cooling and heating load calculations.

| Unit V | AIR CONDITIONING SYSTEMS | 09 |
|---|---|---|

Human Comfort and Air Conditioning - requirements of temperature and humidity-concept of effective temperature, comfort charts. Air Conditioners - Air conditioning systems and their types, selection of system, Components and controls of air distribution, Window air conditioners, split air conditioners, Central air conditioners, Human comfort parameters, load estimation, infiltration, internal heat gains

**REFERENCE(S):**


1. C. P. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill Publishing Company Private Limited, New Delhi, 2008.
2. Langley and C. Billy, Refrigeration and Air conditioning, Ed. 3, Engle wood Cliffs (NJ), Prentice Hall of India, New Delhi, 2009.
3. Roy J. Dossat, Principles of Refrigeration, Pearson Education, New Delhi, 2007.


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|---|---|
| 4. | N. F Stoecker and Jones, Refrigeration and Air Conditioning, Tata McGraw Hill Publishing Company, New Delhi, 2008. |
| 5. | Manohar Prasad, Refrigeration and Air Conditioning, Wiley Eastern Limited, 2007. |
| 6. | J. B Hains, Automatic Control of Heating & Air conditioning, Tata McGraw Hill Publishing Company Private Limited, 2005 |


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX10 | FIBRE REINFORCED PLASTICS | 3 | 0 | 0 | 3 | 60 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To introduce the various materials for composite structure.
- To equip with the knowledge of sandwich structure technology.
- To provide knowledge in fracture mechanics of composites.
- To impart knowledge in fatigue and damping capacity of composite materials.
- To provide understanding of various manufacturing/fabricating techniques for composite structures

**Course Outcomes:** At the end of this course, learners will be able to:

- Select various materials for designing composite structures.
- Apply knowledge of fracture mechanics of composites during designing of composite
- Analyze critically the damping capacity of composite materials.
- Correlate various manufacturing/fabricating techniques for composite structures based on design

| | | |
|---|---|---|
| **Unit I** | **INTRODUCTION** | **09** |
| Definition, Reason for composites, Classifications of composites, Thermosets - Epoxy; Unsaturated polyester resin; vinyl ester, polyimides etc.,- preparation, properties, and uses. | | |
| **Unit II** | **REINFORCEMENTS** | **09** |
| Types, Properties, chemistry and applications of fillers such as silica, titanium oxide, talc, mica etc., Manufacturing process, Properties, structure and uses of Glass fiber-. Carbon, Aramid, Boron, jute, sisal, cotton. | | |
| **Unit III** | **FABRICATIONS OF THERMOSET COMPOSITES** | **09** |
| Hand lay up method, compression and transfer moulding, pressure and vacuum bag process, filament winding, protrusion, reinforced RIM, RRIM, Injection moulding, of thermosets, SMC and DMC, Advantages and disadvantages of each method | | |
| **Unit IV** | **TESTING OF COMPOSITES** | **09** |
| Destructive and non-destructive tests; Destructive- tensile, compression,flexural, impact strength, Hardness – Fatigue- toughness HDT ,basic concepts of fracture mechanisms. | | |
| **Unit V** | **APPLICATIONS OF COMPOSITES** | **09** |
| Aerospace, land transport, marine, structural, chemical plants and corrosion resistant products, mechanical engineering and energy applications sports, electrical, electronic and communication applications, biomedical applications, repairs and maintenance etc., | | |

**REFERENCE(S):**


| | |
|---|---|
| 1. | Hand book of composite by G. Lubin, Van Nostrand Co., New York 1969 |
| 2. | Polymers and Polymer Composites in Construction by L.C. Holleway, 1990 |
| 3. | Engineering Plastics and Composites by John C. Bittence, 1990 |
| 4. | Handbook of Plastics, Elastomers and Composites by Chrles A Harper, 1975 |
| 5. | Designing with Reinforced composites- Technology-Performance, Economics-Rosato, 2st Ed.1997. |


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX11 | PROCESS PLANNING AND COST ESTIMATION | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To introduce the process planning concepts.
- To impart the importance of cost estimation process and procedures.
- To study the procedure to calculate direct, indirect and overhead expenses.
- To learn the procedure to estimate the various machine costs.
- To learn procedure to estimate the machining time for Lathe, drilling, boring, shaping, milling and grinding operations.

**Course Outcomes:** At the end of this course, learners will be able to:

- Explain the concepts of process planning and cost estimation.
- Assess the importance of cost estimation process and its procedures.
- Compute direct, indirect and over head expenses.
- Determine the production cost of forging, welding, and foundry.
- Find the machining time for Lathe, drilling, boring, shaping, milling and grinding operations

| Unit I | PROCESS PLANNING | 09 |
|---|---|---|
| Definition - Objective - Scope - Process planning activities - Approaches - Manual, Computer Aided Process planning - Retrieval, Generative and Semi- generative - Selection processes - Machine selection - Material election parameters - Set of documents for process planning. Production time calculation - Selection of cost optimal processes. | | |
| **Unit II** | **INTRODUCTION TO COST ESTIMATION** | **09** |
| Objectives and functions of Estimating - Costing - Importance and aims of Costing – Difference between Costing and Estimation - Methods of Costing - Types of estimates - Methods of estimates - Importance of Realistic Estimates - Estimating procedure. | | |
| **Unit III** | **ELEMENTS OF COST** | **09** |
| Introduction - Material Cost - Direct and Indirect - Labour cost - Direct, Indirect and Determination of Direct Labour Cost - Expenses - Direct and Indirect - Analysis of overhead expenses - Administrative expenses - Selling and Distributing expenses - Allocation of overhead expenses- Depreciation - Causes and methods of depreciation. | | |
| **Unit IV** | **PRODUCTION COST ESTIMATION** | **09** |
| Estimation in forging shop - Losses in forging and forging cost - Problems - Estimation in Gas cutting and welding shop - Material cost, Labour cost and Finish on cost -Problems - Estimation in foundry shop - Pattern cost, Foundry cost and casting cost - Problems | | |
| **Unit V** | **ESTIMATION OF MACHINING TIME** | **09** |
| Importance of machine time calculations - Estimation of machining time for Lathe, drilling, boring, shaping, milling and grinding operations - Problems | | |

**REFERENCE(S):**


1. R. Kesavan, E.Elanchezhian, B.Vijaya Ramnath, Process planning and cost estimation, New Age International Publications, 2008
2. M.Adithan, Process Planning and Cost Estimation, New Age International Publications, 2007.
3. Peter scalon, Process planning, Design/Manufacture Interface, Elsevier science technology Books, Dec-2002.
4. B. P. Sinha, Mechanical Estimating and Costing, Tata McGraw Hill Publishing Company Private. Limited.,2001.
5. S. K. Mukhopadhyay, Production Planning and Control-Text and cases, Prentice Hall of India Private Limited, 2007.
6. Chitale.A.V., Gupta.R.C., Product Design and Manufacturing, Prentice Hall of India Private Limited, 2000.


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX12 | STATISTICAL QUALITY CONTROL AND RELIABILITY ENGINEERING | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To familiarize with various statistical process control methods.
- To study the methods and characteristics of sampling.
- To introduce Taguchi method of experimental design.
- To describe the concept of reliability and its models.
- To impart knowledge on design of reliability process.

**Course Outcomes:** At the end of this course, learners will be able to:

- Identify Use the different statistical process control charts.
- Explain the importance of sampling methods and its characteristics.
- Implement the Taguchi method for experimental design.
- Evaluate the reliability concept with their models.
- Determine and analyze the reliability process.

| Unit I | QUALITY AND STATISTICAL PROCESS CONTROL | 09 |
|---|---|---|

Quality-Definition, Quality Assurance-Variation in process-Factors, Process capability. Control charts variables X, R and X, Attributes P, C and U-Chart tolerance design. Establishing and interpreting control charts-Charts for variables. Quality rating-Short run.

| Unit II | ACCEPTANCE SAMPLING | 09 |
|---|---|---|

Lot by lot sampling-Types, Probability of acceptance in single, double, multiple sampling plans- Operating Characteristic curves-Producer's risk and consumer's risk-Acceptable Quality Limit, Lot Tolerance Percent Defective, Average Outgoing Quality, Concepts-Standard sampling plans for average outgoing quality and Lot Tolerance Percent Defective, Use of standard sampling plans.

| Unit III | EXPERIMENTAL DESIGN AND TAGUCHI METHOD | 09 |
|---|---|---|

Fundamentals-Factorial experiments, Random design, Latin square design, Taguchi method-Loss function-Experiments, Signal/Noise ratio and performance measure, Orthogonal array.

| Unit IV | CONCEPT OF RELIABILITY | 09 |
|---|---|---|

Definition, reliability vs quality, reliability function-Mean Time Between Failures, Mean Time To Repair, availability, bathtub curve-time dependent failure models-Distributions-Normal, weibull, log normal-Reliability of system and models-serial, parallel and combined configuration -Markove analysis, load sharing systems, standbysystems, co-variant models, static models, dynamic models.

| Unit V | DESIGN OF RELIABILITY | 09 |
|---|---|---|

Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, System safety-analysis of down-time-Repair time distribution, stochastic point processes system repair time, reliability under preventive maintenance state dependent system with repair.

**REFERENCE(S):**


1. Amata Mitra, Fundamentals of Quality Control and improvement, Pearson Education, 2002.
2. Patrick D connor, Practical Reliability Engineering, John-Wiley and Sons Inc, 2002.
3. Charles E Ebling, An Introduction to Reliability and Maintainability Engineering, Tata McGraw Hill, 2000
4. David J Smith, Reliability, Maintainability and Risk: Practical Methods for Engineers, Butterworth 2002.
5. Dhillon, Engineering Maintainability, How to design for reliability and easy maintenance, PH India publications, 2008.


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX13 | NON - TRADITIONAL MACHINING PROCESSES | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To introduce basics of non-traditional machining processes.
- To study the mechanical energy based non-traditional machining processes.
- To provide knowledge on electrical energy based non-traditional machining process.
- To impart knowledge on chemical and electro-chemical energy based processes.
- To impart knowledge on thermal energy based machining processes.

**Course Outcomes:** At the end of this course, learners will be able to:

- Explain the basics of non-traditional machining processes.
- Select the suitable mechanical energy based non-traditional machining processes for the given industrial applications.
- Find the suitable machining processes for machining electrically conductive materials.
- Choose appropriate chemical and electro-chemical energy based processes for precision machining
- Select the suitable thermal energy based process for cutting and machining of the hard materials.

| Unit I | UNCONVENTIONAL MACHINING PROCESS | 09 |
|---|---|---|
| Introduction - Need - Classification - Energies employed in the processes - Brief overview of Abrasive jet machining(AJM), Water jet machining(WJM), Ultrasonic machining(USM), Electric discharge machining(EBM), Electro-chemical machining(ECM), Electron beam machining(EBM), Laser beam machining(LBM), Plasma arc machining(PAM). | | |
| **Unit II** | **MECHANICAL ENERGY BASED PROCESSES** | **09** |
| Abrasive Jet Machining, Water Jet Machining and Ultrasonic Machining - Working Principles, Equipment, Process parameters, Material removal rate, Applications. | | |
| **Unit III** | **ELECTRICAL ENERGY BASED PROCESSES** | **09** |
| Electric Discharge Machining - Working Principles, Equipment, Process Parameters, Material removal rate, Electrode / Tool, Power Circuits, Tool Wear, Dielectric, Flushing, Wire cut EDM - Applications. | | |
| **Unit IV** | **CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES** | **09** |
| Chemical machining - Etchants, Maskants - techniques. Electro-chemical machining - Working principle, Equipment, Process Parameters, Material removal rate, Electrical circuit. Electro-chemical grinding - Electro-chemical honing - Applications. | | |
| **Unit V** | **THERMAL ENERGY BASED PROCESSES** | **09** |
| Laser Beam machining, Plasma Arc Machining - Principles, Equipment. Electron Beam Machining - Principles, Equipment, Types, Beam control techniques, Material removal rate - Applications. | | |

**REFERENCE(S):**


1. P. K. Mishra, Non Conventional Machining, Narosa Publishing House, New Delhi, 2007.
2. P. C. Pandey and H.S.Shan, Modern Machining Processes, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, 2008.
3. Joao Paulo Davim, Nontraditional Machining Processes: Research Advances, Springer, New York,2013.
4. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, Material and Processes in Manufacturing, Prentice Hall of India Pvt. Ltd., New Delhi, 2011.
5. Vijaya Kumar Jain, Advanced Machining Processes, Allied Publishers Pvt. Ltd., New Delhi, 2005.


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX14 | FLEXIBLE MANUFACTURING SYSTEMS | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To introduce the basics of Flexible Manufacturing System (FMS).
- To impart the knowledge on importance of Group Technology (GT).
- To understand the material handling layout configuration with computer controlled system.
- To know the concept of FMS using simulation software and data base system.
- To study the work volume of Robot and its applications.

**Course Outcomes:** At the end of this course, learners will be able to:

- Compare the benefits of FMS over conventional manufacturing system.
- Apply the group technology concepts in machine cell design.
- Construct the material handling layout with computer controlled system for machine cell.
- Select suitable simulation software for applying the FMS concept.
- Identify the suitable robot configuration for automation in FMS.

| Unit I | INTRODUCTION TO FLEXIBLE MANUFACTURING SYSTEM | 09 |
|---|---|---|
| Introduction to FMS - Types of production, characteristics, flexibility in machining systems and its types, need, flexible automation, benefits and application. | | |
| **Unit II** | **GROUP TECHNOLOGY** | **09** |
| Group Technology (GT) - Part families, parts classification and coding systems , features and OPITZ, production flow analysis, cellular manufacturing, composite part concept, machine cell design, types of machine cell designs, key machine concept, grouping parts and machines by rank order clustering, benefits and applications. | | |
| **Unit III** | **COMPONENTS AND COMPUTER CONTROL SYSTEM OF FMS** | **09** |
| FMS - Flexibility, types, components - Workstation, material handling and storage system – Functions of the handling system, material handling equipment and layout configuration, computer control system, planning and implementation issues. | | |
| **Unit IV** | **COMPUTER SOFTWARE, SIMULATION AND DATABASE OF FMS** | **09** |
| FMS simulation software- System issues, types of simulation software, specification, limitations and application of simulation. Manufacturing data systems - Data flow, FMS database systems and planning. | | |
| **Unit V** | **ROBOTIC TECHNOLOGY AND APPLICATIONS** | **09** |
| Introduction to Robotic elements - Joints, links, robot configurations, work volume, types of robot control, end effectors and sensors in robotics. Applications - Material handling, welding, assembly and inspection. | | |

**REFERENCE(S):**


1. Mikell P. Groover, Automation Production Systems and Computer Integrated Manufacturing System, Prentice Hall of India, PTR Upper Saddle River, NJ, USA, 2007.
2. S. R. Prasad, R. Prabhakar and S. Dhandapani, Intelligent Flexible Autonomous Manufacturing Systems, Tata McGraw Hill Publishing Private Limited., New Delhi, 2000.
3. N. K. Jha, Handbook of Flexible Manufacturing Systems, Academic Press Incorporation, SanDiego, 1991.
4. Satya Ranjan Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill Publishing Company Private Limited., New Delhi, 2009.
5. Joseph Talvage and Roger G. Hannam, Flexible manufacturing systems in practice, Marcel Dekker Incorporation, NewYork, 1987.
6. Nanua Singh, Systems Approach to Computer Integrated Design and Manufacturing, John Wiley Sons, Incorporation New York, NY, USA, 2011.


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX15 | COMPUTER INTEGRATED MANUFACTURING | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To introduce the basic concepts of Computer Integrated Manufacturing (CIM).
- To provide knowledge on Group Technology and Computer Aided Process Planning.
- To impart knowledge on Shop Floor Control and Flexible Manufacturing Systems.
- To learn the various CIM implementation and data communication techniques.
- To provide knowledge on the concept of Manufacturing automation protocol, Technical office protocol and database terminology.

**Course Outcomes:** At the end of this course, learners will be able to:

- Assess CAD/CAM integration for changing manufacturing and management scene.
- Construct a machine cell using the concepts of Group Technology and Computer Aided Process Planning.
- Select the suitable material handling and storage system for Flexible Manufacturing Systems.
- Choose the suitable CIM implementation and data communication techniques.
- Use various protocols and database terminology in CIM.

| Unit I | INTRODUCTION | 09 |
|---|---|---|

The changing manufacturing and management scene, External communication, Islands of automation and software, dedicated and open systems,manufacturing automation protocol, introduction to CAD/CAM integration.

| Unit II | GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING | 09 |
|---|---|---|

Classification and coding - DCLASS, MICLASS and OPITZ coding systems. Facility design using G.T. - Benefits of G.T - cellular manufacturing. Process planning, role of process planning in CAD/CAM integration- approaches to computer aided process planning- variant approach and generative approaches.

| Unit III | SHOP FLOOR CONTROL AND FMS | 09 |
|---|---|---|

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

| Unit IV | CIM IMPLEMENTATION AND DATA COMMUNICATION | 09 |
|---|---|---|

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

| Unit V | OPEN SYSTEM AND DATABASE FOR CIM | 09 |
|---|---|---|

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

**REFERENCE(S):**


1. Mikell P Groover,Automation of production systems and computer integrated manufacturing, Pearson Education, United States of America, 2008.
2. Lee Kunwoo, CAD,CAM,CAE systems, Addison Wesley, United States of America, 1999
3. Kant Vajpayee S, Principles of Computer Integrated Manufacturing, Prentice Hall, New Delhi, 2003
4. Radhakrishnan P, Subramanyan S and Raju V, CAD,CAM,CIM, Second Edition New Age International Pvt. Ltd, New Delhi, 2000


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | VIII |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX16 | INDUSTRIAL SAFETY ENGINEERING | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To study the principles of safety management system.
- To introduce the provisions contained in the industrial laws.
- To provide knowledge on safety requirements for engineering industry.
- To learn safety requirement for chemical industry.
- To study the various safety measures adopted in construction industries.

**Course Outcomes:** At the end of this course, learners will be able to:

- Explain safety management system of an industry.
- Implement the provisions of acts and rules in industries.
- Implement and review the safety performance followed in various industries
- Evaluate safety appraisal in chemical industries.
- Generate safety reports on construction industries.

| Unit I | SAFETY MANAGEMENT | 09 |
|---|---|---|

Concepts - Evolution, International Labour Organization (ILO), National Safety Council, Techniques - Job Safety Analysis (JSA), Safety survey, Safety inspection, Safety Sampling, Accident Investigation and Reporting - Concept of an accident, Accident causation models, cost of accident, investigation, Safety Performance Monitoring - Safety indices.

| Unit II | SAFETY AND LAW | 09 |
|---|---|---|

Factory Act 1948-Safety and Health chapters, Tamil Nadu Factories Rules- Safety and Health chapters, Environment and Pollution Laws, ,Building and other construction works act 1996,Motor Vehicle Rules, Explosive Act 1983, Boiler Act.

| Unit III | SAFETY IN ENGINEERING INDUSTRIES | 09 |
|---|---|---|

Safety in metal working machinery and wood working machines, principles, standards and codes - Principles of machine guarding - zero mechanical state (ZMS),types of guards, Personal protective equipments- Safety in handling industrial gases, storage and handling of gas cylinders- Safety in cold forming and hot working of metals- Power press, forging, safety in furnaces, Safety in finishing, inspection and testing, heat treatment, electro plating, leak test, radiography.

| Unit IV | SAFETY IN CHEMICAL INDUSTRIES | 09 |
|---|---|---|

Safety in process design, unit operations, pressure vessel, heat exchanger, safety valves -Plant commissioning and inspection, pressure vessel, non-destructive testing, vibration, corrosion Plant maintenance and emergency planning, management of maintenance HAZOP study, ALOHA SOFTWARE.

| Unit V | SAFETY IN CONSTRUCTION INDUSTRY | 09 |
|---|---|---|

Causes of fatal accidents, Construction regulations, contractual clauses, permit to work, Quality assurance in construction- Education and training Hazards of construction and prevention- excavation, scaffolding, dismantling, road works, construction of high rise buildings - Working at heights, Occupational Safety and Health Administration (OSHA) requirement for working at heights- Working on fragile roofs, work permit systems- Construction machinery, inspection and testing of cranes, chain pulley blocks, earth moving equipment, conveyors- Manual handling, Safety in demolition work, keys to safe demolition, health hazards from demolition, fire and explosion hazard- Safety in confined spaces

**REFERENCE(S):**


1. Blake R.B., Industrial Safety, Prentice Hall, Incorporated, New Jersey,1973.
2. National Safety Council, Accident Prevention Manual for Industrial Operations, Chicago,1988.
3. Subramanian V., The Factories Act, 1948, with Tamil Nadu Factories Rules , 1950, Madras.
4. Environmental Pollution Control Act, 1986
5. BOCW Act,1996, Madras Book agency, Chennai-1
6. Explosive Act, 1884, Eastern Book Company, Lucknow -266 001.


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX17 | INDUSTRIAL ROBOTICS | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To learn the construction and fundamentals of robots.
- To provide knowledge on types of drives and end effectors in robots.
- To impart knowledge on sensors and machine vision system.
- To study the kinematics of robots and its programming method.
- To provide knowledge on the applications of robots in industries.

**Course Outcomes:** At the end of this course, learners will be able to:

- Identify the components and construction of robot manipulator.
- Select a suitable drive and an end effector for industrial robots.
- Choose sensors and machine vision system for industrial robots.
- Formulate forward & inverse kinematics and construct program for robots.
- Discuss the usage and applications of robots in industries.

| Unit I | FUNDAMENTAL OF ROBOTICS PROCESS | 09 |
|---|---|---|

Robot -Definition -Robotics and Automation - Law of robotics -Robot Anatomy -Co-ordinate Systems, Work Envelope, classification - Specifications - Pitch, Yaw, Roll, Joint Notations, Pay Load - Need for Robots.

| Unit II | ROBOT DRIVE SYSTEM AND END EFFECTORS | 09 |
|---|---|---|

Pneumatic Drives, Hydraulic Drive, Mechanical Drives and Electrical Drives. End Effectors - Grippers - Pneumatic gripper, Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers, and Mechanical Grippers -Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers.

| Unit III | SENSORS AND MACHINE VISION SYSTEMS | 09 |
|---|---|---|

Sensors - types - tactile sensors, proximity and range sensors, contact and non-contact sensors, velocity sensors, touch and slip sensors, force and torque sensors. Robotic vision systems, imaging components, image representation, picture coding, object recognition and categorization, visual inspection.

| Unit IV | ROBOT KINEMATICS AND ROBOT PROGRAMMING | 09 |
|---|---|---|

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 APPLICATION | 09 |
|---|---|---|

Causes of fatal accidents, Construction regulations, contractual clauses, permit to work, Quality assurance in construction- Education and training Hazards of construction and prevention- excavation, scaffolding, dismantling, road works, construction of high rise buildings - Working at heights, Occupational Safety and Health Administration (OSHA) requirement for working at heights- Working on fragile roofs, work permit systems- Construction machinery, inspection and testing of cranes, chain pulley blocks, earth moving equipment, conveyors- Manual handling, Safety in demolition work, keys to safe demolition, health hazards from demolition, fire and explosion hazard- Safety in confined spaces

**REFERENCE(S):**


1. M. P. Groover, Industrial Robotics Technology, Programming and Applications, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2001.
2. D. Richard, Klafter, A. Thomas, Chmielewski and Michael Negin, Robotics Engineering, An Integrated Approach, Prentice Hall of India, New Delhi, 2001.
3. K. S. Fu, R. C. Gonzalez and C. S. G. Lee, Robotics Control, Sensing, Vision and Intelligence, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2003
4. Yoram Koren, Robotics for Engineers, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2004.


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|---|---|
| 5. | James G. Keramas, Robot Technology Fundamentals, Cengage Learning, 2011. |
| 6. | Subir Kumar Saha, Introduction to Robotics, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2008. |


| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | VIII |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEX18 | TOTAL QUALITY MANAGEMENT | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To learn concepts, dimension quality and philosophies of TQM.
- To study the TQM principles and its strategies.
- To expose the seven statistical quality and management tools.
- To impart knowledge on TQM tools for continuous improvement.
- To introduce QMS and EMS.

**Course Outcomes:** At the end of this course, learners will be able to:

- Use the concepts, dimension of quality and philosophies of TQM.
- Apply the principles of TQM and its strategies in industries.
- Apply the statistical quality tools and seven management tools.
- Choose the suitable TQM tools for continuous improvement.
- Use the concept of QMS and EMS in industries.

| Unit I | INTRODUCTION | 09 |
|---|---|---|

Definition of Quality - Dimensions of Quality - Quality Planning - Quality costs - Analysis Techniques for Quality Costs - Basic concepts of Total Quality Management - Historical Review - Quality Statements - Strategic Planning, Deming Philosophy - Crosby philosophy - Continuous Process Improvement - Juran Trilogy, PDSA Cycle, 5S, Kaizen - Obstacles to TQM Implementation.

| Unit II | TQM PRINCIPLES | 09 |
|---|---|---|

Principles of TQM, Leadership - Concepts - Role of Senior Management - Quality Council, Customer satisfaction - Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement - Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits - Supplier Partnership - Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures - Basic Concepts, Strategy, Performance Measure.

| Unit III | STATISTICAL PROCESS CONTROL (SPC) | 09 |
|---|---|---|

The seven tools of quality - Statistical Fundamentals - Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables X bar and R chart and attributes P, nP, C, and u charts, Industrial Examples, Process capability, Concept of six sigma - New seven Management tools.

| Unit IV | TQM TOOLS | 09 |
|---|---|---|

Deployment(QFD) - House of Quality, QFD Process, and Benefits - Taguchi Quality Loss Function - Total Productive Maintenance (TPM) - Concept, Improvement Needs, and FMEA - Stages of FMEA- Case studies

| Unit V | QUALITY SYSTEMS | 09 |
|---|---|---|

Need for ISO 9000 and Other Quality Systems - ISO 9000:2000 Quality System - Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 9000:2005 ISO 9001:2008 and ISO 9004:2009 , TS 16949, ISO 14000, AS9100 - Concept, Requirements and Benefits.

**REFERENCE(S):**


| | |
|---|---|
| 1. | DaleH.Bester filed, Total Quality Management, Pearson Education Inc., New Delhi, 2003. |
| 2. | N.Gupta and B.Valarmathi, Total Quality Management, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi,2009. |
| 3. | James R.Evans and William M.Lidsay, The Management and Control of Quality, South- Western 2002. |
| 4. | Dr.S.Kumar, Total Quality Management, Laxmi Publications Ltd. New Delhi, 2006 |
| 5. | P.N.Muherjee, Total Quality Management, Prentice Hall of India, New Delhi, 2006. |


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEY01 | ADDITIVE MANUFACTURING | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To provide knowledge on generic steps of Additive Manufacturing (AM) technique.
- To learn the concept and applications of liquid and solid based AM processes.
- To impart knowledge on powder based AM processes.
- To introduce the concept of open source 3D printers and rapid tooling.
- To expose the emerging trends and applications of Additive Manufacturing technology.

**Course Outcomes:** At the end of this course, learners will be able to:

- Explain the generic steps and classification of Additive Manufacturing processes.
- Select the suitable material and AM process based on applications.
- Identify the suitable AM process to fabricate metallic components.
- Design their own open source 3D printer based on application.
- Implement the reverse engineering techniques for developing prototype

| Unit I | INTRODUCTION | 07 |
|---|---|---|

Needs - Impact of AM and Rapid Tooling on Product Development - Distinction between AM and CNC Machining- The Generalized AM Process chain - CAD Model - Input file formats - Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction - Part Cleaning and finishing - RP Benefits - Classification of RP systems.

| Unit II | LIQUID POLYMER AND SOLID BASED SYSTEMS | 07 |
|---|---|---|

Stereolithography Apparatus (SLA), Digital Light Projection (DLP), Photo polymerization process, Solid Ground Curing (SGC), Fused Deposition Modeling (FDM) and Laminated Object Manufacturing (LOM) - Working Principle, Construction, Materials and Applications.

| Unit III | POWDER BASED SYSTEMS | 10 |
|---|---|---|

Selective Laser Sintering (SLS), Three dimensional Printing (3DP), Direct Metal Deposition (DMD), Ballistic Particle Manufacturing (BPM), Electron Beam Melting (EBM) and Laser Engineered Net Shaping (LENS)- Working Principle, Construction, Process Variables, Materials and Applications.

| Unit IV | OPEN SOURCE PRINTER AND RAPID TOOLING | 11 |
|---|---|---|

Concept of open source 3D printer - Structural details, Control mechanism - Materials and Applications. Introduction to rapid tooling (RT) - Direct and Indirect tooling - Silicone rubber moulding, Epoxy tooling, Spray Metal Coating, 3D printing direct, Electro Optical Sintering (EOS) - Working Principle, Materials and Applications

| Unit V | REVERSE ENGINEERING AND APPLICATIONS OF ADDITIVE MANUFACTURING | 10 |
|---|---|---|

Reverse Engineering - Application of CMM, Laser scanner, CT and MRI scan in acquiring point data - Software for STL file processing. Application of Rapid prototyping in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries. Leading manufacturer of RP systems.

**TEXT BOOK(S):**


1. C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: Principles and applications, Cambridge University Press, 2010.
2. D. T.Pham and S. S.Dimov, Rapid manufacturing, Springer-Verlag, London, 2001.


**REFERENCE(S):**


1. I. Gibson, D. W. Rosen, and B. Stucker, Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010
2. L.W. Liou, F.W. Liou, Rapid Prototyping and Engineering applications: A toolbox for prototype development, CRC Press, 2013.
3. A. K. Kamrani, E. A. Nasr, Rapid Prototyping: Theory and practice, Springer, 2006.


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEY02 | NON - DESTRUCTIVE EVALUATION FOR ENGINEERS | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To learn different surface inspection techniques.
- To provide knowledge on magnetic particle testing.
- To impart knowledge on ultrasonic testing method.
- To provide knowledge on radiography testing method.
- To study various special non destructive testing methods.

**Course Outcomes:** At the end of this course, learners will be able to:

- Select appropriate surface inspection techniques for the components to be inspected
- Explain the magnetic particle testing method for ferrous materials.
- Select and explain the suitable testing method for testing internal defects.
- Apply radiography testing methods for different suitable applications.
- Choose the suitable special non-destructive technique for various applications.

| Unit I | SURFACE TECHNIQUES | 09 |
|---|---|---|

Concepts of Non-Destructive testing (NDT) - Discontinuities and Defects in various manufacturing Component- Types of NDT techniques, Introduction to Standards and Specifications (ASME, ASTM, AWS) - Visual or Optical Testing, Direct and remote visual inspection and Aides-Liquid Penetrant Testing (LPT) Principles - Types and properties of liquid penetrants and developers - Preparation of test materials - Advantages and limitations - Application of penetrants to parts - Fluorescent penetrant test.

| Unit II | MAGNETIC PARTICLE TESTING | 09 |
|---|---|---|

Magnetic Particle Testing (MPT) Principles, applications - Magnetization methods, magnetic Particles, - Dry particle technique and Wet fluorescent particle technique, demagnetization, Advantages and limitations - Magnetic Flux Leakage Testing Principle, Instrumentation and applications - Electromagnetic Induction Techniques, Principle - Instrumentation and applications of Eddy Current Testing (ECT)

| Unit III | ULTRASONIC TESTING | 09 |
|---|---|---|

Ultrasonic Testing (UT) Principle, Types and characteristics of Ultrasonic waves, Attenuation, Couplants, Probes - Inspection methods-Pulse echo, Transmission and Phased Array techniques (PAUT) , Types of scanning and displays, Angle beam inspection of welds, Calibration of ASTM Test blocks, International Institute of Welding IIW) reference blocks, Applications.

| Unit IV | RADIOGRAPHY TESTING | 09 |
|---|---|---|

Radiographic testing (RT) Principle, Sources of X-rays and Gamma rays and their characteristics - Absorption, scattering-Filters and screens, imaging modalities - Film radiography and Digital Radiography - Problems in shadow formation, Exposure factors, film handling and storage Inverse square law, Exposure charts, and Radiographic equivalence. Penetrometers, Safety in radiography, Applications.

| Unit V | SPECIAL TECHNIQUES | 09 |
|---|---|---|

Acoustic Emission Testing (AET) Principle - Advantages and limitations - Instrumentation and applications - Infra Red Thermography (IRT), Contact and non-contact inspection methods, Pressure and Leak Testing - Testing Procedure and applications, LASER Shearography - Typical applications- Requirements - advantages and disadvantages.

**TEXT BOOK(S):**

1. Baldev Raj, Jayakumar T, Thavasimuthu M, Practical Non-Destructive Testing, Narosa Publishing, 1997.

**REFERENCE(S):**

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| | |
|---|---|
| 1. | Mc Gonnagle,Non-Destructive Testing, McGraw Hill Book Co., 1988. |
| 2. | Barry Hull and Vernon John, Non Destructive Testing, Macmillan, 1989. |
| 3. | V-17, Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, 2001 |


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEY03 | INDUSTRIAL SAFETY ENGINEERING | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To provide in depth knowledge in Principles of Environmental safety and its applications in various fields.
- To provide the knowledge of air and water pollution and their control.
- To expose the students to the basics in hazardous waste management.

**Course Outcomes:** At the end of this course, learners will be able to:

- Illustrate and familiarize the basic concepts and scope of engineering safety.
- Understand the standards of professional conduct that are published by professional safety organizations and certification bodies.
- Illustrate the importance of safety of employees while working with machineries.

| Unit I | SAFETY IN METAL WORKING AND WOOD WORKING MACHINES | 09 |
|---|---|---|

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards. Inspection of material handling equipments.

| Unit II | SAFETY IN WELDING AND GAS CUTTING | 09 |
|---|---|---|

Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-colour coding – flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders.

| Unit III | SAFETY IN COLD FORMING AND HOT WORKING OF METALS | 09 |
|---|---|---|

Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes - Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes, hazards and control measures - Safety in Gas Furnace Operation, Cupola, Crucibles, Ovens, Foundry Health Hazards, Work Environment, Material Handling in Foundries, Foundry Production Cleaning And Finishing Foundry Processes.

| Unit IV | SAFETY IN FINISHING, INSPECTION AND TESTING | 09 |
|---|---|---|

Heat treatment operations, Electro Plating, Paint Shops, Sand And Shot Blasting, Safety In Inspection And Testing, Dynamic Balancing, Hydro Testing, Valves, Boiler Drums And Headers, Pressure Vessels, Air Leak Test, Steam Testing, Safety In Radiography, Personal Monitoring Devices, Radiation Hazards, Engineering And Administrative Controls, Indian Boilers Regulation.

| Unit V | INDUSTRIAL SAFETY | 09 |
|---|---|---|

Advances in Industrial Ergonomics and safety, Work and protective clothing, Theory and practice of Industrial safety, Industrial Noise and Vibration, Machine Guarding and Industrial machine safety, Manual material handling, Modeling for safety and health.

**REFERENCES:**


| | |
|---|---|
| 1. | Philip E. Hagan, John Franklin Montgomery, James T. O'Reilly, Accident Prevention Manual – NSC, Chicago, 2009. |
| 2. | Charles D. Reese, Occupational Health and Safety Management, CRC Press, 2003. |
| 3. | John V. Grimaldi and Rollin H. Simonds Safety Management by All India Travelers Book seller, New Delhi, 1989. |


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|---|---|
| 4. | John Davies, Alastair Ross, Brendan Wallace, Safety Management: A Qualitative Systems Approach, CRC Press, 2003. |
| 5. | Health and Safety in welding and Allied processes, welding Institute, UK, High Tech. Publishing Ltd., London, 1989 |
| 6. | Anil Mital Advances in Industrial Ergonomics and Safety Taylor and Francis Ltd, London, 1989 |
| .7. | Dr. Vincent Matthew Ciriello (Prediction of the maximum acceptable weight of lift from the frequency of lift, journal of industrial ergonomics,( 2014), pg .225–237 |


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEY04 | MAINTENANCE ENGINEERING | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is :

- To understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- To educate different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.

**Course Outcomes:** At the end of this course, learners will be able to:

- Explain principles, functions and practices adapted in industry for the successful management of maintenance activities.
- Demonstrate the various policies preventive maintenance.
- Explain Preventive maintenance concepts.
- Explain condition monitoring concepts.
- Carryout various repair methods of machine elements.

| Unit I | PRINCIPLES MAINTENANCE PLANNING | 09 |
|---|---|---|

Basic Principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound maintenance systems - Reliability and machine availability.

| Unit II | PRACTICES OF MAINTENANCE PLANNING | 09 |
|---|---|---|

Mean Time Between Failures, Mean Time To Repair and Mean Waiting Time - Factors of availability - Maintenance organization - Maintenance economics.

| Unit III | MAINTENANCE POLICIES - PREVENTIVE MAINTENANCE | 09 |
|---|---|---|

Maintenance categories - Comparative merits of each category - Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication - Total Productive Maintenance.

| Unit IV | CONDITION MONITORING | 09 |
|---|---|---|

Condition based maintenance - Cost comparison with and without Condition Monitoring - On-load testing and offload testing.

| Unit V | REPAIR METHODS | 09 |
|---|---|---|

Failure analysis - Failures and their development - Repair methods for Maintenance.

**REFERENCE(S):**


1. Srivastava S.K., Industrial Maintenance Management, S. Chand and Company, 2002.
2. Venkataraman.K, Maintenance Engineering and Management, Prentice Hall of India Learning, Pvt. Ltd., 2007.
3. Andrew K.S.Jardine and Albert H.C.Tsang, Maintenance, Replacement and Reliability, Taylor and Francis, 2006.
4. Mishra R.C. and Pathak.K, Maintenance engineering and Management, PHI Learning, Pvt.Ltd., 2012.
5. Higgins R.L, R.Keith Mobley and Darrin Wikoff, Maintenance Engineering Handbook, McGraw-Hill Companies Inc. 2008.


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEY05 | RENEWABLE ENERGY SOURCES | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is :

- To learn about solar radiation and solar thermal systems.
- To provide knowledge on fundamentals of Photovoltaic systems.
- To study about the working of ocean and geothermal energy sources.
- To impart the knowledge on wind energy system.
- To learn about bio mass energy sources and its utilization

**Course Outcomes:** At the end of this course, learners will be able to:

- Explain solar radiation and its conversion into heat using solar collectors.
- Summarize the characteristics of solar photovoltaic system.
- Illustrate the working of ocean and geothermal energy sources.
- Compute wind energy potential and design of wind energy systems.
- Select the bio mass energy sources and its conversion technologies

| Unit I | SOLAR RADIATION AND SOLAR THERMAL SYSTEMS | 09 |
|---|---|---|

Solar radiation at the Earth's surface, solar radiation measurements, solar radiation data, estimation of average solar radiation. Introduction to conversion of solar radiation into heat, flat plate collectors, concentrating collectors – Types.

| Unit II | SOLAR PHOTOVOLTAIC SYSTEMS | 09 |
|---|---|---|

Introduction to photovoltaic system, Voltage current characteristics of a solar cell, interconnection of solar cells, efficiency of a solar cell, configuration of solar photovoltaic panel, merits and limitations and its applications.

| Unit III | OCEAN ENERGY AND GEOTHERMAL ENERGY | 09 |
|---|---|---|

Wave energy - Energy from waves, energy potential. Conversion devices. Tidal energy – energy potential, conversion systems. Ocean thermal energy conversion -Methodology, Applications. Geothermal energy - classification of geothermal resources, schematic of geothermal power plants, operational and environmental problems

| Unit IV | WIND ENERGY | 09 |
|---|---|---|

Basic principles of wind energy conversion - classification of wind turbines, wind turbine rotor, regulating system for rotor, wind power generation curves, wind data and energy estimation. Site selection considerations - Merits and demerits of wind energy systems

| Unit V | BIO-ENERGY | 09 |
|---|---|---|

Biomass resources - Conversion technologies - Biochemical conversion, Biomass gasification, Pyrolysis. Biogas - Production, factors affecting biogas production, biogas plants. Energy recovery from urban waste, power generation from liquid waste, biomass cogeneration, bio-fuel

**REFERENCE(S):**


1. D. P. Kothari, K. C. Singal and Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, Prentice Hall of India , New Delhi, 2009
2. Godfrey Boyle, Renewable energy power for sustainable future, Oxford University Press in association with the Open University, New Delhi,2004
3. S. A. Abbasi and Naseema Abbasi, Renewable energy sources and their environmental impact Prentice Hall of India, New Delhi, 2001
4. John W. Twidell and Anthony D. Weir, Renewable energy resources, English Language Book Society (ELBS), 2006
5. G. D. Rai, Renewable Energy Sources, Khanna Publishers


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEY06 | POWER PLANT ENGINEERING | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is :

- To impart the knowledge on boilers and steam power plant.
- To learn about the various components associated with steam power plant.
- To study the working of nuclear and hydel power plant.
- To learn about the working of diesel and gas turbine power plant.
- To provide the knowledge on power plants using renewable energy and economics of power plants.

**Course Outcomes:** At the end of this course, learners will be able to:

- Explain the working principle of steam power plant and boilers.
- Assess the function of various systems in steam power plant.
- Select the suitable components for nuclear power plants and hydel power plants.
- Expose the working of diesel and gas turbine power plant.
- Explain the different sources of renewable energy and calculate the economics of power plants

| Unit I | INTRODUCTION TO POWER PLANTS AND BOILERS | 09 |
|---|---|---|

Layout of Steam power plant - Components, Selection. Steam Boilers and Cycles - High Pressure and Super Critical Boilers, Fluidized Bed Boilers. Combined Power Cycles. Comparison and Selection

| Unit II | STEAM POWER PLANT | 09 |
|---|---|---|

Fuel and Ash Handling - Combustion Equipment for burning coal, Mechanical Stokers, Pulveriser, Electrostatic Precipitator, and Mechanical Collectors. Draught - different types. Surface Condenser types. Cooling Towers. Pollution controls.

| Unit III | NUCLEAR AND HYDEL POWER PLANTS | 09 |
|---|---|---|

Nuclear Energy - Fission, Fusion Reaction. Layout - Types of Reactors, Pressurized Water Reactor, Boiling Water Reactor, Waste Disposal and safety. Hydel Power Plant - Layout, Essential Elements, pumped storage. Selection of Turbines, Governing of Turbines.

| Unit IV | DIESEL AND GAS TURBINE POWER PLANTS | 09 |
|---|---|---|

Layout of Diesel power Plant - Components, Selection of Engine Type, applications. Gas Turbine Power Plant - Layout, Fuels, Gas Turbine Material. Open and Closed Cycles - Reheating, Regeneration and Intercooling.

| Unit V | OTHER POWER PLANTS AND ECONOMICS OF POWER PLANTS | 09 |
|---|---|---|

Geo thermal power plant. Ocean thermal energy conversion (OTEC). Tidal power plant. Solar thermal power plant. Wind energy. Wind turbines. Magneto hydrodynamic generator (MHD). Cost of Electric Energy - Fixed and operating Costs, Economics of load sharing.

**REFERENCE(S):**


1. S. C. Arora, S. Domkundwar, A course in Power Plant Engineering, Dhanpatrai & Sons, New Delhi, 2008.
2. K.K.Ramalingam, Power Plant Engineering, Scitech Publications (India) Private Limited, 2002.
3. P. K. Nag, Power plant Engineering, Tata McGraw Hill Company Private Limited, New Delhi, 2014.
4. G. R. Nagpal, Power Plant Engineering, Khanna Publishers, New Delhi, 2002.
5. G. D. Rai, Introduction to Power Plant Technology, Khanna Publishers, New Delhi, 2013.
6. R. K. Rajput, Power Plant Engineering, Laxmi Publications, New Delhi, 2007.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | OE |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEY07 | RAPID PROTOTYPING | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is :

- To understand the process of generating 3D Computer Aided Design (CAD) model by different method
- To explain the constructional features and to develop simple program for CNC lathe and Milling machines.
- To provide an exhaustive knowledge on various generic process and benefits of Rapid Prototyping Techniques (RPT).
- To familiarize about materials and process parameters of liquid and solid based RP Techniques.
- To educate powder based methodology and emerging trends with case studies, applications of Additive Manufacturing (AM) technology.

**Course Outcomes:** At the end of this course, learners will be able to:

- Design a 3D model from the 2D data.
- Develop a CNC program for simple components.
- Generate stl file to feed into RP machine.
- Select appropriate liquid or solid materials based RP process to the respective application
- Select appropriate process for aerospace, automotive, electronics, manufacturing and medical applications.

| Unit I | CAD MODELING | 09 |
|---|---|---|

Introduction - Design process - Stages. CAD - Input and Output devices, Modeling methods – Wire frame modelling, Surface modelling, Solid modelling - Constructive Solid Geometry and Boundary Representation Techniques. CAD/CAM data exchange - IGES, STEP. Product Life cycle management (PLM).

| Unit II | AUTOMATION AND CNC MACHINES | 10 |
|---|---|---|

Introduction to Automation - Definition, types, reasons for automating. CNC Machines - Principles, types, features, advantages, applications and CNC Machine structure - Linear motion bearings, Recirculating ball bearings, drive system, and control system. CNC Lathe and Milling programming - Linear and circular interpolation, threading and drilling programs.

| Unit III | ADDITIVE MANUFACTURING | 07 |
|---|---|---|

Introduction - Impact of Additive Manufacturing (AM) and Tooling on Product Development -Distinction between AM and CNC Machining- The Generalized AM Process chain - CAD Model - Input file formats - Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction - Part Cleaning and finishing - AM Benefits - Classification of AM process

| Unit IV | LIQUID AND SOLID MATERIAL BASED SYSTEMS | 08 |
|---|---|---|

Stereo lithography Apparatus (SLA), Solid Ground Curing (SGC), Fused Deposition Modelling (FDM) and Laminated Object Manufacturing (LOM) - Working Principle, Construction, Process, Materials and Applications

| Unit V | POWDER BASED PROCESSES AND APPLICATIONS OF ADDITIVE MANUFACTURING | 11 |
|---|---|---|

Selective Laser Sintering (SLS), Three dimensional Printing (3DP), Electron Beam Melting (EBM) and Laser Engineered Net Shaping (LENS) - Working Principle, Construction, Process Variables, Materials and Applications. Application of Additive Manufacturing in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries.

**TEXT BOOK(S):**


1. Ibrahim Zeid, R.Sivasubramania, CAD/CAM Theory and Practice, Tata McGraw Hill, 2010.
2. M. Aditan, B.S. Pabala, CNC Machines, New age International, 2012.


**REFERENCE(S):**

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| | |
|---|---|
| 1. | C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: Principles and applications, Cambridge University Press, 2010. |
| 2. | D. T.Pham, S. S.Dimov, Rapid manufacturing, Springer-Verlag, London, 2001. |
| 3. | I. Gibson, D. W. Rosen, and B. Stucker, Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010 |


| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | OE |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEY08 | NANOMATERIALS SCIENCE | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is :

- To understand the fundamentals of physics of nanomaterials
- To correlate on multidisciplinary branch
- To acquire the knowledge in nanomaterials synthesis, compile and analyze data and draw conclusions at nano level

**Course Outcomes:** At the end of this course, learners will be able to:

- Classify the size dependant properties of different nanomaterials
- Explain different experimental methods used for the preparation of nanomaterials
- Analyse the data using different characterization techniques
- Illustrate the different techniques to synthesize semiconductor nanostructures and utilize them for application
- Identify the impact of nanomaterials and their applications in Nano devices

| Unit I | NANO SCALE MATERIALS | 09 |
|---|---|---|

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties -magnetic properties of nanoscale materials -differences between bulk and nanomaterials and their physical properties.

| Unit II | NANOMATERIALS SYNTHESIS METHODS | 09 |
|---|---|---|

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process - chemical vapour deposition, plasma enhanced CVD, colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self- organization - DC sputtering and RF sputtering process.

| Unit III | CHARACTERIZATION TECHNIQUES | 09 |
|---|---|---|

General classification of characterization methods - analytical and imaging techniques – microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

| Unit IV | SEMICONDUCTOR NANOSTRUCTURES | 09 |
|---|---|---|

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes- structure, synthesis and electrical properties -applications- fuel cells - quantum efficiency of semiconductor nanomaterials.

| Unit V | NANOMACHINES AND NANODEVICES | 09 |
|---|---|---|

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- organic LEDs - basic processes, carrier injection, excitons, optimization - organic photovoltaic cells- nano motors -bio nano particles-nano - objects - applications of nano materials in biological field.

**TEXT BOOK(S):**


| | |
|---|---|
| 1. | Willam A. Goddard, Donald W.Brenner, Handbook of Nanoscience, Engineering, and Technology, CRC Press, 2012. |


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| | |
|---|---|
| 2. | Charles P. Poole Jr and. Frank J. Owens, Introduction to Nanotechnology, Wiley Interscience, 2007. |

| REFERENCE(S): | |
|---|---|
| 1. | Guozhong Cao, Y. Wang, Nanostructures and Nanomaterials-Synthesis, Properties &Applications, Imperials College Press, 2011. |
| 2. | T. Pradeep, NANO: The Essentials Understanding Nanoscience and Nanotechnology, McGraw - Hill Education (India) Ltd, 2012. |

| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | OE |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEY09 | ADVANCED MECHATRONICS FOR ENGINEERS | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.

**Course Outcomes:** At the end of this course, learners will be able to:

- Discuss the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology.
- Discuss the architecture of Microprocessor and Microcontroller, Pin Diagram, Addressing Modes of Microprocessor and Microcontroller.
- Discuss Programmable Peripheral Interface, Architecture of 8255 PPI, and various device interfacing
- Explain the architecture, programming and application of programmable logic controllers to problems and challenges in the areas of Mechatronics engineering.
- Discuss various Actuators and Mechatronics system using the knowledge and skills acquired through the course and also from the given case studies

| Unit I | INTRODUCTION | 09 |
|---|---|---|

Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and dynamic characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors

| Unit II | PROGRAMMABLE PERIPHERAL INTERFACE | 09 |
|---|---|---|

Introduction – Architecture of 8255, Keyboard interfacing, LED display –interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface.

| Unit III | MICROPROCESSOR AND MICROCONTROLLER | 09 |
|---|---|---|

. Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram,

| Unit IV | INTRODUCTION TO PROGRAMMABLE LOGIC CONTROLLER | 09 |
|---|---|---|

Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC

| Unit V | ACTUATORS AND MECHATRONIC SYSTEM DESIGN | 09 |
|---|---|---|

Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages. Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier.

| TEXT BOOK(S): | |
|---|---|
| 1. | Bolton, "Mechatronics", Prentice Hall, 2008 |
| 2. | Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 5th Edition, Prentice Hall, 2008. |

| REFERENCE(S): | |
|---|---|
| 1. | Bradley D.A, Dawson D, Buru N.C and Loader A.J, "Mechatronics", Chapman and Hall, 1993 |
| 2. | Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013 |
| 3. | Devadas Shetty and Richard A. Kolk, "Mechatronics Systems Design", PWS publishing company, 2007. |

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| | |
|---|---|
| 4. | Krishna Kant, "Microprocessors & Microcontrollers", Prentice Hall of India, 2007 |
| 5. | Michael B.Histand and Davis G.Alciatore, "Introduction to Mechatronics and Measurement systems", McGraw Hill International edition, 2007 |

| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | OE |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEY10 | AUTOMOBILE ENGINEERING | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To have the practice for assembling and dismantling of engine parts and transmission
- To understand the construction and working principle of various parts of an automobile.

**Course Outcomes:** At the end of this course, learners will be able to:

- Recognize the various parts of the automobile and their functions and materials.
- Discuss the engine auxiliary systems and engine emission control.
- Distinguish the working of different types of transmission systems.
- Explain the Steering, Brakes and Suspension Systems.
- Predict possible alternate sources of energy for IC Engines.

| Unit I | VEHICLE STRUCTURE AND ENGINES | 09 |
|---|---|---|

Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines –components-functions and materials, variable valve timing (VVT).

| Unit II | ENGINE AUXILIARY SYSTEMS | 09 |
|---|---|---|

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 (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

| Unit III | TRANSMISSION SYSTEMS | 09 |
|---|---|---|

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 | 09 |
|---|---|---|

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 (ABS), electronic brake force distribution (EBD) and Traction Control.

| Unit V | ALTERNATIVE ENERGY SOURCES | 09 |
|---|---|---|

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles-Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students

**TEXT BOOK(S):**

| | |
|---|---|
| 1. | Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002. |
| 2. | Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 13th Edition 2014. |

**REFERENCE(S):**

| | |
|---|---|
| 1. | Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012. |
| 2. | Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998. |
| 3. | Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999. |
| 4. | Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart - Will Cox Company Inc, USA ,1978. |
| 5. | Newton ,Steeds and Garet, "Motor Vehicles", Butterworth Publishers,1989. |

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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | OE |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEY11 | ROBOTICS | 3 | 0 | 0 | 3 | 45 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To learn the construction and fundamentals of robots.
- To provide knowledge on types of drives and end effectors in robots.
- To impart knowledge on sensors and machine vision system.
- To study the kinematics of robots and its programming method.
- To provide knowledge on the applications of robots in industries.

**Course Outcomes:** At the end of this course, learners will be able to:

- Identify the components and construction of robot manipulator.
- Select a suitable drive and an end effector for industrial robots.
- Choose sensors and machine vision system for industrial robots.
- Formulate forward & inverse kinematics and construct program for robots.
- Discuss the usage and applications of robots in industries.

| Unit I | FUNDAMENTAL OF ROBOTICS PROCESS | 09 |
|---|---|---|

Robot -Definition -Robotics and Automation - Law of robotics -Robot Anatomy -Co-ordinate Systems, Work Envelope, classification - Specifications - Pitch, Yaw, Roll, Joint Notations, Pay Load - Need for Robots.

| Unit II | ROBOT DRIVE SYSTEM AND END EFFECTORS | 09 |
|---|---|---|

Pneumatic Drives, Hydraulic Drive, Mechanical Drives and Electrical Drives. End Effectors - Grippers - Pneumatic gripper, Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers, and Mechanical Grippers -Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers.

| Unit III | SENSORS AND MACHINE VISION SYSTEMS | 09 |
|---|---|---|

Sensors - types - tactile sensors, proximity and range sensors, contact and non-contact sensors, velocity sensors, touch and slip sensors, force and torque sensors. Robotic vision systems, imaging components, image representation, picture coding, object recognition and categorization, visual inspection.

| Unit IV | ROBOT KINEMATICS AND ROBOT PROGRAMMING | 09 |
|---|---|---|

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 APPLICATION | 09 |
|---|---|---|

Causes of fatal accidents, Construction regulations, contractual clauses, permit to work, Quality assurance in construction- Education and training Hazards of construction and prevention- excavation, scaffolding, dismantling, road works, construction of high rise buildings - Working at heights, Occupational Safety and Health Administration (OSHA) requirement for working at heights- Working on fragile roofs, work permit systems- Construction machinery, inspection and testing of cranes, chain pulley blocks, earth moving equipment, conveyors- Manual handling, Safety in demolition work, keys to safe demolition, health hazards from demolition, fire and explosion hazard- Safety in confined spaces

**REFERENCE(S):**


1. M. P. Groover, Industrial Robotics Technology, Programming and Applications, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2001.
2. D. Richard, Klafter, A. Thomas, Chmielewski and Michael Negin, Robotics Engineering, An Integrated Approach, Prentice Hall of India, New Delhi, 2001.
3. K. S. Fu, R. C. Gonzalez and C. S. G. Lee, Robotics Control, Sensing, Vision and Intelligence, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2003
4. Yoram Koren, Robotics for Engineers, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2004.
5. James G. Keramas, Robot Technology Fundamentals, Cengage Learning, 2011
6. Subir Kumar Saha, Introduction to Robotics, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2008.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | OE |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEY12 | ADVANCED FINITE ELEMENT ANALYSIS | 3 | 0 | 0 | 3 | 60 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To impart basic knowledge in finite element method.
- To provide knowledge in 1D elements.
- To provide knowledge in 2D elements.
- To study heat conduction problems using finite element method.
- To provide knowledge on higher order and iso parametric elements.

**Course Outcomes:** At the end of this course, learners will be able to:

- Apply the numerical methods to formulate the simple finite element problems.
- Apply one dimensional finite element method to solve bar, beam and truss type problems.
- Apply finite element method for plane stress, plane strain and axisymmetric conditions.
- Determine temperature distribution of one and two dimensional heat transfer problems using one and two
- dimensional finite elements.
- Apply the numerical methods to formulate the higher order and isoperimetric problems.

| Unit I | INTRODUCTION | 09 |
|---|---|---|

Relevance and scope of finite element methods - strain vs displacement relations - stresses and equilibrium - natural and essential boundary conditions - Rayleigh Ritz - Galerkin method- FEM procedure - Discretisation of domain-element shapes, types, size, location and numbers.

| Unit II | ONE-DIMENSIONAL (1D) ELEMENTS | 09 |
|---|---|---|

Coordinate system types-global, local and natural. shape function of 1D bar element -Finite element formulation - stiffness matrix, load vector, boundry condition and assembly of global equation-1D bar element and two node truss element- problems in 2D truss. Introduction to beam element.

| Unit III | TWO-DIMENSIONAL (2D) ELEMENTS | 09 |
|---|---|---|

Shape function for linear triangular element-Finite element formulation- Constant Strain Triangular (CST) element -plane stress, plane strain - axisymmetric elements - problems.

| Unit IV | HEAT TRANSFER APPLICATIONS | 09 |
|---|---|---|

Shape function for 1D and 2D triangular element heat conduction - stiffness matrix, load vector and assembly of global equation for 1D and 2D triangular element heat conduction, heat generation with convective boundary conditions for linear element.

| Unit V | HIGHER ORDER AND ISOPARAMETRIC ELEMENT | 09 |
|---|---|---|

Selection of order of polynomial-linear, simplex, complex and multiplex elements. Mesh refinement methods and convergence requirements. Iso, Sub and Super parametric element. Shape functions for a 2-D four nodded and eight nodded Isoparametric rectangular element using natural coordinate system - problems. Gaussian quadrature method-problems.

**REFERENCE(S):**


2. S. S. Rao, Finite Element Method in Engineering, Elsevier India, 2005.
3. David V. Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi,2005.
3. Robert D. Cook, s. David , Malkucs Michael E. Plesha, Concepts and Applications of Finite Element Analysis, John Wiley, New Delhi,2007
5. T. R. Chandrupatla and A. D. Belegundu, Introduction to Finite Elements Engineering, Pearson Education, New Delhi, 2002.
5. S. S. Bhavikati, Finite Element Analysis, New Age International Publishers, 2015.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | OE |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEY13 | ENTREPRENEURSHIP DEVELOPMENT | 3 | 0 | 0 | 3 | 60 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

**Course Outcomes:** At the end of this course, learners will be able to:

- Gain knowledge and skills needed to run a business successfully

| Unit I | ENTREPRENEURSHIP | 09 |
|---|---|---|

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

| Unit II | MOTIVATION | 09 |
|---|---|---|

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

| Unit III | BUSINESS | 09 |
|---|---|---|

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 | 09 |
|---|---|---|

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

| Unit V | SUPPORT TO ENTREPRENEURS | 09 |
|---|---|---|

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

**TEXTBOOKS:**


1. Donald F Kuratko, "Entrepreneurship – Theory, Process and Practice", 9 th Edition, Cengage Learning, 2014.
2. Khanka. S.S., "Entrepreneurial Development" S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.


**REFERENCES:**


1. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.
2. Hisrich R D, Peters M P, "Entrepreneurship" 8 th Edition, Tata McGraw-Hill, 2013.
3. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2 nd Edition Dream tech, 2005.
4. Rajeev Roy, "Entrepreneurship" 2 nd Edition, Oxford University Press, 2011.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | OE |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEY14 | PRODUCTION TECHNOLOGY OF AGRICULTURAL MACHINERY | 3 | 0 | 0 | 3 | 60 | 100 | |

**Course Objective (s):** The purpose of learning this course is:

- 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.

**Course Outcomes:** At the end of this course, learners will be able to:

- Apply the different manufacturing process and use this in industry for component production.

| Unit-I | ENGINEERING MATERIALS | 10 |
|---|---|---|

Engineering materials - their classification - Mechanical properties of materials, strength, elasticity,plasticity, stiffness, malleability, ductility, brittleness, toughness, hardness, resilience,machinability, formability, weldability. Steels and cast irons: Carbon steels, their classification based on percentage of carbon as low, mild, medium & high carbon steel, their properties & applications. Wrought iron, cast iron. Alloy steels: Stainless steel, tool steel.

| Unit-II | MACHINING | 8 |
|---|---|---|

Basic principles of lathe - machine and operations performed on it. Basic description of machines and operations of Shaper-Planner, Drilling, Milling & Grinding.

| Unit-III | WELDING | 7 |
|---|---|---|

Introduction, classification of welding processes. Gas welding, types of flames and their applications. Electric Arc welding. Resistance welding, Soldering & Brazing processes and their uses.

| Unit-IV | ADVANCED MANUFACTURING PROCESS | 10 |
|---|---|---|

Abrasive flow machining - abrasive jet machining - water jet machining - Electro Discharge Machining (EDM) - Wire cut EDM - Electro Chemical Machining (ECM) - Ultrasonic Machining / Drilling (USM / USD) - Electron Beam Machining (EBM) - Laser Beam Machining (LBM).

| Unit-V | CNC MACHINE | 9 |
|---|---|---|

Numerical control (NC) machine tools - CNC: types, constitutional 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.

**TEXTBOOKS:**


1. Manufacturing Engineering and Technology", Kalpakjian and Schmid, Pearson, 2010
2. Hajra Choudry, "Elements of workshop technology - Vol II", Media promoters, 2002.


**REFERENCES:**


1. Gupta. K.N., and Kaushik, J.P., 1998, Workshop Technology Vol I and II, New Heights,Daryaganj, New Delhi.
2. Arthur. D., et. al. 1998, General Engineering Workshop Practice, Asia Publishing House, Bombay.
3. Chapman W.A.J., Workshop Technology, 1992, Part I, II, III, E.L.B.S. and Edward Amold Publishers Ltd, London.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEZ01 | GEOMETRIC DIMENSIONING AND TOLERANCING | 1 | 0 | 0 | 1 | 15 | 100 | |

**Course Objective (s):** The purpose of learning this course is :

- To understand the basics of GD&T and its practical applications
- To understand the proper way to specify dimensions and tolerances, symbols, datum, position, location, run out and profile

**Course Outcomes**: At the end of this course, learners will be able to:

- Classify the standards and fundamentals of limits, fits and tolerance.
- Explain the rules and symbols of dimension and tolerance in various products.

| Unit I | GEOMETRIC DIMENSIONING AND TOLERANCING | 15 |
|---|---|---|

Introduction to Geometric Dimensioning and Tolerancing - Dimensioning and Tolerancing Fundamentals -Symbols, Terms, and Rules-Datum Application, Datum feature identification-Inclined, cylindrical datum feature. Form flatness, straightness, circularity, cylindricity - Position Maximum Material Condition, Least material Condition - Location - Position, Coaxiality - Concentricity Symmetry Exercises - Run out - Definition, circular run out, total run out Profile Definition, Specifying profile, radius refinement with profile of conical feature.

**REFERENCE(S):**


1. Gene R Cogorno, Geometric Dimensioning and Tolerancing for Mechanical Design, McGraw Hill, 2006
2. Alex Krulikowski, Fundamentals of Geometric Dimensioning and Tolerancing, Delmar Cengage Learning, 1997
3. Gary K Griffith, Geometric Dimensioning and Tolerancing: Application and Inspection, Prentice Hall, 2001.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEZ03 | PIPING ENGINEERING | 1 | 0 | 0 | 1 | 15 | 100 | |

**Course Objective (s):** The purpose of learning this course is :

- To impart knowledge on piping processes.
- To create expertise in Preparation of Plot Plan-Preparation of Equipment Layouts

**Course Outcomes:** At the end of this course, learners will be able to:

- Construct the process diagram for piping network
- Plan the process layouts and design efficient piping systems

| Unit I | PIPING ENGINEERING | 15 |
|---|---|---|

Introduction to Piping, Process Diagrams (PFD, UFD, P&ID, Line List etc) Pipe Fittings- Pipe Flanges, Valves and Piping Special Items -Various codes and standards used in power and process industries-. Overview of Technical Queries and Technical Bid Evaluations - Preparation of Plot Plan- Preparation of Equipment Layouts- Preparation of Piping General Arrangement Drawings-Preparation of Cross Sectional Drawings-Piping Isometric Drawings-Material Take off-Preparation of Piping Material Specification-, Valve Material Specification-Pipe Wall thickness Calculations-Branch reinforcement calculations-Introduction to Stress Analysis-Types of stresses- Significance of forces and moments in piping system-Expansion Loop and Bellows-Pipe Supports-Support Types-Support Selection-Support Location-Support Span Calculation.

**REFERENCE(S):**


1. Sam Kannappan, Introduction to piping stress analysis, John Wiley & sons, 2006.
2. Mohinder L. Nayyar, Piping Engineering Hand book, McGraw Hill, 2000.
3. M. W. Kellogg Company, Design of Piping Systems - John Wiley & Sons, 2006.


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEZ04 | PROBLEM SOLVING TECHNIQUES | 1 | 0 | 0 | 1 | 15 | 100 | |

**Course Objective (s):** The purpose of learning this course is :

- To understand the basic concepts of quality control method of problem solving
- To create an awareness and understanding of quality control tools & techniques

**Course Outcomes:** At the end of this course, learners will be able to:

- Explain the quality control method of problem solving techniques.
- Carry out quality control measures using the quality control tools & techniques

| Unit I | PROBLEM SOLVING TECHNIQUES | 15 |
|---|---|---|

Quality Control Tools and story -seven steps of story -seven quality control tools-problem definition - observation - analysis - solution identification - actions and execution - checking - standardization - case study -basic problem solving.

**REFERENCE(S):**


1. L.Suganthi and Anand A Samuel, Total Quality Management, PHI Learning, 2009.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEZ02 | LEAN MANUFACTURING | 1 | 0 | 0 | 1 | 15 | 100 | |

**Course Objective (s):** The purpose of learning this course is :

- To acquire the general knowledge to deliver consistently high quality and value added products and services to the customer in a lean environment
- To understand the terminology relating to lean operations in both service and manufacturing organizations

**Course Outcomes:** At the end of this course, learners will be able to:

- Summarize the quality requirements to provide products and services in lean environment
- Implement technologies related lean operations and its significance in manufacturing processes

| Unit I | LEAN MANUFACTURING | 15 |
|---|---|---|

History Evolution - Toyota production system - Lean manufacturing overview - Work place organization - Visual controls - Pull production and cellular manufacturing - Value flow pull - Value and perfection lean Mapping the present Mapping the future - Product and process development Value stream analysis - Over production - Waiting - Work In Progress - Transportation - Inappropriate processing - Excess motion or ergonomic problems - Defected products - Under- utilization of employees - Just In Time - Kanban tooling - Total Productive Maintenance 5S - Single Minute Die Exchange - Lean six sigma - Flow charting - Identifying and eliminating unnecessary steps - Setup time - reduction approaches - Steps in implementing lean strategy Lean accounting system.

**REFERENCE(S):**


| | |
|---|---|
| 1. | Dennis P Hobbs, Lean Manufacturing Implementation, J. Ross Publications,2004 |
| 2. | Jeffrey K Liker, The Toyota Way-14 Management Principles, McGraw Hill, New York, 2004 |
| 3. | Pascal Dennis, Lean Production Simplified, Productivity Press, USA, 2002 |
| 4. | James P Womack, Daniel T. Jones, Lean Thinking: Banish waste and create wealth in your corporation, Simon & Schuster, UK Limited, Free Press, 2003 |
| 5. | Jay Arthur, Lean Six-Sigma Demystified, Tata McGraw-Hill Company, New Delhi, 2007 |
| 6. | Richard J Schonberger, World Class Manufacturing, Free Press, 2008 |


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEZ05 | AUTOMOTIVE EXHAUST SYSTEM | 1 | 0 | 0 | 1 | 15 | 100 | |

**Course Objective (s):** The purpose of learning this course is :

- To unederstand the concepts and design of exhaust systems and catalytic converters
- To disseminate information about various types of exhaust systems and strategies relevant to Indian automotive industry
- To identify the various factors to be considered for selection of exhaust manifold system

**Course Outcomes:** At the end of this course, learners will be able to:

- Explain the various factors influencing the performance of exhaust systems and catalytic converters
- Execute design and modeling of exhaust manifold systems
- Implement the CFD tool to improve the automotive exhaust systems

| Unit I | AUTOMOTIVE EXHAUST SYSTEM | 15 |
|---|---|---|

Exhaust system - Exhaust system Function -Parts - Types - Catalytic Convertor - Types -2 WAY -3 WAY CATCON Mufflers - Types - Principles - Design trade off - BS IV and above norms - EGR - SCR- EGR Function - Pollution control - SCR - Function -Pollution control - CATIAV5 application for Exhaust system - Modeling - Assembly - Drafting - Basics with Exhaust manifold modeling practical session - CFD analysis - Uniformity index - Space velocity - Flow analysis - Pressure drop - CPSI optimization

**REFERENCE(S):**


1. Dr. Kirpal Singh, Automobile Engineering (Volume II), Standard publishers distributors.
2. Ronald M. Heck, Robert J. Farrauto and Suresh T. Gulati, Catalytic Air Pollution Control: Commercial Technology, Wiley, 3rd Edition, Feb 2009.


| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEZ06 | CONTINUOUS IMPROVEMENT | 1 | 0 | 0 | 1 | 15 | 100 | |

**Course Objective (s):** The purpose of learning this course is :

- To acquire the general knowledge to deliver consistently high quality and value added products and services to the customer in a Manufacturing environment
- To understand the terminology relating to continuous improvement in manufacturing organizations

**Course Outcomes:** At the end of this course, learners will be able to:

- Identify the continuous improvement metrics
- Understand and appreciate various tools applied and methodology adopted to run a KAIZEN event

| Unit I | CONTINUOUS IMPROVEMENT | 15 |
|---|---|---|

History -Evolution - Toyota production system - Lean Manufacturing - Fundamentals, Importance, Definitions, Phases, Lead time - Supplier - Manufacturer - Customer Chain, Work place organization - Visual controls - Pull production and cellular manufacturing -Waste identification - Over production - Waiting - Work In Progress - Transportation - Inappropriate processing - Excess motion or ergonomic problems - Defected products - Under utilization of employees - Organizations Vision, Mission, Strategy Deployment and Key performance Indicators. Importance of Measurement. Gap Analysis, Identification of KAIZEN projects. Methodology, team formation, Problem statement, Data collection, Brainstorming, Analysis, containment action, corrective action and preventive action. Overview of performance metrics visual control.

**REFERENCE(S):**


1. Dennis P Hobbs, Lean Manufacturing Implementation, J. Ross Publications, 2004
2. Jeffrey K Liker, The Toyota Way-14 Management Principles, Mc-Graw Hill, New York, 2004


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|---|---|
| 3. | Pascal Dennis, Lean Production Simplified, Productivity Press, USA, 2002 |
| 4. | James P Womack, Daniel T. Jones, Lean Thinking: Banish waste and create wealth in your corporation, Simon & Schuster UK Limited, Free Press, 2003 |
| 5. | Jay Arthur, Lean Six-Sigma Demystified, Tata McGraw-Hill Company, New Delhi, 2007 |
| 6. | Richard J Schonberger, World Class Manufacturing, Free Press, 2008. |


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEZ07 | INDIAN PATENT LAW | 1 | 0 | 0 | 1 | 15 | 100 | |

**Course Objective (s):** The purpose of learning this course is :

- To make students familiar about Indian patent law
- To make the students find the patentability of any invention
- To make the students aware of legal background of various process of Indian Patent

**Course Outcomes:** At the end of this course, learners will be able to:

- Summarize the various provisions of Indian Patent Law
- Find patentability of any invention
- Assess the legal provisions of Indian patent system

| Unit I | INDIAN PATENT LAW | 15 |
|---|---|---|

Preliminary, Inventions Not Patentable, Applications for Patents, Publication and Examination of Applications, Opposition Proceedings to Grant of Patents, Anticipation , Provisions for Secrecy of Certain Inventions, Grant of Patents and Rights Conferred Thereby, Patents of Addition, Restoration of Lapsed Patents, Surrender and Revocation of Patents, Register of Patents, Patent Office and Its Establishment, Powers of Controller Generally, Working of Patents, Compulsory Licenses and evocation, Central Government, Suits Concerning Infringement of Patents, Appeals to the Appellate Board, Penalties, Patent Agents, International Arrangements.


| REFERENCE(S): | |
|---|---|
| 1. | Indian Patent Act ,1970 |
| 2. | Indian Patent Rules,2003 |
| 3. | www.ipindia.nic.in |


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEZ08 | RAILWAY TRACK TECHNOLOGY | 1 | 0 | 0 | 1 | 15 | 100 | |

**Course Objective (s):** The purpose of learning this course is :

- To familiar about Indian Railway and types
- To understand the Railway track and its types.

**Course Outcomes:** At the end of this course, learners will be able to:

- Summarize Indian Railway system and types of rails
- Explain Railway track system

| Unit I | RAILWAY TRACK TECHNOLOGY | 15 |
|---|---|---|

Indian Railway overview, Evolution, Structure, Grades, Coning of Wheels and Caning of Rails, Types of Rails, Rail Material, Rail Joints, Sleepers, Rail and Sleeper Fastening, Railway Curves, Track Maintenance, Modern Track Construction, Track Inspection, High Speed Tracks and Special Tracks, Derailment Investigations.

**REFERENCE(S):**


1. Railway Track Engineering, Fourth Edition, by J.S.Mundrey, McGraw Hill Education (India) Private Limited, 2009


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEZ09 | GLASS ENGINEERING | 1 | 0 | 0 | 1 | 15 | 100 | |

**Course Objective (s):** The purpose of learning this course is :

- To understand the basics of Glass making and various types in real world practice
- To understand the applications of commercial and special purpose glasses for various engineering applications

**Course Outcomes:** At the end of this course, learners will be able to:

- Classify glasses and select suitable glass for suitable engineering application.
- Explain the glass making and treatment processes in a glass Industry

| Unit I | GLASS ENGINEERING | 15 |
|---|---|---|

Introduction, History of Glass, Raw Materials & Manufacturing Process, Glass Properties, Care and Storage, Glass Processing, Types of glass based on application, Float Glass, Processed Glasses - (Laminated Safety Glass, Heat Treated Glass, Curved Toughened Glass, Insulated Glass), Reflective & Coated Glass, Special Purpose Glasses for fire resistance, bullet proof & sound proof requirements, Decorative Glass, Standards and Testing, Fields of application - applied engineering - facades - selection of glass for facades.

**REFERENCE(S):**


1. Glass Engineering Handbook, by Errol Bertram Shand (Author), W. H. Armistead (Foreword), Literary Licensing, LLC (May 19, 2012)
2. Introduction to Glass Science and Technology , Royal Society of Chemistry, James E Shelby, 12 Jan 2005.


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEZ10 | PLASTICS - DESIGN, PROCESSING TOOLING, ASSEMBLY AND TESTING | 1 | 0 | 0 | 1 | 15 | 100 | |

**Course Objective (s):** The purpose of learning this course is :

- To know the various plastic materials used in Automotive, home appliance, Medical fields
- To understand the basic and advanced methods of plastic processing and the tooling & equipment used for it.
- To learn various post processing requirements such as painting, foiling, pad printing.
- To learn the various plastic joining processes and plastic testing methods.

**Course Outcomes:** At the end of this course, learners will be able to:

- Classify the plastic material and its applications
- Explain the plastic processing methods & machine, tooling used for it
- Indicate the post processing requirements and its significance
- Assess the plastic joining processes characteristics

| Unit I | PLASTICS - DESIGN, PROCESSING, TOOLING, ASSEMBLY AND TESTING | 15 |
|---|---|---|

Introduction on Plastics, Types of plastics - Thermo plastics, Thermo setting plastics, Applications in Automobiles, Home appliances etc., Basic concepts on plastic design, Mould flow analysis Plastic processing- Preheating, Molding, Molding types - Injection molding, compression molding, Roto molding , 2K molding., Tooling- Core, Cavity, Inserts, heating & cooling circuits , Tool materials, Molding machines - Types, Tonnage & other specifications. Molding defects -Warpage, Catching, Weld line, burning, Sink marks etc, Method of avoiding defects Post molding process- Annealing, Texturing, color foiling, Pad printing, Painting etc., Assembly of Plastics- Ultrasonic welding, Heat sinking, Vibration welding. Testing of Plastics-UV testing, scratch resistance, Flammability, Resistance against chemicals, impact test.

**REFERENCE(S):**


1. Hand book of Plastic Technologies - Charles A Harper
2. Plastic Engineering - R.J Crawford
3. Plastic Materials and Processes-A Concise Encyclopedia - Charles A. Harper& Edward M.Petrie


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEZ11 | 5S - INTRODUCTION AND IMPLEMENTATION | 1 | 0 | 0 | 1 | 15 | 100 | |

**Course Objective (s):** The purpose of learning this course is :

- To impart the knowledge on 5S fundamental and implementation concepts
- To provide the 5S training for implementation in engineering fields

**Course Outcomes:** At the end of this course, learners will be able to:

- Demonstrate various steps of 5S implementation principles
- Practice 5S in real time life and engineering fields

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| Unit I | 5S - INTRODUCTION AND IMPLEMENTATION | 15 |
|---|---|---|

Need for implementing 5S and advantages-Explanation on 5S- methodology -zone formation, individual responsibility, hidden and common area and no man- land-Introduction to SEIRI-Tagging system, Disposal Policy, SEIRI Museum - 1S Practical - Introduction to SEITON -PEEP, Points for Storage, Safety, Quantity Identification - 2S Practical - Introduction to SEISO-Cleaning methods, Schedules, Accessories, Responsibilities - 3S Practical, Introduction to SEIKETSU - Evolving Standard Practices, Visual Controls - 4S Practical- Introduction to SHITSUKE-Self audit, Check lists. Evaluation - 5S Practical, Management audit, Jagruthi groups, Motivation, Awards, manuals. Practice: Form students group, assign areas and do 5S practice

**REFERENCE(S):**


1. L.Suganthi and Anand A Samuel, Total Quality Management, PHI Learning, 2009


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEZ12 | ENERGY AUDITING AND INSTRUMENTS | 1 | 0 | 0 | 1 | 15 | 100 | |

**Course Objective (s):** The purpose of learning this course is :

- To acquire knowledge about various thermal and electrical energy audit instruments used in the field as per Bureau of Energy Efficiency, Govt. of India
- To gain the skill in using the Energy Audit Instruments for field measurements

**Course Outcomes:** At the end of this course, learners will be able to:

- Apply the measurement skill of energy related parameters in industrial environment
- Interpret the measurements for its accuracy and genuineness
- Express the analytical skill in quantification of energy flow in and out of an energy system

| Unit I | ENERGY AUDITING AND INSTRUMENTS | 15 |
|---|---|---|

Introduction to Energy Conservation Act 2001, Basics of Energy Audit, Instruments : Clip on power meter, Infrared Thermometer, Vane Anemometer, Pitot tube with digital pressure meter, Stroboscope, Hygrometer, Combustion efficiency Monitor, Light Meter, Specifications, Limitations, applications and measurement calculations for Pressure, flow (Air and Water), power consumption, waste heat recovery calculations.

**REFERENCE(S):**


1. Energy Audit Manual published by Energy Management Centre, Govt of Kerala , Kerala – Manual-2017.
2. CO2 Emission Mitigation through Energy Conservation- A Practical Guide. by Dr. M. Thirugnanasambandam, Published by Shanlax Publishers- 2018


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEV01 | INTORDUCTION TO RISK ANALYSIS | - | -- | - | - | - | - | |

**Course Objective (s):** The purpose of learning this course is:

- To understand the importance of risk analysis.
- To understand the working principles instruments.
- To understand the risk assessment techniques.
- To create awareness on various soft wares in risk analysis.
- To understand the methods to carry out consequence analysis.

**Course Outcomes:** At the end of this course, learners will be able to:

- Explain the importance of risk analysis.
- Demonstrate the working principles instruments.
- Demonstrate risk assessment techniques.
- Apply consequent analysis techniques.
- Explain the methods to carry out consequence analysis.

**Unit I** **HAZARD, RISK ISSUES AND HAZARD ASSESSMENT**

**HAZARD, RISK ISSUES AND HAZARD ASSESSMENT**

Introduction, hazard monitoring-risk issue – Probability, reliability, Hazard assessment, procedure, methodology; safety audit, checklist analysis, what-if analysis, safety review.

**Unit II** **INSTRUMENTATION**

Applications of Advanced Equipments and Instruments- Thermocalorimetry, Differential Scanning Calorimeter (DSC), Thermo Gravimetric Analyzer (TGA), Principles of operations, Applications, advantages. Explosive Testing, Deflagration Test, Detonation Test, Ignition Test, Sensitive Test, Impact Sensitive Test (BAM) and Friction Sensitive Test (BAM).

**Unit III** **RISK ANALYSIS QUANTIFICATION AND SOFTWARE**

preliminary hazard analysis (PHA), hazard operability studies (HAZOP), Fault Tree Analysis & Event Tree Analysis, Logic Symbols, fire explosion and toxicity index(FETI) - Hazard analysis(HAZAN)- Failure Mode and Effect Analysis(FMEA)- Basic concepts of Software on Risk analysis. ALOHA

**Unit IV** **CONSEQUENCES ANALYSIS**

Introduction to modeling procedures, Basic concepts used in Consequence Analysis, Fire Radiation Models - Pool Fires, Flares, Torch Fires, BLEVEs and Fireballs, Release Models- Liquid, Vapor, Aerosol, Vapor Dispersion - Source Models, Aerosols, Pool, Vaporization, Dense Gas Dispersion, Momentum Jet Dispersion, Explosions - TNT Models, TNO Multi- Energy, Baker- Strehlow, Examples of model applications to accidental releases.

**Unit V** **CASE STUDIES**

Past accident analysis as information sources for Hazard analysis and consequences analysis of Geneva chemical accident, Mexico disaster, Flixborough, Bhopal, Seveso, Pasadena, Feyzin disaster (1966), Port Hudson disaster-convey report, hazard assessment of nonnuclear installation- Richmond report, risk analysis of size potentially Hazardous Industrial objects- Rasmussen masses report, Reactor safety study of Nuclear Power Plant.

**REFERENCE(S):**


1. P. Frank. Less Butterworth-Hein, Loss Prevention in Process Industries (Vol.I, II and III), Butterworth-Hein UK 1990.
2. F.I. Khan, S.A. Abbasi, Advanced Risk Assessment In Chemical Process Industries, Discovery Publishing House, 2000.
3. Center for Chemical Process Safety (CCPS), Quantitative Risk assessment in Chemical Industries, Institute of Chemical Industries, Centre for Chemical process safety. Second Edition, 2000.
4. Guidelines for Hazard Evaluation Procedures, Centre for Chemical Process safety, AICHE 2008.


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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEV02 | MODELING USING CATIA V5 | - | - | - | - | - | - | |

**Course Objective (s):** The purpose of learning this course is:

- To acquire knowledge in sketching and constraining.
- To acquire knowledge in creating solid models using various features of CATIA V5.
- To have a clear idea in assembling the modeled parts using CATIA V5.
- To impart knowledge in drafting and sectioning.
- To impart knowledge in wireframe and surface modeling using various features of CATIAV5.

**Course Outcomes:** At the end of this course, learners will be able to:

- Make sketching and constraining using CATIA V5.
- Model any three dimensional objects by CATIA V5.
- Construct assembly after part modeling using CATIA V5.
- Make sectioning and drafting using CATIA V5.
- Make wireframe and surface modeling, using CATIA V5.

| Unit I | INTRODUCTION TO CATIA V5 |
|---|---|

Modifying Units - Modifying the Grid Settings - Understanding the Sketcher Terms – Specification Tree - Grid - Snap to Point - Construction/Standard Element - Select Toolbar .Drawing Sketches Using the Sketcher Tools. Drawing Lines, Center Lines, Rectangles, and Parallelograms. Creating Points, Drawing Circles, Arcs, Profiles..

| Unit II | DRAWING SKETCHES IN THE SKETCHER |
|---|---|

Sketching Tools - Drawing Ellipses, Splines, Keyhole Profiles , Hexagons, Editing and Modifying Sketches - Trimming , Quick Trim , Filleting , Chamfering, Mirroring Translating, Rotating Scaling, Offsetting, Modifying ,Deleting.

| Unit III | CONSTRAINING SKETCHES AND CREATING BASE FEATURES |
|---|---|

Constraining Sketches, Adding Geometrical Constraints -Defining Constraints , Exiting the Sketcher Workbench , Creating Base Features by Extruding , Revolving Sketches , Rotating, Modifying the View , Tutorial 1 , Tutorial 2 & Exercise 1 Exercise 2 .

| Unit IV | REFERENCE ELEMENTS AND SKETCH-BASED FEATURES |
|---|---|

Importance of Sketching Planes - Reference Elements, Reference Planes , Creating Points , Creating Reference Lines ,Other Sketch-Based Features ,Creating Drafted Filleted Pad Features , Multi-Pad Features , Pocket Features , Drafted Filleted Pocket Features , Multi-Pocket , Groove .

| Unit V | CREATING DRESS-UP AND HOLE FEATURES |
|---|---|

Advanced Modeling Tools - Creating Hole Features - Fillets - Chamfers -Adding a Draft to the Faces of the Model - Shell Feature. Editing Features of a Model

| Unit V | TRANSFORMATION FEATURES AND ADVANCED MODELING TOOLS |
|---|---|

Transformation Features - Translating Bodies -Rotating -Creating Symmetry -Mirroring – Creating Rectangular Patterns, Circular Patterns , User Patterns. Advanced Modeling Tools - Creating Rib Features -Slot Features - Multi-Sections Solids

| Unit VI | ASSEMBLY MODELING |
|---|---|

Assembly Modeling - Types of Assembly Design Approaches -Creating Bottom-Up Assemblies - Creating Top-Down Assemblies -Editing Assemblies

| Unit VI | WORKING WITH THE DRAFTING WORKBENCH |
|---|---|

The Drafting Workbench -Starting a New File in the Drafting Workbench -Type of Views-Generating Drawing Views - Automatically Generating Views - Individual Drawing Views - Exploded View - Editing and Modifying Drawing Views- Modifying the Hatch Pattern of Section Views. Inserting the Frame and the Title Block - Annotations, Generating the Bill of Material (BOM) -Generating Balloons.

| Unit VII | WORKING WITH THE WIREFRAME AND SURFACE MODELING |
|---|---|

Need of Surface Modeling - Creating Wireframe Elements - Creating Circles - Splines - Helix - Surfaces - Extruded Surfaces - Revolved Surfaces -Spherical Surfaces - Cylindrical Surfaces - Offset Surfaces - Sweep Surfaces - Multi-Sections Surfaces -Operation on Shape Geometry -- Surface Operations.

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| REFERENCE(S): | |
|---|---|
| 1. | CATIA: Introduction to Modeling, Version 5, Release 21, Ascent, Center for Technical Knowledge, 2012. |
| 2. | Richard Cozzens, CATIA V5 Workbook Release V5-6R2013, SDC Publications, 2013. |

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|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEV03 | MODELING IN SOLID WORKS | - | - | - | - | - | - | |

**Course Objective (s):** The purpose of learning this course is:

- To acquire knowledge in sketching and constraining.
- To acquire knowledge in creating solid models using various features of Solidworks.
- To have a clear idea in assembling the system using Solidworks.
- To impart knowledge in drafting and sectioning.
- To impart knowledge in simulation and animations using various features of Solidworks.

**Course Outcomes:** At the end of this course, learners will be able to:

- Make sketching and constraining using Solid Works
- Model any three dimensional objects by Solid Works.
- Construct assembly after part modeling using Solid Works.
- Make sectioning and drafting using Solid works
- Create simulation and animations using various features of Solidworks.

| Unit I | SKETCHING |
|---|---|

Introduction to Solid Works, Working tools and tool box. 2D - Line, spline - Types, Circle, ellipse, Parabola and Arc-Types, Rectangle-types, fillet , chambering, Polygon- Types, text operations, point. 3D - Line, spline- Types, Circle, ellipse, Parabola and Arc-Types, Rectangle-types, fillet , chambering, Polygon- Types, text operations, point, 3D Curves, Dimension -types, Viewing option of the Drawing, 2D Plane, Axis, point and its types. Editing Commands - Trimming, Converting Options

| Unit II | PART MODELING |
|---|---|

Creation –Extrude, Revolve, Swept, Loft boundary options, 3D Plane, Axis &Point Making. Cutting – Extrude cut, Revolve cut, Swept cut, Loft cut, boundary cut, 3D fillet and chamber, Spring Formation, Hole Wizard. Editing Options - Pattern and its types, Rib, Draft, Shell, Wrap, Dome, and Mirror.

| Unit III | ASSEMBLY MODELING |
|---|---|

Inserting Part Drawing, Edit Component, insert Component, Mate, Smart Fasteners, Move and Rotating Component, Hide/Show the Component, Assembly features, New Motion Study, Bill of Materials, Explode views, Explode line Sketches, Animation – Options.

| Unit IV | DRAFTING |
|---|---|

Drawing Layout and Sheet size, drawing insert, Viewing Drawing – Standard and Model, Projected and Auxilary, Section Detail views, Breaking and joining the Object. Annotation- Smart Dimensions, Note, Text insert, Surface Finish symbols, Tolerance indications, Area Fill (Hatch), Markings, Tables of data and Bill of Materials.

| Unit V | PRACTICE SESSION |
|---|---|

Automobile Component, Engine components, Machine tool Component Part and Assembly.

**REFERENCE(S):**


1. Dassault Systèmes SolidWorks 2015: Advanced Part Modeling, Dassault Systèmes SolidWorks Corporation, 2014.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | - |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEV04 | CORE JAVA PROGRAMMING | - | - | - | - | - | - | |

**Course Objective (s):** The purpose of learning this course is:

- To design, write, debug and run Java programs using JDK tools
- To create a programs using decision making statements and looping statements
- To control the abnormal termination of the program using exception handling mechanism
- To develop User Defined packages and interfaces
- To develop Graphical User Interface applications using Applet

**Course Outcomes:** At the end of this course, learners will be able to:

- Design a class for real world objects using Java program.
- Apply control structures to perform decision making and iterations for the simple problems
- Develop programs using inheritance and exception handling mechanisms in Java
- Create packages to group the classes for application development.
- Develop simple GUI application for the real world problems.

| Unit I | JAVA BASICS |
|---|---|
| Overview- Environment Setup Basic Syntax - Object & Classes - Basic Data types – Variable Types - Modifier Types | |
| **Unit II** | **BASIC OPERATORS** |
| Basic Operators - Loop Control - Decision Making -Numbers Methods-Characters Methods-Strings Methods-Arrays-Date & Time | |
| **Unit III** | **ARRAYS** |
| Methods- Type - Overloading - Exceptions – Try Catch – Multiple try catch – Finally – Inhertiance – Base class –child class – super | |
| **Unit IV** | **POLYMORPHISM** |
| Polymorphism – Method overriding – Interfaces- creating interfaces – implementing Interfaces-Packages | |
| **Unit V** | **INPUT / OUTPUT METHODS** |
| Files and I/O – Byte Streams – Character Streams - GUI Programs-Java Applets | |

**REFERENCE(S):**


1. Herbert Schildt, Java -Complete Reference, 8th edition Tata McGraw Hill, 2012.
2. Kathy sierra and Bert Bates Head, First Java, second edition, Oreilly, 2010.
3. Harvey M. Deitel and Paul J. Deitel, Java How to Program, Prentice Hall of India, 2010.
4. Gary Cornell and Cay S.Horstmann, Core Java Vol.1 and Vol.2, Sun Microsystems Press,2008
5. Herbert Schildt, Java(R) 7, A Beginners Guide, Tata McGraw Hill, 2010.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | - |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEV05 | TOOL DESIGN AND MANUFACTURING | - | - | - | - | - | - | |

**Course Objective (s):** The purpose of learning this course is:

- To understand mechanics of metal cutting, materials, heat treatment and tool design.
- To acquire knowledge of principles in work holding devices.
- To understand principles of designing jigs, fixtures and dies for industrial applications.
- To acquire the concept of press tool operation and die making procedures.
- To understand the complex shapes and machining in dies and moulds.

**Course Outcomes:** At the end of this course, learners will be able to:

- Apply metal cutting methods and design the tools.
- Design work holding devices.
- Develop jigs and fixtures for conventional and automated manufacturing.
- Develop press tools and dies for forming of parts
- Apply micro machining techniques to machine complex shapes

**Unit I**

Introduction to tool materials, heat treating, general motions of machine tools – metal cutting principles, mechanics of metal cutting – chip formation – friction and temperature. Cutting tool design. Cutting tool selection, chip formation, tool wear, cutting forces, control of the causes of tool wear and failure.

**Unit II**

Work holding principles, general considerations, Locating principles, work piece surfaces, types of location, degrees of freedom, basic locating rules, locational tolerances, fool proofing, basic types of locators, clamping principles, types of clamps, standard components, other elements. Various types of fixtures, designing fixture - developing the preliminary fixture design - computer applications in fixture design and analysis.

**Unit III**

Fundamentals of cutting tool design - types and its properties, tool geometry - design of single and multi point cutting tools, design of press working tools, power presses, cutting (shearing) operations, die and punch design, selection of die sets – simple and progressive die - bending die – single and double action die. Introduction – principle of operation –Wire cut EDM – Electrical Discharge Machining (EDM) – Electro Chemical Machining (ECM) in die making applications

**REFERENCE(S):**


1. G C Sen and A. Battacharya, Principles of Metal Cutting, New Central Book Agency, India, 1969
2. E. K. Henriksen, Jig and Fixture Design Manual, Industrial Press, New York, 1973
3. C Donaldson, G H Lecain and V C Goold, Tool Design, TMH, 1978
4. J R Paquin and R E Crowley, Die Design Fundamentals, New York-Industrial Press Inc, 2005
5. P K Mishra, Nonconventional Machining, Narosa Publishing House, New Delhi, 2008


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | - |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEV06 | CNC PROGRAMMING AND OPERATIONS | - | - | - | - | - | - | |

**Course Objective (s):** The purpose of learning this course is:

- To understand GD & T, process planning and quality requirements.
- To acquire the knowledge of tooling and work holding devices used in CNC machining.
- To acquaint with CNC machine features and controls.
- To acquire the knowledge of CNC programming and tool path simulation.
- To understand set up procedure of tooling and job in CNC machine and operation of the CNC machines.

**Course Outcomes:** At the end of this course, learners will be able to:

- Apply GD & T and plan the process, operations and quality in CNC machining.
- Select method of tooling and work holding devices for machining in CNC machining.
- Operate the CNC controller, load and edit the CNC program.
- Prepare the CNC program and simulate tool path.
- Setup the tooling, job in CNC machine and operate the machine.

**Unit I**

Emphasis on tooling and work holding requirements, cutting tool materials (H.S.S., carbide, ceramic and diamond) selection. Introduction to process planning, quality control charting - Statistical Process Control (SPC) techniques and geometric dimensioning and tolerancing (GD&T).

**Unit II**

Introduction to machining technology, Computerized Numerical Control (CNC), Familiarization of control panel, machine tool set-up operation and programming. Apply accident prevention practices and procedures, work-holding, tooling, machine set-up and operation, program proof-out and quality control. Set-up, align, and zero-out work holding devices, tooling adapters, and tool holders.

**Unit III**

Fundamentals of cutting tool design - types and its properties, tool geometry - design of single and multi point Perform dry/first/production runs and inspections, adjusting various register values to assure tool qualification, and part dimensionality. Communicate and apply piece-part set-up and inspection procedures.

**Unit IV**

Analyze program problems and perform basic editing operations via Manual Data Input (MDI) operations, edit canned cycle functions utilizing calculations / data, Demonstrate upload/downloading and other Distributed Networked Computer (DNC) functions on a shop floor computer network

**Unit V**

Part program preparation of turning, facing and taper turning cycles. Simulation and machine operations

**REFERENCE(S):**


1. P. Radhakrishnan, Computer Numerical Control Machines, New Central Book Agency, India,2004
2. HMT, Mechatronics, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2010.
3. Hillwig, Lenzi, Precision Machining Technology: Workbook and Projects Manual Cengage Learning (ISBN 9781285444550), 2015
4. Richard A. Gizelbach, CNC Machining Fundamentals and Applications, Goodheart-Wilcox Company, Inc. 2009.
5. T.K. Kundra, P.N. Rao and N.K. Tiwari, CNC and Computer Aided Manufacturing, Tata


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | - |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEV07 | WELDING INSPECTION & TESTING | - | - | - | - | - | - | |

**Course Objective (s):** The purpose of learning this course is:

- To provide knowledge on the different welding process, Selection of power source and Electrodes for metallic materials.
- To impart knowledge on the welding design for various metal structures.
- To demonstrate the response of weld material to mechanical loading through mechanical property correlation
- To Acquiring the necessary background for understanding Nondestructive testing process
- To recall welding standards and codes..

**Course Outcomes:** At the end of this course, learners will be able to:

- Select suitable welding process, power source, Electrode for different materials.
- Acquire the knowledge of weld design and weld geometry.
- Evaluate weld metal property against fracture in real-time applications.
- Acquire the knowledge of different nondestructive testing inspection process.
- Attain knowledge of welding standards and codes

| Unit I | Welding and Allied Process |
|---|---|

Arc welding power source - Gas welding and cutting, Fusion welding – Introduction of Shielded Metal Arc welding -Gas Tungsten Arc welding - Gas Metal Arc welding - Submerged Arc welding. Weldability of carbon steel and low alloy steel- Heat Treatment of weldments.

| Unit II | Weld Design, Codes & Standards |
|---|---|

Welding symbols-Welding design - Selection of joint - Electrode Designation & Types -. Weld defects- Surface and subsurface defects –Distortion and Residual Stress– Causes of weld defect & Remedial action. Welding Procedure Specification- ASME codes for Consumables and welding position - Safety in welding.

| Unit III | Destructive Testing |
|---|---|

Metal Properties - Destructive Testing as per ASTM standards- Tensile Tests, Impact Tests, Hard ness Test - Bend Tests. Weld Microstructure study, Fractography-SEM &TEM,

| Unit IV | NDT- Surface & Subsurface Tecchniques |
|---|---|

Concepts of Non-Destructive testing (NDT) - Visual or Optical Testing -Liquid Penetrant Testing (LPT) Principles - Preparation of test materials - Advantages and limitations - Fluorescent penetrant test. Magnetic Particle Testing (MPT) Principles, applications - Dry particle technique and Wet fluorescent particle technique, Eddy Current Testing (ECT).

| Unit V | NDT- Ultrasonic Testing & Radiography Testing |
|---|---|

Ultrasonic Testing (UT) Principle, Couplants, Probes - Inspection methods-Pulse echo, Transmission and Phased Array techniques, Angle beam inspection of welds, Calibration of ASTM Test blocks (International Institute of Welding IIW) reference blocks. Radiographic testing (RT) Principle, Sources of X-rays and Gamma rays and their characteristics, Safety in radiography, Applications.

**REFERENCE(S):**


1. Howard.B. Cary, Modern Welding Technology Fifth Edison, Prentice Hall, Ohio-2005
2. R. S. Parmer, Welding Processes & Technology, Khanna Publishers, New Delhi, 2008.
3. Mechanical Testing &Evaluation, Volume 8, American Society for Metals, 2005.
4. Baldev Raj, Jayakumar T, Thavasimuthu M, Practical Non-Destructive Testing, Narosa Publishing, 1997
5. ASNT Hand Book, Non Destructive Testing 4Th Edison, vol-10, 2006.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | - |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEV08 | PUMP INSPECTION AND TESTING | - | - | - | - | - | - | |

**Course Objective (s):** The purpose of learning this course is:

- To gain knowledge on standard industrial practice of pump inspection and testing.
- To understand various industrial requirements on pump inspection.
- To provide knowledge about various test procedures, their limitations and its corresponding acceptance criterion pertained to pump inspection.
- To obtain knowledge on the industrial pump testing procedures.
- To provide knowledge to analyze the characteristic curves of pump with respect to the cl ient requirements.

**Course Outcomes:** At the end of this course, learners will be able to:

- Understand the basic requirements in the pump inspection and testing.
- Demonstrate practical limitations and acceptance criterion for case specific inspection and test ing
- Identify shop test requirements based on the characteristic to be tested.
- Understand the procedure to be followed for various pump test conditions.
- Analyze the performance graphs to identify the pump performance in order to meet the client requirement.

| Unit I | INTRODUCTION |
|---|---|

Need for pump inspection and testing – Stages – Reference documents and their acceptance criterion – Responsibility classification – Requirement categorization – Inspection requirements – Shop tests requirements – Inspection and testing checklist – Shop test procedure.

| Unit II | INSPECTION REQUIREMENTS |
|---|---|

Material identification as per standards – Heat test for materials – Material of Construction classification – Casting defect checks – Mill test – NDT – Heat treatment test – Welding review – Casting repair classification – Procedure for major repairs.

| Unit III | SHOP TEST REQUIREMENTS |
|---|---|

Hydrostatic test – Pressure parts – Cooling passage – Chloride content – Mechanical seals – Unit integrity – Vibration level – alignment – Pump performance – NPSH..

| Unit IV | PERFORMANCE TESTING |
|---|---|

Testing configuration – shop test stand limitations – Test equipment and instrumentation – Test stand setup – Recorded test data list – Performance curve – Acceptance criteria check

| Unit V | NPSH TESTING |
|---|---|

Testing configuration – flow point graphical representation – Recorded test data list – NPSH testing procedure – NPSH test log – NPSH curve.

**REFERENCE(S):**


1. American Petroleum Institute (API) 610 – Centrifugal pumps for general refinery services.
2. American Petroleum Institute (API) 674 – Positive displacement pumps for general refinery services.
3. ANSI/ASME Standard B73.1M – Specification for horizontal end suction centrifugal pumps for chemical process.
4. ANSI/ASME Standard B73.2M – Specification for vertical centrifugal pumps for chemical process.
5. ANSI/HI 6.6 – Reciprocating pump tests
6. ANSI/HI 5.1-5.6 – Sealless rotodynamic pumps for nomenclature, definitions, application, operation and test.


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| Department | MECHANICAL ENGINEERING | | | | | R 2019 | Semester | - |
|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Hours / Week | | | Credit | Total Hours | Maximum Marks | |
| | | L | T | P | C | | | |
| 19MEV09 | SHEET METAL TOOLS - DESIGN AND MANUFACTURING PROCESS | - | - | - | - | - | - | |

**Course Objective (s):** The purpose of learning this course is:

- To understand mechanics of metal cutting, materials, heat treatment and tool design
- To acquire knowledge of principles in work holding devices.
- To understand principles of designing jigs, fixtures and dies for industrial applications.
- To acquire the concept of press tool operation and die making procedures.
- To understand the complex shapes and machining in dies and moulds.

**Course Outcomes:** At the end of this course, learners will be able to:

- Apply metal cutting methods and design the tools.
- Design work holding devices.
- Develop jigs and fixtures for conventional and automated manufacturing.
- Develop press tools and dies for forming of parts
- Apply micro machining techniques to machine complex shapes

**Unit I** **SHEET METAL TOOL DESIGN AND MANUFACTURING PROCESS**

Introduction to tool materials, heat treating, general motions of machine tools metal cutting principles, mechanics of metal cutting chip formation friction and temperature. Cutting tool design. Cutting tool selection, chip formation, tool wear, cutting forces, control of the causes of tool wear and failure.

**Unit II** **SHEET METAL TOOL DESIGN AND MANUFACTURING PROCESS**

Work holding principles, general considerations, locating principles, work piece surfaces, types of location, degrees of freedom, basic locating rules, locational tolerances, fool proofing, basic types of locators, clamping principles, types of clamps, standard components, other elements. Various types of fixtures, designing fixture - developing the preliminary fixture design - computer applications in fixture design and analysis.

**Unit III**

Fundamentals of cutting tool design - types and its properties, tool geometry - design of single and multi point cutting tools, design of press working tools, power presses, cutting (shearing) operations, die and punch design, selection of die sets simple and progressive die - bending die single and double action die. Introduction principle of operation -Wire cut EDM Electrical Discharge Machining (EDM) Electro Chemical Machining (ECM) in die making applications

**REFERENCE(S):**


1. G C Sen and A. Battacharya, Principles of Metal Cutting, New Central Book Agency, India,1969
2. E. K. Henriksen, Jig and Fixture Design Manual, Industrial Press, New York, 1973
3. C Donaldson, G H Lecain and V C Goold, Tool Design, TMH, 1978
4. J R Paquin and R E Crowley, Die Design Fundamentals, New York-Industrial Press Inc, 2005
5. P K Mishra, Nonconventional Machining, Narosa Publishing House, New Delhi, 2008


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