



EXCEL ENGINEERING COLLEGE

(Autonomous)

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai
Accredited by NBA and NAAC with "A+" and Recognized by UGC(2f&12B)
KOMARAPALAYAM - 637303

B.E. MECHANICAL ENGINEERING REGULATION – 2020 CHOICE BASED CREDIT SYSTEM I TO VIII SEMESTERS CURRICULUM AND SYLLABI

| I SEMESTER | | | | | | | | | |
|---------------------------------|--|----------|----------------|---|---|----|---------------|-----|-------|
| Code No. | Course | Category | Periods / Week | | | C | Maximum Marks | | |
| | | | L | T | P | | CA | FE | Total |
| Theory Course(s) | | | | | | | | | |
| 20MA105 | Mathematics – I for Mechanical Sciences | BS | 3 | 2 | 0 | 4 | 40 | 60 | 100 |
| 20EC103 | Basics of Electrical and Electronics Engineering | ES | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20ME102 | Fundamentals of Mechanical Engineering | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Theory with Practical Course(s) | | | | | | | | | |
| 20ENEXX | Language Elective – I | HSS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| 20CH103 | Chemistry for Mechanical Sciences | BS | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| 20ME101 | Engineering Graphics | ES | 1 | 0 | 4 | 3 | 50 | 50 | 100 |
| Mandatory Course | | | | | | | | | |
| 20MC101 | Induction Programme | MC | 2 Weeks | | | 0 | 100 | - | 100 |
| TOTAL | | | 15 | 2 | 8 | 20 | 370 | 330 | 700 |

| Language Electives – I | | | | | | | | | |
|------------------------|--------------------------------|----------|----------------|---|---|---|---------------|----|-------|
| Code No. | Course | Category | Periods / Week | | | C | Maximum Marks | | |
| | | | L | T | P | | CA | FE | Total |
| 20ENE01 | Communicative English | HSS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| 20ENE02 | Advanced Communicative English | HSS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |

Passed in Board of Studies Meeting on 25.02.2022
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Approved in Academic Council Meeting on 09.03.2022

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| IISEMESTER | | | | | | | | | |
|---------------------------------|---|----------|----------------|---|---|----|---------------|-----|-------|
| Code No. | Course | Category | Periods / Week | | | C | Maximum Marks | | |
| | | | L | T | P | | CA | FE | Total |
| Theory Course(s) | | | | | | | | | |
| 20MA205 | Mathematics – II for Mechanical Sciences | BS | 3 | 2 | 0 | 4 | 40 | 60 | 100 |
| 20ME201 | Engineering Mechanics | ES | 3 | 2 | 0 | 4 | 40 | 60 | 100 |
| Theory with Practical Course(s) | | | | | | | | | |
| 20ENEXX | Language Elective – II | HSS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| 20PH203 | Physics for Mechanical Sciences | BS | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| 20CS201 | Problem Solving using Python | ES | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| Practical Course(s) | | | | | | | | | |
| 20ME202 | Mechanical Engineering Practices Laboratory | ES | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| Mandatory Course | | | | | | | | | |
| 20MC201 | Environmental Sciences | MC | 2 | 0 | 0 | 0 | 100 | - | 100 |
| Total | | | 16 | 4 | 8 | 20 | 380 | 320 | 700 |

| Language Electives – II | | | | | | | | | |
|-------------------------|--------------------------------|----------|----------------|---|---|---|---------------|----|-------|
| Code No. | Course | Category | Periods / Week | | | C | Maximum Marks | | |
| | | | L | T | P | | CA | FE | Total |
| 20ENE02 | Advanced Communicative English | HSS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| 20ENE03 | Hindi | HSS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| 20ENE04 | French | HSS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| 20ENE05 | German | HSS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |

| III SEMESTER | | | | | | | | | |
|------------------|--|----------|----------------|---|---|---|---------------|----|-------|
| Code No. | Course | Category | Periods / Week | | | C | Maximum Marks | | |
| | | | L | T | P | | CA | FE | Total |
| Theory Course(s) | | | | | | | | | |
| 20MA301 | Transforms and Boundary Value Problems | BS | 3 | 2 | 0 | 4 | 40 | 60 | 100 |
| 20ME301 | Engineering Thermodynamics | ES | 3 | 2 | 0 | 4 | 40 | 60 | 100 |

| | | | | | | | | | |
|--|--|----|-----------|----------|----------|-----------|------------|------------|------------|
| 20ME302 | Engineering Materials and Metallurgy | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20ME303 | Fluid Mechanics and Machinery | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20ME304 | Kinematics of Machinery | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Theory with Practical Course(s) | | | | | | | | | |
| 20ME305 | Manufacturing Technology – I | PC | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| Practical Course(s) | | | | | | | | | |
| 20ME306 | Computer Aided Machine Drawing Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 20ME307 | Fluid Mechanics and strength of materials laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| Mandatory Course | | | | | | | | | |
| 20MC302 | Interpersonal skills | MC | 0 | 0 | 2 | 0 | 100 | - | 100 |
| TOTAL | | | 18 | 4 | 8 | 23 | 450 | 450 | 900 |

| IV SEMESTER | | | | | | | | | |
|---------------------------------|--|----------|----------------|---|---|----|---------------|-----|-------|
| Code No. | Course | Category | Periods / Week | | | C | Maximum Marks | | |
| | | | L | T | P | | CA | FE | Total |
| Theory Course(s) | | | | | | | | | |
| 20MA401 | Numerical Analysis and Statistics | BS | 3 | 2 | 0 | 4 | 40 | 60 | 100 |
| 20ME401 | Strength of Materials | ES | 3 | 2 | 0 | 4 | 40 | 60 | 100 |
| 20ME402 | Thermal Engineering | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20ME403 | Manufacturing Technology – II | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Theory with Practical Course(s) | | | | | | | | | |
| 20ME404 | Engineering Metrology | PC | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| 20EE409 | Electrical Drives and Microprocessor | ES | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| Practical Course(s) | | | | | | | | | |
| 20ME405 | Thermal Engineering Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 20ME406 | Manufacturing Technology Laboratory – II | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| Mandatory Course | | | | | | | | | |
| 20MC401 | Soft Skills | MC | 2 | 0 | 0 | 0 | 100 | - | 100 |
| Total | | | 20 | 4 | 8 | 24 | 470 | 430 | 900 |


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| V SEMESTER | | | | | | | | | |
|---------------------------------|---|----------|----------------|---|---|----|---------------|-----|-------|
| Code No. | Course | Category | Periods / Week | | | C | Maximum Marks | | |
| | | | L | T | P | | CA | FE | Total |
| Theory Course(s) | | | | | | | | | |
| 20ME501 | Design of Machine Elements | PC | 3 | 2 | 0 | 4 | 40 | 60 | 100 |
| 20ME502 | Heat and Mass Transfer | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20ME503 | Computer Aided Manufacturing | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEEXX | Professional Elective – I | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20YYOXX | Open Elective – I | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Theory with Practical Course(s) | | | | | | | | | |
| 20ME504 | Dynamics of Machinery | PC | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| Practical Course(s) | | | | | | | | | |
| 20ME505 | Heat Transfer Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 20ME506 | Computer Aided Manufacturing Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| TOTAL | | | 18 | 2 | 6 | 22 | 350 | 450 | 800 |

| VI SEMESTER | | | | | | | | | |
|---------------------------------|-------------------------------|----------|----------------|---|---|----|---------------|-----|-------|
| Code No. | Course | Category | Periods / Week | | | C | Maximum Marks | | |
| | | | L | T | P | | CA | FE | Total |
| Theory Course(s) | | | | | | | | | |
| 20ME601 | Design of Transmission System | PC | 3 | 2 | 0 | 4 | 40 | 60 | 100 |
| 20ME602 | Finite Element Analysis | PC | 3 | 2 | 0 | 4 | 40 | 60 | 100 |
| 20MEEXX | Professional Elective - II | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20YYOXX | Open Elective – II | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Theory with Practical Course(s) | | | | | | | | | |
| 20ME603 | Mechatronics Engineering | PC | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| Practical Course(s) | | | | | | | | | |
| 20ME604 | Modeling Laboratory | PC | 0 | 0 | 4 | 2 | 50 | 50 | 100 |
| 20ME605 | Mini Project | EEC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 20ME606 | Internship | EEC | Two Weeks | | | 1 | 100 | 0 | 100 |
| Total | | | 15 | 4 | 6 | 22 | 410 | 390 | 800 |

N. Natarajan
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[Signature]
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| VII SEMESTER | | | | | | | | | |
|---------------------|--|----------|----------------|---|---|----|---------------|-----|-------|
| Code No. | Course | Category | Periods / Week | | | C | Maximum Marks | | |
| | | | L | T | P | | CA | FE | Total |
| Theory Course(s) | | | | | | | | | |
| 20ME701 | Entrepreneurship and Professional Ethics | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20ME702 | Total Quality Management | HSS | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEEXX | Professional Elective - III | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEEXX | Professional Elective - IV | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20YYOXX | Open Elective – III | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Practical Course(s) | | | | | | | | | |
| 20ME704 | Simulation and Analysis Laboratory | PC | 0 | 0 | 4 | 2 | 50 | 50 | 100 |
| 20ME705 | Design Project | EEC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| TOTAL | | | 15 | 0 | 6 | 18 | 300 | 400 | 700 |

| VIII SEMESTER | | | | | | | | | |
|---------------|----------------------------|----------|----------------|----------|-----------|-----------|---------------|------------|------------|
| Code No. | Course | Category | Periods / Week | | | C | Maximum Marks | | |
| | | | L | T | P | | CA | FE | Total |
| 20MEEXX | Professional Elective - V | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEEXX | Professional Elective – VI | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20ME801 | Major Project | EEC | 0 | 0 | 20 | 10 | 50 | 50 | 100 |
| Total | | | 6 | 0 | 20 | 16 | 130 | 170 | 300 |


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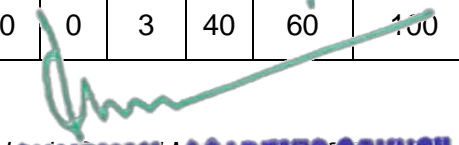
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| PROFESSIONAL ELECTIVES (PE) | | | | | | | | | |
|--|---|----------|----------------|---|---|---|---------------|----|-------|
| Stream – I Design Engineering | | | | | | | | | |
| Code No. | Course | Category | Periods / Week | | | C | Maximum Marks | | |
| | | | L | T | P | | CA | FE | Total |
| 20MEE01 | Design Thinking | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE02 | Product Design | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE03 | Tool and Die Design | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE04 | Design of Hydraulic and Pneumatic Systems | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE05 | Design for Manufacturing and Assembly | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE06 | Optimization Techniques in Engineering Design | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE07 | Computational Fluid Dynamics | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE08 | Engineering Tribology | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE09 | Mechanical Vibrations | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE10 | Design of pressure vessels | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Stream – II Thermal Engineering | | | | | | | | | |
| 20MEE21 | Non-Conventional Energy Sources | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE22 | Power Plant Engineering | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE23 | Refrigeration and Air Conditioning | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE24 | Turbo Machines | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE25 | Gas Dynamics and Jet Propulsion | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE26 | Internal Combustion Engines | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE27 | Cryogenic Engineering | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE28 | Design of Heat exchangers | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE29 | Cogeneration and Waste Heat Recovery Systems | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE30 | Gas turbines | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Stream – III Manufacturing Engineering | | | | | | | | | |
| 20MEE41 | Additive Manufacturing | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE42 | Industrial Automation | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |


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| | | | | | | | | | |
|---|--------------------------------------|----|---|---|---|---|----|----|-----|
| 20MEE43 | Modern Manufacturing Processes | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE44 | Industrial Robotics | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE45 | Advanced casting techniques | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE46 | Advanced welding techniques | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE47 | Process Planning and cost estimation | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE48 | Operations Research | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE49 | Manufacturing of composite materials | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE50 | CNC Machine tools | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE51 | Supply chain management | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Stream – IV Automobile Engineering | | | | | | | | | |
| 20MEE61 | Automobile Engineering | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE62 | Automotive transmission systems | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE63 | Vehicle body engineering | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE64 | Alternate fuels for automobiles | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE65 | Automotive emission and control | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE66 | Two and three wheelers | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE67 | Off road vehicles | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE68 | Electric and hybrid vehicles | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE69 | Vehicle maintenance | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEE70 | Smart mobility | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |


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| OPEN ELECTIVE COURSES (For Other Branches) | | | | | | | | | |
|--|--------------------------------|----------|----------------|---|---|---|---------------|----|-------|
| Code No. | Course | Category | Periods / Week | | | C | Maximum Marks | | |
| | | | L | T | P | | CA | FE | Total |
| 20MEO01 | Integrated Product Development | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEO02 | Manufacturing processes | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEO03 | Automotive Technology | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEO04 | Alternate energy sources | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEO05 | Robotics | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20MEO06 | Principles of management | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |

| ONECREDIT COURSES | | | | | | | | | |
|-------------------|--|----------|----------------|---|---|---|---------------|----|-------|
| Code No. | Course | Category | Periods / Week | | | C | Maximum Marks | | |
| | | | L | T | P | | CA | FE | Total |
| 20MEA01 | Lean Manufacturing | EEC | 1 | 0 | 0 | 1 | 100 | 0 | 100 |
| 20MEA02 | Internet of things | EEC | 1 | 0 | 0 | 1 | 100 | 0 | 100 |
| 20MEA03 | Plastics – Processing, Tooling, Assembly and Testing | EEC | 1 | 0 | 0 | 1 | 100 | 0 | 100 |
| 20MEA04 | Automotive Electronics | EEC | 1 | 0 | 0 | 1 | 100 | 0 | 100 |
| 20MEA05 | CNC Programming | EEC | 1 | 0 | 0 | 1 | 100 | 0 | 100 |
| 20MEA06 | PLC Programming | EEC | 1 | 0 | 0 | 1 | 100 | 0 | 100 |
| 20MEA07 | Vehicle testing and certification | EEC | 1 | 0 | 0 | 1 | 100 | 0 | 100 |


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SUMMARY

| S. No | CATEGORY | CREDITS PER SEMESTER | | | | | | | | TOTAL CREDITS (AICTE) | CREDITS in % |
|--------------|----------|----------------------|----|-----|----|----|----|-----|------|-----------------------|--------------|
| | | I | II | III | IV | V | VI | VII | VIII | | |
| 1. | HSS | 3 | 3 | | | | | 3 | | 9 (10-14) | 5.45% |
| 2. | BS | 8 | 8 | 4 | 4 | | | | | 24 (22-28) | 14.55% |
| 3. | ES | 6 | 9 | 4 | 8 | | | | | 26 (24) | 15.76% |
| 4. | PC | 3 | | 15 | 12 | 16 | 14 | 5 | | 66 (48) | 40.00% |
| 5. | PE | | | | | 3 | 3 | 6 | 6 | 18 (18) | 10.91% |
| 6. | OE | | | | | 3 | 3 | 3 | | 9 | 5.45% |
| 7. | EEC | | | | | | 2 | 1 | 10 | 13 (12-16) | 7.88% |
| 8. | MC | 0 | 0 | 0 | 0 | | | | | 0 | 0.00% |
| Total | | 20 | 20 | 23 | 24 | 22 | 22 | 18 | 16 | 165 | 100% |

HSS - Humanities and Social Sciences

BS - Basic Sciences

ES - Engineering Sciences

PC - Professional Core

PE - Professional Electives

OE - Open Electives

EEC - Employability Enhancement Courses

MC - Mandatory Courses (Non-Credit Courses)

CA - Continuous Assessment

FE - Final Examination


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I SEMESTER

| | | | | | |
|-------------------------|---|----------|----------|----------|----------|
| 20MA105 | Mathematics - I for Mechanical Sciences (Common to AERO, MECH and SAFETY & FIRE ENGG) | L | T | P | C |
| | | 3 | 2 | 0 | 4 |
| Nature of Course | Basic Sciences | | | | |
| Pre requisites | Fundamentals of Basic Mathematics | | | | |

Course Objectives

The course is intended to

1. Acquire the concept of matrix algebra techniques.
2. Acquaint the mathematical tools needed in evaluating limits, derivatives and differentiation of one variable.
3. Learn the concept of calculus for solving the problems mathematically and obtaining solutions.
4. Study the functions of several variables, Taylor's series expansion and Jacobian techniques.
5. Introduce the concepts of evaluating multiple integrals.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|--|---------------|
| CO1 | Apply the concept of orthogonal reduction to diagonalise the given matrix. | Apply |
| CO2 | Interpret the limit definition and rules of differentiation to differentiate the functions. | Understand |
| CO3 | Identify the circle of curvature, evolutes and envelope of the curves. | Understand |
| CO4 | Classify the maxima and minima for a given function with several variables through by stationary points. | Apply |
| CO5 | Compute double and triple integrals. | Apply |

Course Contents**Unit – I Matrices****12**

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties(statement only) – Cayley-Hamilton theorem and its applications – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

Unit – II Limits and Continuity**12**

Representation of functions – Limit of a function – Continuity – Derivatives – Differentiation rules – Maxima and Minima of functions of one variable

Unit – III Differential Calculus**12**

Curvature – radius of curvature (Cartesian and polar-co-ordinates) – Centre of curvature – Circle of curvature – Involute and evolute – envelope.

Unit – IV Functions of Several Variables**12**

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

Unit – V Multiple Integrals**12**

Double integration – Cartesian and polar coordinates – Change of order of integration – Area as double integral – Triple integration – Volume of solids by triple integration.

Total: 60 Periods

Passed in Board of studies Meeting on 21.10.2020

Approved in Academic Council Meeting on 06.11.2020


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Text Books:

1. Grewal B.S, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2016.
2. Veerarajan.T, "Engineering Mathematics for Semester I and II", Tata McGraw Hill, 3rd Edition, 2014.

Reference Books:

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 1st edition, 2017.
2. Bali N.P, Manish Goyal, "A text book of Engineering Mathematics: Semester-I", Laxmi Publications (P) Ltd, 8th Edition, 2015.

Additional References:

1. <https://nptel.ac.in/courses/111/105/111105121>
2. <https://nptel.ac.in/courses/122101003/2>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|--|
| Cos | POs | | | | | | | | | | | | PSOs | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | |
| CO1 | 3 | 3 | 2 | | | | | | | | | | | 2 | | |
| CO2 | 3 | 3 | 2 | | | | | | | | | | | 2 | | |
| CO3 | 3 | 2 | 2 | | | | | | | | | | | 2 | | |
| CO4 | 2 | 3 | 2 | | | | | | | | | | | 1 | | |
| CO5 | 3 | 3 | 2 | | | | | | | | | | | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | | |

| Formative assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Bloom's Level | Assessment Component | Marks | Total marks |
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|----------------------------------|----------------|---------------|-------------------|
| Bloom's Category | Internal Assessment Examinations | | | Final Examination |
| | IAE 1 (7.5) | IAE 2 (7.5) | IAE 3 (10) | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 30 | 30 | 30 | 60 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

| | | | | | |
|------------------|--|---|---|---|---|
| 20EC103 | Basics of Electrical and Electronics Engineering | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Engineering Sciences | | | | |
| Pre requisites | Fundamentals of Electrical Engineering | | | | |

Course Objectives

1. The course is intended to understand the basic concepts of electrical elements and measuring instruments.
2. Gain knowledge of circuit laws.
3. Understand the various components used in electrical installations.
4. Illustrate the construction and operation of various electrical machines.
5. Explore the knowledge on semiconductor and digital circuits

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|---|---------------|
| CO1 | Explain the basic concepts of electrical elements and measuring instruments | Understand |
| CO2 | Apply various circuit laws for solving complex circuits | Apply |
| CO3 | Analyze the functions of various components used in electrical systems | Apply |
| CO4 | Classify the static and dynamic machines and explain their operation. | Apply |
| CO5 | Understand the basic functionalities of electronic circuits and devices | Apply |

Course Contents:**Unit – I Electrical Elements and Measuring Instruments**

9

Resistance, Inductance, Capacitance, Wires and Cables Ammeter, Voltmeter, Wattmeter, Energy meter, Thermistor and Anemometer

Unit– II Electrical Circuits and Theorems

9

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Theorems; Thevinin's, Norton's, Superposition, Maximum power transfer

Unit – III Electrical Installations Devices:

9

Types of Protection devices: Fuses, MCB, ELCB, equipments for house wiring, simple house wiring and pump motor wiring.

Unit - IV Electrical Machines

9

Construction and operating characteristics: DC Motor, Single Phase Transformer, Three phase Induction motor, Single phase induction motors, Synchronous Motor, and Stepper Motor.

Unit – V Semiconductor Devices and Digital Electronics

9

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion

Total: 45 Periods

Passed in Board of studies Meeting on 21.10.2020

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Text Books

1. Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics ", S. Chand & Co. Ltd., 2008
2. Kothari D. P., and I.J Nagarath I,J , "Electrical Machines – Basic Electrical and Electronics Engineering", McGraw Hill Education (India) Private Limited, Third Reprint, 2016.
3. Leonard S Bobrow, "Foundations of Electrical Engineering", Oxford University Press, 2013.

Reference Books:

1. Nagsarkar T.K., and Sukhija M.S., "Basic of Electrical Engineering", Oxford University Press, 2011.
2. Laszlo Solymar, Donald Walsh, Richard R. A. Syms, "Electrical Properties of Materials", Oxford University press, 2014.
3. Toro V.D., "Electrical Engineering Fundamentals", Prentice Hall India, 2014.
4. Mehta V K, "Principles of Electronics", S.Chand & Company Ltd, 1994.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|--|
| COs | Pos | | | | | | | | | | | | PSOs | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | |
| CO1 | 3 | 3 | 2 | | | | | | | | | | 3 | 1 | 2 | |
| CO2 | 3 | 3 | 2 | | | | | | | | | | 3 | 1 | 2 | |
| CO3 | 3 | 3 | 2 | | | | | | | | | | 3 | 1 | 2 | |
| CO4 | 3 | 3 | 2 | | | | | | | | | | 3 | 1 | 2 | |
| CO5 | 3 | 3 | 2 | | | | | | | | | | 3 | 1 | 2 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | | |

| Formative assessment | | | |
|----------------------|---------------------------------|-------|-------------|
| Bloom's Level | Assessment Component | Marks | Total marks |
| Understand | Quiz / Presentation/Tutorial | 5 | 15 |
| Understand | Assignment / Video presentation | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|-----------------------------|----------------|---------------|------------------------------|
| Bloom's Category | Continuous Assessment Tests | | | Terminal Examination (60) |
| | IAE 1 (7.5) | IAE 2 (7.5) | IAE 3 (10) | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 30 | 30 | 30 | 60 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |

| | | | | | |
|------------------|--|---|---|---|---|
| 20ME102 | Fundamentals of Mechanical Engineering | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Engineering Sciences | | | | |
| Pre requisites | Nil | | | | |

Course Objectives

The course is intended to

1. Impart knowledge of mechanical engineering fundamentals of application.
2. Gain knowledge of mechanical process and their applications.
3. Learn the principles of power plant engineering with suitable properties.
4. Develop a clear understanding about internal combustion engines.
5. Explore the knowledge on thermodynamics for refrigeration cycles

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|--|---------------|
| CO1 | Summarize the metal casting process. | Understand |
| CO2 | The joining process of metal to arc, electrode and gas welding process | Understand |
| CO3 | Compare the properties of water tube and tube boilers | Understand |
| CO4 | Infer and compare the performance of I.C engines | Understand |
| CO5 | Contrast the refrigeration and air conditioning systems | Understand |

Course Contents**Unit I Metal Casting Process** 9

Manufacturing Process: Casting, pattern, pattern materials, types, allowances, molding tools, preparation of green sand mould, and manufacturing of cast iron, Cupola furnace, and operation, casting defects, causes and remedies.

Unit II Metal Joining Process 9

Arc welding, Arc welding equipment, electrode, welding process, defects in welding Gas welding, equipment

Unit III Power Plant Engineering 9

Thermal systems: Introduction, Classification of Power Plants, Working principle of steam, fire tube and water tube boilers

Unit IV Internal Combustion Engines 9

Internal combustion engines as automobile power plant, working principle of Petrol and Diesel Engines, Four stroke and two stroke cycles, Comparison of four stroke and two stroke engines

Unit V Refrigeration and Air Conditioning Systems 9

Terminology of Refrigeration and Air Conditioning, Principle of vapor compression refrigeration system, Layout of typical domestic refrigerator, Window and Split type room Air conditioner

Total: 45 Periods

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Text Books

1. Shanmugam G., Palanichamy M.S., "Basic Civil and Mechanical Engineering", McGraw Hill Education, 2018.
2. Hajra Choudhury, "Elements of Workshop Technology, Vol. I and II", Media Promoters Pvt Ltd., Mumbai, 2010
- 3 Rao P.N., "Manufacturing Technology", Tata McGraw-Hill Publishing Limited, II Edition, 2018

Reference Books

1. Magendran Parashar B.S. and Mittal R.K. "Elements of Manufacturing Processes", Prentice Hall of India, 2003.
2. Gowri S., Hariharan P. and Suresh Babu A., "Manufacturing Technology 1", Pearson Education, 2008.
3. Sharma, P.C., "A text book of Production Technology", Chand, S and Company, IV Edition, 2003.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|-----|------|---|---|--|
| COs | POs | | | | | | | | | | | | PSOs | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | |
| CO1 | 3 | 3 | 2 | | | | | | | | | | 1 | | | |
| CO2 | 3 | 3 | 2 | | | | | | | | | | 1 | | | |
| CO3 | 3 | 3 | 2 | | | | | | | | | | 1 | | | |
| CO4 | 3 | 3 | 2 | | | | | | | | | | 1 | | | |
| CO5 | 3 | 3 | 2 | | | | | | | | | | 1 | | | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | | |

| Formative assessment | | | |
|----------------------|---|-------|-------------|
| Bloom's Level | Assessment Component | Marks | Total marks |
| Understand | Direct Measures : Quiz / Presentation/ Tutorial | 5 | 15 |
| Understand | Indirect measures : Assignment/Video presentation | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|----------------|----------------|---------------|---------------------------|
| Bloom's Category | Exams | | | Final Examination (60) |
| | IAE 1 (7.5) | IAE 2 (7.5) | IAE 3 (10) | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 30 | 30 | 30 | 60 |
| Analyse | 0 | 0 | 0 | 0 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

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| | | | | | |
|------------------|--|---|---|---|---|
| 20CH103 | Chemistry for Mechanical Sciences (Common to Aeronautical, Mechanical and Safety & Fire Engineering) | L | T | P | C |
| | | 3 | 0 | 2 | 4 |
| Nature of Course | Basic Sciences | | | | |
| Prerequisites | Nil | | | | |

Course Objectives

The course is intended to

1. Impart knowledge and understanding about the constituents present in water and the need for purification of water.
2. Understand the fundamentals of batteries.
3. Understand the nature and physical properties of lubricating oils.
4. Gain knowledge about fuels and calorific value of solid fuel, liquid fuel and gaseous fuel.
5. Understand the causes and control measures of corrosion.

Course Outcomes

On successful completion of the course, students will be able to

| CO.No | Course Outcome | Bloom's Level |
|-------|---|---------------|
| CO1 | Develop innovative and eco-friendly method for water purification to meet the growing industrial demand | Apply |
| CO2 | Understand the basic principles and mechanism of working of batteries and fuel cells | Understand |
| CO3 | Interpret the importance of viscosity measurement of lubricating oils | Understand |
| CO4 | Classify fuels based on their efficiency of combustion | Understand |
| CO5 | Demonstrate the importance of protection of metals from corrosion | Apply |

Course Contents**Unit-I Water Analysis and Water Treatment**

9

Water analysis: Sources of water, Hard water and soft water, Hardness of water, acidity, alkalinity, pH value, amount of free CO₂, fluoride content and chloride content. Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD). Water treatment: Definition, Zeolite process, Conditioning methods: Internal conditioning (Phosphate, Calgon) and external conditioning (Demineralization), Desalination, Reverse osmosis (RO).

Unit-II Energy Storage Devices

9

Batteries: Definition, characteristics and classification, Primary battery: Alkaline battery, Secondary battery: lead acid battery, nickel cadmium battery, lithium battery and lithium ion battery, Fuel cells: construction and working of phosphoric acid fuel cell.

Unit-III Lubricants

9

Meaning, mechanism of lubrication, liquid lubrication, properties, viscosity index, flash point and fire point, cloud point and pour point, oiliness, kinematic viscosity and common types of kinematic viscometer. Solid lubricants: graphite and molybdenum sulphide.

Unit-IV Fuels and Combustion

9

Solid fuel: Coal and its varieties, analysis of coal: proximate and ultimate with their significance, metallurgical coke: Definition Liquid fuel: petroleum oil. Knocking: octane number, improving octane number by additives Diesel: cetane number. Gaseous fuels - Water gas and Liquefied Petroleum Gas. Combustion: Introduction, Calorific value: Gross and net calorific value, Dulong's formula and problems.

Unit-V Corrosion and its Control

9

Corrosion: Classification, Types: Chemical corrosion and electrochemical corrosion, mechanism. Corrosion control: Corrosion inhibitors, cathodic protection (sacrificial anodic protection, impressed current cathodic protection), Protective coating, Paint constitutions and Electroplating (Au).

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Laboratory Component

| S.No. | Name of the Experiment | CO Mapping | RBT |
|-------|---|------------|------------|
| 1 | Determination of hardness of water | CO1 | Apply |
| 2 | Determination of chloride content in water sample | CO1 | Apply |
| 3 | Conductometric titration of strong acid versus strong base | CO2 | Understand |
| 4 | Determination of strength of HCl by pH metry | CO2 | Understand |
| 5 | Estimation of copper in brass by EDTA method | CO3 | Apply |
| 6 | Determination of viscosity of a liquid using Ostwald Viscometer | CO3 | Understand |
| 7 | Determination of water of crystallization of copper sulphate pentahydrate | CO4 | Apply |
| 8 | Determination alkalinity of water sample and making a comparative study of corrosion rate | CO5 | Understand |

Total: 30 Periods**Text Books**

1. O. G. Palanna, "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 2nd Edition, 2017.
2. P. C. Jain and Monicka Jain, "Engineering Chemistry", Dhanapat Rai Publishing Company Pvt. Ltd, 11th Edition, 2017.

Reference Books

1. B. Sivasankar "Engineering Chemistry" Tata McGraw – Hill Pub.Co.Ltd, New Delhi, 2nd Edition, 2009.
2. R.Sivakumar and N. Sivakumar, "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 1st Edition, 2009.
3. Sivanesan and Nandagopal, "Engineering Chemistry-I", V.K.Pub. Pvt.Ltd, 2nd Edition 2011.

Additional Resources

1. <https://nptel.ac.in/downloads/122101001>
2. <https://nptel.ac.in/courses/103103033/module9/lecture1.pdf>
3. <https://nptel.ac.in/courses/102103044/3>
4. <https://www.spectrosci.com/resource-center/lubrication-analysis/literature/e-guides/guide-to-measuring-oil-viscosity>
5. <https://www.youtube.com/watch?v=G53gfwG9a7k>
6. <https://www.sciencedirect.com/topics/chemistry/phosphoric-acid-fuel-cells>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | | | | | | | | | | | | | |
| CO2 | 3 | 2 | | | | | | | | | | | | | |
| CO3 | 3 | 2 | | | | | | | | | | | | | |
| CO4 | 3 | 2 | | | | | | | | | | | | | |
| CO5 | 3 | 2 | | | | | | | | | | | | | |
| | 3 | High | | | | 2 | Medium | | | | | | Low | | |

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| Summative Assessment | | | | | | |
|----------------------|-----------------------|--------------|-------------|----------------|-----------------------|---------------------------------|
| Bloom's Level | Continuous Assessment | | | | | Final Examination (Theory) [50] |
| | Theory | | | | Practicals | |
| | IAE-I [7.5] | IAE-II [7.5] | IAE-III[10] | Attendance [5] | Rubric based CIA [20] | |
| Remember | 30 | 20 | 10 | | 20 | 40 |
| Understand | 10 | 20 | 30 | | 20 | 40 |
| Apply | 10 | 10 | 10 | | 10 | 20 |
| Analyze | | | | | | |
| Evaluate | | | | | | |
| Create | | | | | | |

| 20ME101 | Engineering Graphics (Common to Aeronautical, Agriculture, Civil, Mechanical, Safety and Fire Engineering & Food Technology) | L | T | P | C |
|------------------|---|---|---|---|---|
| | | 1 | 0 | 4 | 3 |
| Nature of Course | Engineering Sciences | | | | |
| Prerequisites | Nil | | | | |

Course Objectives:

The course is intended to

1. Understand technical drawings in various fields of engineering
2. Imagine and visualize the geometric details of engineering objects.
3. Translate the geometric information of engineering objects into engineering drawings.
4. Develop the graphical skills for communication of concepts, ideas and design of engineering products through technical drawings.
5. Visualize and draw isometric and perspective views

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|---|---------------|
| CO 1 | Develop the conic sections, special curves, and draw orthographic views from pictorial views. | Apply |
| CO 2 | Apply the principles of orthographic projections of points in all quadrants, lines and planes in first quadrant. | Apply |
| CO 3 | Construct the projections of simple solids like prisms, pyramids, cylinder and cone. | Apply |
| CO 4 | Build the sectional views of solids like cube, prisms, pyramids, cylinders & cones and development of its lateral surfaces. | Apply |
| CO 5 | Organize and draw isometric and perspective sections of simple solids. | Apply |

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Course Contents**Concepts and Conventions (Not for Examination)****1**

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

UNIT -I Plane Curves and Free Hand Sketching**(3+12)**

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

UNIT –II Projection of Points, Lines and Plane Surface**(3+12)**

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

UNIT –III Projection of Solids**(3+12)**

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 Surface**(3+12)**

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

UNIT -V Isometric and Perspective Projections**(3+12)**

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

TOTAL: (15+60) Periods**TEXT BOOKS**

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2011
2. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2012.

REFERENCE BOOKS

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.

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3. Parthasarathy N S and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.

Web References

1. [http://nptel.ac.in/courses/112103019/Engineering drawing](http://nptel.ac.in/courses/112103019/Engineering%20drawing)
2. <http://pioneer.netserv.chula.ac.th/~kjiapon/self-practice.html>

Publication of Bureau of Indian Standards

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

Special points applicable only to Final Examinations of Engineering Graphics:

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

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|-----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | | | | | | | | | | 1 | 2 | | |
| CO2 | 3 | 2 | | | | | | | | | | 1 | 2 | | |
| CO3 | 3 | 2 | | | | | | | | | | 1 | 2 | | |
| CO4 | 3 | 3 | | | | | | | | | | 1 | 2 | | |
| CO5 | 3 | 2 | | | | | | | | | | 1 | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Summative assessment | | | | | | |
|----------------------|-----------------------|--------------|--------------|----------------|-----------------------------|---------------------------------------|
| Bloom's Level | Continuous Assessment | | | | | Final Examination (Theory) [50 marks] |
| | Theory | | | | Practical | |
| | IAE-I [7.5] | IAE-II [7.5] | IAE-III [10] | Attendance [5] | Rubric based CIA [20 Marks] | |
| Remember | 10 | 10 | 10 | | 20 | 20 |
| Understand | 20 | 20 | 20 | | 40 | 40 |
| Apply | 20 | 20 | 20 | | 40 | 40 |
| Analyse | | | | | | |
| Evaluate | | | | | | |
| Create | | | | | | |

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| | | | | | |
|------------------|------------------------|---|---|---|---|
| 20MC101 | Induction Programme | L | T | P | C |
| | | 2 | 0 | 0 | 0 |
| Nature of Course | Mandatory, Non Credit. | | | | |
| Pre requisites | Nil | | | | |

Course Objectives

The course is intended to

1. To nurture the character and behaviour as a student.
2. To have broad understanding of society and relationships.
3. To impart interpersonal and soft skills.
4. To inspire the students in the field of engineering.
5. To provide exposure to industries.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|--|---------------|
| CO 1 | Perform curricular and co-curricular activities excellently. | Knowledge |
| CO 2 | Do the skill based training with excellence. | Understand |
| CO 3 | Work as team for the given task | Apply |
| CO 4 | Gain character and behaviour | Knowledge |
| CO 5 | Demonstrate the acquired skills effectively | Apply |

Course Contents**PHYSICAL ACTIVITY**

Yoga, Sports

CREATIVE ARTS (students can select any one of their choice)

Painting, sculpture, pottery, music, craft making and so on

UNIVERSAL HUMAN VALUES

Enhancing soft skills

LITERARY AND PROFICIENCY MODULES

Reading, Writing, Speaking- Debate, Role play etc.,

Communication and computer skills

LECTURES BY EMINENT PEOPLE

Guest lecture by subject experts

VISIT TO LOCAL CITIES

Meditation centers / Industry

FAMILARIZATION TO DEPARTMENT / BRANCH INNOVATION

Lectures by Departments Head and senior faculty members

Total Hours: 45

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Mapping of COs with POs and PSOs

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | | | | | | 2 | 1 | 2 | | | | 3 | 2 | | |
| CO2 | | | | | | 2 | 1 | 2 | | | | 3 | 2 | | |
| CO3 | | | | | | 2 | 1 | 2 | | | | 3 | 2 | | |
| CO4 | | | | | | 2 | 1 | 2 | | | | 3 | 2 | | |
| CO5 | | | | | | 2 | 1 | 2 | | | | 3 | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Bloom's Level | Continuous Assessment (Non-Credit, Mandatory) | | | | |
|---------------|---|---------------|-----------------|---------------------------|-----------------|
| | Test -I [20] | Test -II [20] | Test - III [20] | Assignment/ Activity [20] | Attendance [20] |
| Remember | 10 | 10 | 10 | | |
| Understand | 20 | 20 | 20 | 10 | |
| Apply | 20 | 20 | 20 | 10 | |
| Analyse | | | | | |
| Evaluate | | | | | |
| Create | | | | | |

| | | | | | |
|------------------|--|---|---|---|---|
| 20ENE01 | COMMUNICATIVE ENGLISH (Common to all B.E. / B.Tech. Programmes) | L | T | P | C |
| | | 2 | 0 | 2 | 3 |
| Nature of Course | Humanities and Social Science | | | | |
| Pre requisites | Nil | | | | |

Course Objectives

The course is intended to

- Improve lexical, grammatical and semantic competence.
- Enhance communicative skills in real life situations.
- Augment thinking in all forms of communication.
- Equip with oral and written communication skills.
- Gain employability skills.

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Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|--|---------------|
| CO1 | Use effectively the lexical, grammatical and semantic knowledge | Remember |
| CO2 | Communicate with clarity using intentional vocabulary in English | Apply |
| CO3 | Articulate perfectly and express their opinions confidently using communicative strategies | Remember |
| CO4 | Accomplish listening and reading skills for lifelong learning | Understand |
| CO5 | Comprehend, interpret and present data | Understand |

Course Contents**Unit - I Basic structure and Usage**

6

Parts of Speech – Articles – Tenses - Subject-Verb Agreement – Different Grammatical forms of the same word - Listening to Speeches and Conversations from Globareana software – Listening to Announcements – Listening and Gap Filling.

Unit - II Vocabulary and Language Development

6

Intentional vocabulary used in and around Airport, Hospital, Hotel, Court – Abbreviations and acronyms - One Word Substitution - Compound words – Homophones and Homonyms – Types of sentences - Ordering Jumbled Sentences Letter writing – informal.

Unit – III Oral Communication Skills

6

Improving fluency – Articulation with pronunciation – Voice modulation in Speaking – One minute talk -Self Introduction and introducing ones friend – Telephonic conversations – Group Discussion – Modal Auxiliaries – discourse markers.

Unit – IV Comprehensive Listening and Reading

6

Effective listening Strategies – Listening to Interviews from Globareana software – Phrasal verbs – Reading Comprehension – “An Astrologer’s Day” by R.K.Narayan and “Building a New State” by Dr. A.P.J. Abdul Kalam.

Unit – V Effective Writing

6

Interpretation and presentation of data – developing Hints – general essays and paragraph writing – Report Writing – survey report and accident report - Instructions and Recommendations.

Total: 30 Periods

Laboratory Components

| S.No | List of Exercises | CO Mapping | RBT |
|------|--|------------|------------|
| 1 | Role-play – One minute talk | 3 | Understand |
| 2 | Role-play – Telephonic conversations | 3 | Understand |
| 3 | Listening to speeches and lectures and gap filling | 4 | Understand |
| 4 | Group Discussion. | 4 | Understand |
| 5 | Articulation with pronunciation practice | 3 | Apply |
| 6 | Listening to Announcements – Listening and Gap Filling | 4 | Understand |
| 7 | Listening to Interviews & Native speakers' Conversations | 4 | Understand |

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| | | | |
|----|---|---|------------|
| 8 | Reading practice with articles in magazine and news papers. | 4 | Understand |
| 9 | Model – Job Interviews | 4 | Understand |
| 10 | Introspective report – Personal analysis | 5 | Understand |
| 11 | Telephone etiquette | 3 | Remember |
| 12 | Reading – Shorter texts and News Articles | 4 | Understand |
| 13 | Role Play – Getting and Giving Permission | 3 | Remember |
| 14 | Self Introduction(Formal) | 3 | Understand |
| 15 | Recommendations/Suggestions | 3 | Apply |

Total: 30 Periods

Text Books

1. Rizvi, Ashraf M., "Effective Technical Communication", Tata McGraw Hill Publishing Company Limited, New Delhi, 5th Edition, 2007.
2. Board of Editors, "Using English – A Coursebook for Undergraduate Engineers and Technologists", Orient BlackSwan Private Limited, Hyderabad, 2nd Edition, 2017.

Reference Books:

1. Meenakshi Raman and Sangeetha Sharma, "Technical Communication", Oxford University Press, USA, 10th Edition, 2007.
2. John Cunnison Catford, "A Practical Introduction to Phonetics", Clarendon Press, Jamaica, 2nd Edition, 2001.
3. Hewings. M, "Advanced English Grammar", Cambridge University Press, Chennai, 3rd Edition, 2000.
4. S P Dhanavel "English and Soft Skills", Orient BlackSwan Private Limited, Hyderabad, 1st Edition, 2010.

Web reference:

https://www.googleadservices.com/pagead/aclick?sa=L&ai=DChcSEWij4dCTucfsAhXE1pYKHch4ABMYABABGgJ0bA&ohost=www.google.com&cid=CAASEuRo76H-Vx9BpazOOBfXeJSKVQ&sig=AOD64_3O-HNEnUO4A5sc31MsUfaTBGG-dQ&q&aduri&ved=2ahUKEWjC3ceTucfsAhXBeisKHatIBewQ0Qx6BAgFEAE

| Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO) | | | | | | | | | | | | | | | |
|--|-----|------|---|---|---|---|--------|---|---|----|----|-----|------|---|---|
| Cos | Pos | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO2 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO3 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO4 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO5 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

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| Bloom's Level | Summative assessment | | | | | |
|---------------|-----------------------|--------------|---------------|----------------|-----------------------------|---------------------------------------|
| | Continuous Assessment | | | | | Final Examination (Theory) [50 marks] |
| | Theory Marks | | | | Practical | |
| | IAE-I [7.5] | IAE-II [7.5] | IAE -III [10] | Attendance [5] | Rubric based CIA [20 Marks] | |
| Remember | 20 | 20 | 20 | | 40 | 40 |
| Understand | 20 | 20 | 20 | | 40 | 40 |
| Apply | 10 | 10 | 10 | | 20 | 20 |
| Analyse | | | | | | |
| Evaluate | | | | | | |
| Create | | | | | | |

| | | | | | |
|------------------|--|---|---|---|---|
| 20ENE02 | Advanced Communicative English (Common to all B.E / B.Tech. Programmes) | L | T | P | C |
| | | 2 | 0 | 2 | 3 |
| Nature of Course | Humanities and Social Sciences | | | | |
| Pre requisites | Basics of Communicative English | | | | |

Course Objectives

The course is intended to

1. Demonstrate satisfactory control over complex structures and mechanics in English.
2. Develop fluency and accuracy in oral communication.
3. Communicate effectively and actively in social interactions.
4. Read English at inspectional level.
5. Face interviews with confidence.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|---|---------------|
| CO1 | Apply knowledge of English grammar for effective communication | Remember |
| CO2 | Make use of common English phrases and vocabulary strength. | Understand |
| CO3 | Build self-confidence and enhance professionalism | Apply |
| CO4 | Implement listening, reading and writing skills in real - life situations | Apply |
| CO5 | Speak fluently in English with proper pronunciation, intonation, tone and accent. | Understand |

Course Contents

Unit – I Grammar and usage

6

Active voice and passive voice – Prefixes and suffixes – Connotation – Clauses - If conditionals – Idioms & Phrases - Right forms of verbs – Modal Auxiliaries - Spotting errors.

Unit - II Lexical competence

6

Technical Vocabulary - Expressions – Frequency – Cause and effect - Words often Miss-spelled – Syntax and structure - Homophones and Homonyms- Verbal analogy - Idioms and Phrases.

Unit - III Conversational etiquette

6

Processes description – Tone and accent in speech – Role-play (Job-Interview) – Presentation skills – Mechanics of presentation - Telephone etiquette – Group Discussion strategy - Formal & Informal subjective and objective introduction – Body Language – Mock Interview.

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Unit – IV Listening reading and writing

6

Listen to Scientific / Technical talks and gap filling – Listening to TED/INK Talks – Reading – “Water: The Elixir of Life” by Sir. C.V.Raman. “Progress” by St. John Ervine - Instructions and Recommendations – Letter writing formal – Job application- Report writing – Introspective report – Creative writing – Essays and Paragraphs.

Unit – V Phonetics

6

Production and classification of speech sound – International Phonetic Alphabet and transcriptions – Phonological rules – way and Place of articulation – Vowels, consonants and diphthongs. Specific characteristics feature of vowel sounds.

Total: 30 Periods**Laboratory Components**

| S.No. | List of Exercises | CO Mapping | RBT |
|-------|--|------------|------------|
| 1 | Role-play – Processes Description | CO2 | Remember |
| 2 | Listening to TED/INK Talks and gap filling | CO4 | Understand |
| 3 | Group Discussion | CO3 | Understand |
| 4 | Articulation with pronunciation practice | CO3 | Apply |
| 5 | Reading – Longer texts and Technical Articles (Skimming & Scanning). | CO4 | Apply |
| 6 | Presentation skills – Mechanics of presentation | CO5 | Understand |
| 7 | Individual presentation on given topics | CO5 | Remember |
| 8 | Telephone etiquette | CO5 | Understand |
| 9 | Instructions and Recommendations | CO5 | Remember |
| 10 | Writing – General Essays. | CO4 | Apply |
| 11 | Report writing technique- write up | CO4 | Remember |
| 12 | Introspective report – Personal analysis | CO4 | Understand |
| 13 | Model Job Interviews | CO3 | Understand |
| 14 | Job Interviews(Role play) | CO3 | Apply |
| 15 | Body Language | CO3 | Understand |

Total: 30 Periods**Text Books**

1. Rizvi, Ashraf.M, “Effective Technical Communication”, Tata McGraw Hill Publishing Company Limited, New Delhi, 5th Edition, 2007.
2. Hewings. M, “Advanced English Grammar”, 3rd Edition, Cambridge University Press, Chennai, 5th Edition, 2000.
3. Board of Editors, “Using English – A Coursebook for Undergraduate Engineers and Technologists”, Orient BlackSwan Private Limited, Hyderabad, 2nd Edition, 2017.

Reference Books:

1. Raman M & Sangeetha Sharma, “Technical Communication”, Oxford University Press, USA, 10th Edition, 2007.
2. John Cunnison Catford, “A Practical Introduction to Phonetics”, Clarendon Press, Jamaica, 2nd Edition, 2001.
3. Norman Whitby, Business Benchmark – “Pre-Intermediate to Intermediate, Students Book”, Cambridge University Press, 1st Edition, 2006.
4. Dhanavel S. P., “English and Soft Skills”, 1st Edition, Orient BlackSwan Private Limited, Hyderabad, 1st Edition, 2010.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|-----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO2 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO3 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO4 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO5 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Summative assessment | | | | | | |
|----------------------|-----------------------|--------------|---------------|----------------|-----------------------------|---------------------------------------|
| Bloom's Level | Continuous Assessment | | | | | Final Examination (Theory) [50 marks] |
| | Theory Marks | | | | Practical | |
| | IAE-I [7.5] | IAE-II [7.5] | IAE -III [10] | Attendance [5] | Rubric based CIA [20 Marks] | |
| Remember | 20 | 20 | 20 | | 40 | 40 |
| Understand | 20 | 20 | 20 | | 40 | 40 |
| Apply | 10 | 10 | 10 | | 20 | 20 |
| Analyse | | | | | | |
| Evaluate | | | | | | |
| Create | | | | | | |

II SEMESTER

| 20MA205 | Mathematics - II for Mechanical Sciences (Common to AERO, MECH and SAFETY & FIRE ENGG) | L | T | P | C |
|------------------|---|---|---|---|---|
| | | 3 | 2 | 0 | 4 |
| Nature of Course | Basic Sciences | | | | |
| Pre requisites | Fundamentals of Basic Mathematics | | | | |

Course Objectives

The course is intended to

1. Acquire the mathematical skills to solve the differential equations.
2. Acquaint the concepts of vector calculus needed in mechanical engineering field.
3. Study the rigorous and analytic approach to analyze the conformal mapping.
4. Learn the concept of complex integration to evaluate definite integrals.
5. Introduce Laplace transform techniques to solve ordinary differential equations.

Course Outcomes

On successful completion of the course, students will be able to

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| CO. No. | Course Outcome | Bloom's Level |
|---------|---|---------------|
| CO1 | Solve the linear and simultaneous differential equations. | Understand |
| CO2 | Apply the basics of vector calculus comprising of gradient, line surface, volume integrals and the classical theorems. | Apply |
| CO3 | Identify the concepts of analytic functions and its properties and apply it in conformal mapping. | Apply |
| CO4 | Determine the singularities and its corresponding residues for the given function. | Apply |
| CO5 | Compare Laplace transform, Inverse Laplace transform and solve the linear differential equations by Laplace transform techniques. | Apply |

Course Contents**Unit - I Ordinary Differential Equations****12**

Differential equations with variable co-efficient: Cauchy's and Legendre's form of linear equation – Method of variation of parameters – Introduction of first order non- linear differential equation.

Unit – II Vector Calculus**12**

Gradient, Divergence and Curl –Directional derivative –Irrotational and solenoidal vector fields – Vector integration –Green's, Gauss divergence and Stokes' theorem –Statement, Verification and Simple applications

Unit – III Complex Differentiation and Conformal mapping**12**

Functions of a complex variable –Analytic functions –Statement of Cauchy –Riemann equations – Harmonic functions–Harmonic conjugate –Construction of analytic functions –Conformal mapping : $w = z + c$, cz , $1/z$ and Bilinear transformation.

Unit – IV Complex Integration**12**

Cauchy's Integral theorem (statement only) – Cauchy's integral formula – Taylor's and Laurent's series – Classification of singularities – Cauchy's residue theorem – Contour integration – Circular and semi-circular contours.

Unit – V Laplace Transforms**12**

Laplace transforms –Transform of elementary functions –Properties –Transform of periodic functions - Inverse Laplace transforms –Statement and applications of Convolution theorem –Initial and Final value theorems – Method of solving second order ODE with constant coefficients by using Laplace transforms technique.

Total: 60 Periods

Text Books

1. Grewal B.S, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2016.
2. Bali N.P, Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications (P) LTD, 6th edition, 2015.

Reference Books

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 1st edition, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons (Asia) Limited, 10th Edition, 2018.

Additional References

1. https://onlinecourses.nptel.ac.in/noc16_ma05
2. <https://nptel.ac.in/courses/122/104/122104017>

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

| Cos | Pos | | | | | | | | | | | | PSOs | | |
|-----|-----|------|---|---|---|---|--------|---|---|----|----|-----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 2 | | | | | | | | | | | 2 | |
| CO2 | 2 | 3 | 2 | | | | | | | | | | | 1 | |
| CO3 | 3 | 2 | 1 | | | | | | | | | | | 3 | |
| CO4 | 3 | 2 | 1 | | | | | | | | | | | 1 | |
| CO5 | 2 | 3 | 2 | | | | | | | | | | | 2 | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

Formative assessment

| Bloom's Level | Assessment Component | Marks | Total marks |
|---------------|-----------------------------|-------|-------------|
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

Summative Assessment

| Bloom's Category | Internal Assessment Examinations | | | Final Examination (60) |
|------------------|----------------------------------|----------------|---------------|---------------------------|
| | IAE 1 (7.5) | IAE 2 (7.5) | IAE 3 (10) | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 30 | 30 | 30 | 60 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

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| | | | | | |
|------------------|---|---|---|---|---|
| 20ME201 | Engineering Mechanics (Common to Aeronautical, Agriculture, Civil, Mechanical and Safety and Fire Engineering) | L | T | P | C |
| | | 3 | 2 | 0 | 4 |
| Nature of Course | Engineering Sciences | | | | |
| Pre requisites | Fundamentals of Basic Mathematics and Physics | | | | |

Course Objectives

The course is intended to

1. Develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.
2. Make the students understand the vector and scalar representation of forces and Moments and the static equilibrium of particles and rigid bodies.
3. Understand the effect of friction on equilibrium, laws of motion, kinematics of motion and the interrelationship.
4. Make the students understand the properties of surfaces and solids, prediction of behavior of particles and rigid bodies under motion.
5. Make the students familiar with frictional laws and its application

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|--|---------------|
| CO 1 | Illustrate the vectorial and scalar representation of forces and moments | Apply |
| CO 2 | Find the rigid body in equilibrium. | Apply |
| CO 3 | Determine the properties of surfaces and solids. | Apply |
| CO 4 | Calculate dynamic forces exerted in rigid body | Apply |
| CO 5 | Determine the friction and the effects by the laws of friction | Apply |

Course Contents**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 - additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT - II Equilibrium of Rigid Bodies**12**

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

UNIT- III Properties of Surfaces and Solids**12**

Centroids and centre of mass– Centroids of lines and 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 theorem and perpendicular axis theorem –Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical

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and spherical solids from first principle – Relation to area moments of inertia

UNIT – IV Dynamics of Particles**12**

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

UNIT - V Friction and Elements of Rigid Body Dynamics**12**

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction- Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder and fly wheel

TOTAL: 60 Periods**Text Books**

1. Rajasekaran, S. and Sankarasubramanian, G, "Fundamentals of Engineering 17 Mechanics", Vikas Publishing House Pvt. Ltd., New Delhi, 2009
2. Kumar, K.L., "Engineering Mechanics", Tata McGraw-Hill Publishing Company, New Delhi, 3rd Revised Edition, 2008

References

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", Tata McGraw-Hill Publishing Company, New Delhi, 8th Edition 2004
2. Hibbeler, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", Pearson Education, 11th Edition, 2010

Web References

1. <http://nptel.ac.in/courses/122104015/>
2. <http://nptel.ac.in/courses/112103109/>

Online Resources

1. <https://ocw.mit.edu/courses>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|-----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | | 1 | | | | | | | | | 3 | | |
| CO2 | 3 | 2 | | 1 | | | | | | | | | 3 | | |
| CO3 | 3 | 2 | | 1 | | | | | | | | | 3 | | |
| CO4 | 3 | 2 | | 1 | | | | | | | | | 3 | | |
| CO5 | 3 | 2 | | 1 | | | | | | | | | 3 | | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Formative assessment | | | |
|----------------------|-------------------------------|-------|-------------|
| Bloom's Level | Assessment Component | Marks | Total marks |
| Remember | Online Quiz or Tutorial Class | 5 | 15 |
| Understand | Assignment | 5 | |
| | Attendance | 5 | |

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| Summative Assessment | | | | |
|----------------------|----------------------------------|----------------|---------------|---------------------------|
| Bloom's Category | Internal Assessment Examinations | | | Final Examination (60) |
| | IAE 1 (7.5) | IAE 2 (7.5) | IAE 3 (10) | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 20 | 20 | 20 | 40 |
| Analyse | | | | |
| Evaluate | 10 | 10 | 10 | 20 |
| Create | | | | |

| | | | | | |
|------------------|---|---|---|---|---|
| 20PH203 | Physics for Mechanical Sciences (Common to Aeronautical, Mechanical & Fire and Safety Engineering) | L | T | P | C |
| | | 3 | 0 | 2 | 4 |
| Nature of Course | Basic Sciences | | | | |
| Pre requisites | Fundamentals of Basic Physics | | | | |

Course Objectives

The course is intended to

1. Impart knowledge of properties of matter like elasticity and its applications
2. Provide knowledge of optics, especially laser and their applications in fiber optics.
3. Learn the thermal properties of materials and their applications.
4. Understand the magnetic, piezo-electric and superconducting properties of materials.
5. Expose to new engineering materials like nano materials, shape memory alloys and metallic glasses.

Course Outcomes

On successful completion of the course, students will be able to

| CO.No. | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO1 | Explain the knowledge about elastic modulus | Understand |
| CO2 | Compare the working of lasers and propagation of light through optical fibers and its applications | Understand |
| CO3 | Demonstrate the thermal conductivity of good and bad conductors | Understand |
| CO4 | Outline the magnetic, piezoelectric and superconducting properties of the materials | Understand |
| CO5 | Explain a conceptual understanding about the properties of new engineering materials like shape memory alloys, composites and metallic glasses | Understand |

Course Contents**UNIT I Properties of Matter**

9

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever – uniform and non-uniform bending - I-shaped girders - stress due to bending in beams.

UNIT II Laser and Fiber Optics

9

Lasers: population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibers (material, refractive index, mode) – optical fiber communication system- fiber optic endoscope.

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Unit III Thermal Physics

9

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications.

Unit IV Magnetic, Piezo Electric and Super Conducting Materials

9

Ferromagnetism- domain theory- types of energy- hard and soft magnetic materials – ferrites, Piezoelectric effect – piezoelectric crystal – Piezo-electric generator - principle and working – application of piezoelectric effect, Superconductivity – Meissner effect – Effect of magnetic field – Type I and Type II superconductors.

Unit V New Engineering Materials

9

Metallic glasses – preparation, properties and applications – Shape memory alloys – Types, characteristics and applications – Nano materials – preparation – physical vapour deposition - sol gel method, properties and applications. Carbon Nano tube - properties and applications.

Total : 45 Periods**Laboratory Components**

| S.No | List of Experiments | CO Mapping | RBT |
|------|---|------------|-------|
| 1 | Determination of rigidity modulus – Torsion pendulum | CO1 | Apply |
| 2 | Determination of Young's modulus by non-uniform bending method. | CO1 | Apply |
| 3 | Determination of wavelength, and particle size using Laser | CO2 | Apply |
| 4 | Determination of acceptance angle in an optical fiber | CO2 | Apply |
| 5 | Determination of thermal conductivity of a bad conductor by Lee's Disc method | CO3 | Apply |
| 6 | Determination of velocity of sound and compressibility of liquid by Ultrasonic interferometer | CO2 | Apply |
| 7 | Determination of Coefficient of viscosity of liquid | CO1 | Apply |

Total:30 Periods**TEXT BOOKS**

1. Bhattacharya D.K. and Poonam T., "Engineering Physics", Oxford University Press, 2nd Edition, 2015.
2. Avadhanulu M.N. and Kshirsagar P.G., "A Text book of Engineering Physics", S.Chand and company., New Delhi, 10th Edition, 2014.
3. William D Callister Jr. and David G Rethwisch., "Materials Science and Engineering", 9th Edition, John Wiley & Sons, Inc, 2019.

REFERENCES

1. David Halliday. Robert Resnick, and Jearl Walker., "Principles of Physics", Wiley, 10th Edition, 2014..
2. Raymond A Serway. and John W Jewett., "Physics for Scientists and Engineers", Cengage Learning, 9th Edition, 2019.
3. Raghavan V., "Materials Science and Engineering, A First course", PHI Learning, 5th Edition, 2015.

Web References:

1. <https://nptel.ac.in/courses/115/101/115101012/>
2. <https://www.youtube.com/watch?v=9bhG0hkKjCA>
3. <https://theconstructor.org/concrete/expansion-joint-concrete/25161/>
4. <https://spaceplace.nasa.gov/laser/en/>

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| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|--|
| COs | POs | | | | | | | | | | | | PSOs | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | |
| CO1 | 3 | 1 | 1 | | | | | | | | | | | | | |
| CO2 | 3 | 1 | 1 | | | | | | | | | | | | | |
| CO3 | 3 | 1 | 1 | | | | | | | | | | | | | |
| CO4 | 3 | 1 | 1 | | | | | | | | | | | | | |
| CO5 | 3 | | 1 | | | | | | | | | | | | | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | | |

| Summative assessment | | | | | | |
|----------------------|---------------------|--------------|--------------|----------------|-----------------------------|---------------------------------------|
| Bloom's Level | Internal Assessment | | | | | Final Examination (Theory) [50 marks] |
| | Theory Marks | | | | Practical | |
| | IAE-I [7.5] | IAE-II [7.5] | IAE-III [10] | Attendance [5] | Rubric based CIA [20 Marks] | |
| Remember | 10 | 10 | 10 | | | 20 |
| Understand | 35 | 35 | 35 | | 40 | 70 |
| Apply | 5 | 5 | 5 | | 60 | 10 |
| Analyse | | | | | | |
| Evaluate | | | | | | |
| Create | | | | | | |

| | | | | | |
|------------------|---|---|---|---|---|
| 20CS201 | PROBLEM SOLVING USING PYTHON (Common to all Branches) | L | T | P | C |
| | | 3 | 0 | 2 | 4 |
| Nature of Course | Engineering Sciences | | | | |
| Pre requisites | Mathematical and Logical Knowledge | | | | |

Course Objectives

The course is intended to

1. Think logically and write algorithm and draw flow charts for problems.
2. Read and write simple Python programs.
3. Develop Python programs with conditionals and loops.
4. Define Python functions and call them.
5. Use Python data structures — lists, tuples, dictionaries and files.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|--|---------------|
| CO1 | Develop algorithmic solutions to simple computational problems and read, write, execute by simple python programs. | Apply |
| CO2 | Structure simple python programs for solving problems. | Understand |
| CO3 | Administer the role of control statements and functions involving the idea of modularity. | Apply |
| CO4 | Represent compound data using python strings and lists. | Apply |
| CO5 | Read and write data from/to files in python Programs. | Understand |

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Course Contents**UNIT I Basics of Computers & Problem Solving 9**

Computer Basics – Components-Computer organization - Computer Software- Types of software - Software Development steps -Need for logical analysis and thinking- Algorithms – Flowchart - Number system.

UNIT II Introduction of Python Programming 9

Introduction-Python Interpreter-Interactive and script mode -Values and types, variables, operators, expressions, statements, precedence of operators, Multiple assignments, comments, Input and Output Statements.

UNIT III Control statements and Functions 9

Conditional (if), alternative (if-else), chained conditional (if-elif-else)-Iteration-while, for, break, continue, pass – Functions - Introduction, inbuilt functions, user defined functions, passing parameters, return values, recursion, Lambda functions.

UNIT IV Strings and Lists 9

Strings-String slices, immutability, string methods and operations -Lists-creating lists, list operations, list methods, mutability, aliasing, cloning lists, list and strings, list and functions-list processing-list comprehension, searching and sorting.

UNIT V Tuples, Dictionaries and Files 9

Tuples- Tuple assignment, lists and tuples, Tuple as return value- Dictionaries-operations and methods, Files and Exception-Text files, reading and writing files, format Operator, Exception handling

TOTAL : 45 Periods**Laboratory Components**

| S.No | List of Exercises | CO Mapping | RBT |
|------|--|------------|------------|
| 1 | Write a algorithm & draw flowchart for simple computational problems | CO1 | Understand |
| 2 | Write a program to perform different arithmetic operations on numbers in python. | CO2 | Understand |
| 3 | Write a python program to implement the various control Structures | CO3 | Apply |
| 4 | Write a python program for computational problems using recursive function. | CO3 | Apply |
| 5 | Demonstrate use of list for data validation. | CO4 | Apply |
| 6 | Develop a python program to explore string functions | CO4 | Analyze |
| 7 | Implement linear search and binary search. | CO4 | Apply |
| 8 | Develop a python program to implement sorting methods | CO4 | Analyze |
| 9 | Develop python programs to perform operations on dictionaries. | CO5 | Analyze |
| 10 | Write a python program to read and write into a file | CO5 | Apply |

TOTAL: 30 Periods

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Text Books

1. Reema Thareja, "Problem Solving and Programming with Python", Oxford University Press, 2018.
2. Dr. R. Nageswara Rao, "Core Python Programming", Dream tech Press, 2017.

Reference Books

1. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012
2. Ashok Namdev Kamthane, Amit Ashok Kamthane, "Programming and Problem Solving with Python", Mc-Graw Hill Education, 2018.
3. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem Solving Focus", Wiley India Edition, 2013
4. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 | |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 | |
| CO3 | 3 | 2 | 2 | | | | | | | | | | 3 | 1 | |
| CO4 | 3 | 2 | 2 | | | | | | | | | | 3 | 1 | |
| CO5 | 3 | 2 | 2 | | | | | | | | | | 3 | 1 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Summative assessment | | | | | | |
|----------------------|-----------------------|--------------|--------------|----------------|-----------------------------|--|
| Bloom's Level | Continuous Assessment | | | | | End Semester Examination (Theory) [50 marks] |
| | Theory Marks | | | | Practical | |
| | IAE-I [7.5] | IAE-II [7.5] | IAE-III [10] | Attendance [5] | Rubric based CIA [20 Marks] | |
| Remember | 10 | 10 | 10 | | | 20 |
| Understand | 20 | 20 | 20 | | 30 | 50 |
| Apply | 20 | 20 | 20 | | 50 | 30 |
| Analyse | | | | | 20 | |
| Evaluate | | | | | | |
| Create | | | | | | |

| | | | | | |
|------------------|---|---|---|---|---|
| 20ME202 | Mechanical Engineering Practices Laboratory | L | T | P | C |
| | | 0 | 0 | 2 | 1 |
| Nature of Course | Engineering Sciences | | | | |
| Pre requisites | Fundamentals of Science | | | | |

Course Objectives

The course is intended

1. To provide hands on training in foundry practice
2. To practice butt joints, lap joints and T- joints by Metal arc welding.
3. To fabricate models using sheet metal
4. To make joints using carpentry tools.
5. To build pipeline joints as per location and functional requirements.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|--|---------------|
| CO 1 | Construct green sand mould in foundry | Apply |
| CO 2 | Experiment with arc welding equipments to join the structures | Apply |
| CO 3 | Make the models using sheet metal | Apply |
| CO 4 | Fabricate joints in carpentry components | Apply |
| CO 5 | Carry out basic machining operations and pipe connections including plumbing works | Apply |

List of Exercises

| S.No | Exercises | CO Mapping | RBT LEVEL |
|-------------------------|--|------------|-----------|
| Foundry | | | |
| 1 | Preparation of green sand mould | CO 1 | Apply |
| Welding | | | |
| 2 | Lap joint using Arc welding | CO 2 | Apply |
| 3 | Butt joint using Arc welding | CO 2 | Apply |
| 4 | Tee joint using Arc welding | CO 2 | Apply |
| Sheet metal | | | |
| 5 | Fabrication of tray using sheet metal | CO 3 | Apply |
| 6 | Fabrication of cone using sheet metal | CO 3 | Apply |
| Carpentry | | | |
| 7 | Cross lap joint using wood | CO 4 | Apply |
| 8 | Tee lap joint using wood | CO 4 | Apply |
| 9 | Dove-tail joint using wood | CO 4 | Apply |
| Special Machines | | | |
| 10 | Drilling of hole in the given work piece | CO 5 | Apply |
| Plumbing | | | |
| 11 | External thread cutting | CO 5 | Apply |
| 12 | Domestic water pipe line connection | CO 5 | Apply |

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|-----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | | | 3 | | | | | | | | | 3 | 2 | | |
| CO2 | | | 3 | | | | | | | | | 2 | 2 | | |
| CO3 | | | 3 | | | | | | | | | 2 | 2 | | |
| CO4 | | | 3 | | | | | | | | | 2 | 2 | | |
| CO5 | | | 3 | | | | | | | | | 2 | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Summative Assessment based on Continuous and Final Examination | | |
|--|---|------------------------------|
| Bloom's Level | Rubric based Continuous Assessment [50 marks] | Final Examination [50 marks] |
| Remember | | |
| Understand | 20 | 20 |
| Apply | 30 | 30 |
| Analyze | | |
| Evaluate | | |
| Create | | |

| 20MC201 | ENVIRONMENTAL SCIENCES (Common to Agriculture, Food Technology, Aero, Civil, Mechanical and Fire & Safety Engineering) | L | T | P | C |
|------------------|---|---|---|---|---|
| | | 2 | 0 | 0 | 0 |
| Nature of Course | Mandatory | | | | |
| Prerequisites | Nil | | | | |

Course Objectives

The course is intended to

1. Understand the concept of eco system and environment.
2. Become conversant with ecological balance and values of bio diversity.
3. Know the role of human in prevention of pollution and making a clean environment.
4. Get knowledge about conservation of non conventional energy resources.
5. Study about the nature and management of e-waste and solid waste.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|---|---------------|
| CO1 | Describe the ecosystem and environment | Understand |
| CO2 | Understand the ecological balance and preservation of bio diversity | Understand |
| CO3 | Demonstrate various types of pollution in order to control pollution | Apply |
| CO4 | Classify the energy sources for the conservation of non conventional energy sources | Understand |
| CO5 | Identify the nature and management of e-waste and solid waste | Apply |

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Course Contents**Unit-I Ecosystem**

Eco system - Food chains, Food webs and Ecological pyramids. Ecosystem - (a) Forest eco system, (b) Aquatic eco system (pond ecosystem and marine ecosystem).

6

Unit-II Biodiversity

Introduction to Bio diversity, Values of Bio diversity, Threads to Bio diversity, Endangered and Endemic species of India, Hotspots of biodiversity. Conservation of Bio diversity: In-Situ and Ex-Situ conservation of bio diversity.

6

Unit-III Environmental Pollution

Definition, Causes, Effects and Control of (a) Air pollution (b) Water pollution (c) Soil pollution Electrostatic Precipitator for controlling air pollution

6

Unit-IV Non Conventional Energy Resources

Introduction, Types: Solar Energy, Wind Energy and Geo Thermal Energy.

6

Unit-V Environmental Management

Sustainable Development, Role of Information technology in Environment and Human HIV and AIDS: causes and control measures, Green chemistry: Definition and Principles

6

Activity Component

| S.No | Name of the Experiment | CO Mapping | RBT |
|------|---|------------|------------|
| 1 | Field study of simple eco system: pond, river and hill slopes | CO1 | Understand |
| 2 | Case study regarding environmental management | CO5 | Apply |

Total: 30 periods**Text Books**

1. Anubha Kaushik and C.P. Kaushik, "Environmental Science and Engineering, New Age International Publishers, New Delhi, 2nd Edition, 2015
2. V. Kumar, "An Introduction to Green Chemistry" Vishal publishing Co. Reprint Edition, 2010

Reference Books

1. Masters, Gilbert M, "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi, 2nd Edition, 2012
2. Santosh Kumar Garg and Rajeshwari Garg "Ecological and Environmental Studies", Khanna Publishers, Nai Sarak, Delhi, 2nd Edition, 2014

Additional Resources

1. <https://nptel.ac.in/courses/122103039/38>
2. <https://bch.cbd.int/cms/ui/collaboration/download/download.aspx?id=909>
3. [https://nptel.ac.in/courses/105102089/air%20pollution%20\(Civil\)/Module-3/3a.htm](https://nptel.ac.in/courses/105102089/air%20pollution%20(Civil)/Module-3/3a.htm)
4. www.vssut.ac.in/lecture_notes/lecture1428910296.pdf
5. nptel.ac.in/courses/120108004/module7/lecture8.pdf

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

| COs | POs | | | | | | | | | | | | PSOs | | |
|-----|-----|------|---|---|---|---|---|--------|---|----|----|----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | | | | | | | 3 | | | | | 3 | | | |
| CO2 | | | | | | | 3 | | | | | 3 | | | |
| CO3 | | | | | | | 3 | | | | | 3 | | | |
| CO4 | | | | | | | 3 | | | | | 3 | | | |
| CO5 | | | | | | | 3 | | | | | 3 | | | |
| | 3 | High | | | | | 2 | Medium | | | | 1 | Low | | |

| Bloom's Level | Continuous Assessment | | | | |
|---------------|-----------------------|-------------|--------------|-----------------|---------------|
| | IAE-I [20] | IAE-II [20] | IAE-III [20] | Attendance [10] | Activity [30] |
| Remember | 30 | 20 | 20 | | |
| Understand | 10 | 20 | 20 | | |
| Apply | 10 | 10 | 10 | | |
| Analyze | | | | | |
| Evaluate | | | | | |
| Create | | | | | |

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| | | | | | |
|-------------------------|--|----------|----------|----------|----------|
| 20ENE02 | Advanced Communicative English (Common to all B.E./B.Tech. Programmes) | L | T | P | C |
| Nature of Course | Humanities and Social Sciences | 2 | 0 | 2 | 3 |
| Pre requisites | Basics of Communicative English | | | | |

Course Objectives

The course is intended to

1. Demonstrate satisfactory control over complex structures and mechanics in English.
2. Develop fluency and accuracy in oral communication.
3. Communicate effectively and actively in social interactions.
4. Read English at inspectional level.
5. Face interviews with confidence.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|---|---------------|
| CO1 | Apply knowledge of English grammar for effective communication | Remember |
| CO2 | Make use of common English phrases and vocabulary strength | Understand |
| CO3 | Build self-confidence and enhance professionalism | Apply |
| CO4 | Implement listening, reading and writing skills in real - life situations | Apply |
| CO5 | Speak fluently in English with proper pronunciation, intonation, tone and accent. | Understand |

Course Contents**Unit – I Grammar and usage**

6

Active voice and passive voice – Prefixes and suffixes – Connotation – Clauses - If conditionals – Idioms & Phrases - Right forms of verbs – Modal Auxiliaries - Spotting errors.

Unit - II Lexical competence

6

Technical Vocabulary - Expressions – Frequency – Cause and effect - Words often Miss-spelled – Syntax and structure - Homophones and Homonyms- Verbal analogy - Idioms and Phrases.

Unit - III Conversational etiquette

6

Processes description – Tone and accent in speech – Role-play (Job-Interview) – Presentation skills – Mechanics of presentation - Telephone etiquette – Group Discussion strategy - Formal & Informal subjective and objective introduction – Body Language – Mock Interview.

Unit – IV Listening reading and writing

6

Listen to Scientific / Technical talks and gap filling – Listening to TED/INK Talks – Reading – "Water: The Elixir of Life" by Sir. C.V.Raman. "Progress" by St. John Ervine - Instructions and Recommendations – Letter writing formal – Job application- Report writing – Introspective report – Creative writing – Essays and Paragraphs.

Unit – V Phonetics

6

Production and classification of speech sound – International Phonetic Alphabet and transcriptions – Phonological rules – way and Place of articulation – Vowels, consonants and diphthongs. Specific characteristics feature of vowel sounds.

Total: 30 Periods

Laboratory Components

| S.No | List of Exercises | CO Mapping | RBT |
|------|--|------------|------------|
| 1 | Role-play – Processes Description | 2 | Remember |
| 2 | Listening to TED/INK Talks and gap filling | 4 | Understand |

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| | | | |
|----|--|---|------------|
| 3 | Group Discussion | 3 | Understand |
| 4 | Articulation with pronunciation practice | 3 | Apply |
| 5 | Reading – Longer texts and Technical Articles (Skimming & Scanning). | 4 | Apply |
| 6 | Presentation skills – Mechanics of presentation | 5 | Understand |
| 7 | Individual presentation on given topics | 5 | Remember |
| 8 | Telephone etiquette | 5 | Understand |
| 9 | Instructions and Recommendations | 5 | Remember |
| 10 | Writing – General Essays. | 4 | Apply |
| 11 | Report writing technique- write up | 4 | Remember |
| 12 | Introspective report – Personal analysis | 4 | Understand |
| 13 | Model Job Interviews | 3 | Understand |
| 14 | Job Interviews(Role play) | 3 | Apply |
| 15 | Body Language | 3 | Understand |

Total: 30 Periods

Text Books

1. , "Using English – A Coursebook for Undergraduate Engineers and Technologists", Orient Rizvi, Ashraf.M, "Effective Technical Communication", Tata McGraw Hill Publishing Company Limited, New Delhi, 5th Edition, 2007.
2. Hewings. M, "Advanced English Grammar", 3rd Edition, Cambridge University Press, Chennai, 5th Edition, 2000.
3. Board of Editors BlackSwan Private Limited, Hyderabad, 2nd Edition, 2017.

Reference Books:

1. Raman M & Sangeetha Sharma, "Technical Communication", Oxford University Press, USA, 10th Edition, 2007.
2. John Cunnison Catford, "A Practical Introduction to Phonetics", Clarendon Press, Jamaica, 2nd Edition, 2001.
3. Norman Whitby, Business Benchmark – "Pre-Intermediate to Intermediate, Students Book", Cambridge University Press, 1st Edition, 2006.
4. Dhanavel S. P., "English and Soft Skills", 1st Edition, Orient BlackSwan Private Limited, Hyderabad, 1st Edition, 2010.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|-----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO2 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO3 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO4 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO5 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Summative assessment | | | | | | |
|----------------------|-----------------------|--------------|---------------|----------------|-----------------------------|---------------------------------------|
| Bloom's Level | Continuous Assessment | | | | | Final Examination (Theory) [50 marks] |
| | Theory Marks | | | | Practical | |
| | IAE-I [7.5] | IAE-II [7.5] | IAE -III [10] | Attendance [5] | Rubric based CIA [20 Marks] | |
| | | | | | | |
| Remember | 20 | 20 | 20 | | 40 | 40 |
| Understand | 20 | 20 | 20 | | 40 | 40 |
| Apply | 10 | 10 | 10 | | 20 | 20 |
| Analyse | | | | | | |
| Evaluate | | | | | | |
| Create | | | | | | |

| | | | | | |
|------------------|--------------------------------|---|---|---|---|
| 20ENE03 | Hindi | L | T | P | C |
| | | 2 | 0 | 2 | 3 |
| Nature of Course | Humanities and Social Sciences | | | | |
| Pre requisites | Basic Perceptive of Language | | | | |

Course Objectives

The course is intended for learners.

1. To help students acquire the basics of Hindi
2. To teach them how to converse in Hindi on simple day-to-day situations
3. To help students acquire the ability to understand a simple technical text in Hindi

Course Outcomes

On successful completion of the course, students will be able to

| CO.No. | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO.1 | Construct simple sentences and use vocabulary required for day-to-day conversation | Remember |
| CO.2 | Distinguish and understand the basic sounds of Hindi language. | Remember |
| CO.3 | Appear for Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha. | Remember |
| CO.4 | Distinguish the words used in daily life | Understand |
| CO.5 | Express individual opinion and speak fluently in Hindi | Understand |

Course Contents:**UNIT I : Introduction**

6

Hindi Alphabet: Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - owl Signs- Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

UNIT II :Reading

6

Nouns: Genders (Masculine & Feminine Nouns long vowels and short vowels - -Masculine & Feminine - Reading Exercises

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UNIT III: Grammar

6

Pronouns and Tenses: 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 : Vocabulary

6

Classified Vocabulary: Parts of body - Relatives - Spices - Eatables - Fruit & Vegetables - Clothes - Directions - Seasons - Professions

UNIT V: Speaking

6

Speaking: Model Sentences and Rhymes - Speaking practice for various occasions.

Total: 30 Periods**Reference:**

1. Hindi Prachar Vahini-1 by Dakshin Bharat Hindi Prachar Sabha Chennai
2. B.R.Kishore, Self Hindi Teacher for Non-Hindi Speaking People, Vee Kumar Publications(P)Ltd., New Delhi,2009
3. Videos, Stories, Rhymes and Songs

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|-----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO2 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO3 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO4 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO5 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Summative assessment | | | | | | |
|----------------------|-----------------------|--------------|---------------|----------------|-----------------------------|---------------------------------------|
| Bloom's Level | Continuous Assessment | | | | | Final Examination (Theory) [50 marks] |
| | Theory Marks | | | | Practical | |
| | IAE-I [7.5] | IAE-II [7.5] | IAE -III [10] | Attendance [5] | Rubric based CIA [20 Marks] | |
| | | | | | | |
| Remember | 20 | 20 | 20 | | 40 | 40 |
| Understand | 20 | 20 | 20 | | 40 | 40 |
| Apply | 10 | 10 | 10 | | 20 | 20 |
| Analyse | | | | | | |
| Evaluate | | | | | | |
| Create | | | | | | |

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| | | | | | |
|-------------------------|--------------------------------|----------|----------|----------|----------|
| 20ENE04 | French | L | T | P | C |
| | | 2 | 0 | 2 | 3 |
| Nature of Course | Humanities and Social Sciences | | | | |
| Pre requisites | Basic Perceptive of Language | | | | |

Course Objectives

The course is intended for learners.

1. To prepare the students for DELF A1 Examination
2. To teach them to converse fluently in French in day-to-day scenarios

Course Outcomes

On successful completion of the course, students will be able to

| CO.No. | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO1 | To help students acquire familiarity in the French alphabet & basic vocabulary | Remember |
| CO2 | Listen and identify individual sounds of French | Remember |
| CO3 | Use basic sounds and words while speaking | Remember |
| CO4 | Read and understand short passages on familiar topics | Understand |
| CO5 | Understand and use basic grammar and appropriate vocabulary in completing language tasks | Understand |

Course Contents:**UNIT I : Entrer En Contact**

6

La langue française, alphabets, les nombres, les jours, les mois. Grammaire Les verbes s'appeler, être, avoir, les articles définis, indéfinis
Communication - Saluer, s'informer sur quelqu'un, demander de se présenter
Lexique - Les alphabets, les nationalités, âge, les pays, les couleurs, les jours de la semaine, les mois de l'année, les professions

UNIT II : Partager Son Lieu De Vie

6

Les français et leur habitat, des habitations inusitées Grammaire - Verbes - Conjugaison : Présent (Avoir / être / ER, IR, RE : Régulier et Irrégulier) – Adjectifs du lieu
Communication - Chercher un logement, décrire son voisin, s'informer sur un logement
Lexique - L'habitat, les pièces, l'équipement, la description physique

UNIT III: Vivre Au Quotidien

6

Grammaire - Articles contractés, verbes vouloir, pouvoir, devoir, adjectif interrogative, future proche
Communication - Exprimer ses goûts, parler de ses loisirs, justifier un choix, exprimer une envie
Lexique - le temps libre et les loisirs, les saisons, les activités quotidiennes, le temps (le matin, le soir, la nuit)

UNIT IV: Comprendre Son Environnement Ouvrir La Culture

6

Grammaire – Verbes - Finir, Sortir, les adjectifs démonstratifs, le passé composé, l'imparfait
Communication - Proposer à quelqu'un de faire quelque chose, raconter une sortie au cinéma
Lexique - Les sorties, la famille, art, les vêtements et les accessoires

UNIT V: Gouter A La Campagne

6

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Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom de quantite Communication Accepter et refuser une invitation, donner des instructions, commander au restaurant Lexique Les services et les commerces, les aliments, les ustensiles, argent.

Total: 30 Periods

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|-----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO2 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO3 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO4 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO5 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Summative assessment | | | | | | |
|----------------------|-----------------------|--------------|---------------|----------------|-----------------------------|---------------------------------------|
| Bloom's Level | Continuous Assessment | | | | | Final Examination (Theory) [50 marks] |
| | Theory Marks | | | | Practical | |
| | IAE-I [7.5] | IAE-II [7.5] | IAE -III [10] | Attendance [5] | Rubric based CIA [20 Marks] | |
| Remember | 20 | 20 | 20 | | 40 | 40 |
| Understand | 20 | 20 | 20 | | 40 | 40 |
| Apply | 10 | 10 | 10 | | 20 | 20 |
| Analyse | | | | | | |
| Evaluate | | | | | | |
| Create | | | | | | |

| | | | | | |
|------------------|--------------------------------|---|---|---|---|
| 20ENE05 | German | L | T | P | C |
| | | 2 | 0 | 2 | 3 |
| Nature of Course | Humanities and Social Sciences | | | | |
| Pre requisites | Basic Perceptive of Language | | | | |

Course Objectives

The course is intended for learners.

1. To help students appear for the A1 level Examination
2. To teach them how to converse fluently in German in day-to-day scenarios

Course Outcome

On successful completion of the course, students will be able to

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| CO.No. | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO1 | Listen and identify individual sounds of German | Remember |
| CO2 | Use basic sounds and words while speaking | Remember |
| CO3 | Read and understand short passages on familiar topics | Remember |
| CO4 | Use basic sentence structures while writing | Understand |
| CO5 | Understand and use basic grammar and appropriate vocabulary in completing language tasks | Understand |

Course Contents:**UNIT I Introduction** 6

Introduction to German language: Alphabet - Numbers - Greetings - Days and Seasons- Working with Dictionary

UNIT II Pronunciation 6

Nouns - articles - Speaking about one self - Listening to CD supplied with the books, paying special attention to pronunciation

UNIT III Basic Syntax 6

Regular & Irregular verbs - Personal pronouns - family - Introduction to types of sentences

UNIT IV Vocabulary 6

Question words-Types of Questions - Nominative case- Verb Conjugation - country - nationalities

UNIT V: Action Words 6

Verbs - to be & to have - conjugation - Hobbys - Framing basic Questions and answers

Total: 30 Periods**Reference(s)**

1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2015.
2. Langenscheidt Eurodictionary - German - English / English - German, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2009
3. Grundkurs, DEUTSCH Lehrbuch Hueber München, 2007.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|-----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO2 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO3 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO4 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO5 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

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| Summative assessment | | | | | | |
|----------------------|-----------------------|--------------|---------------|----------------|-----------------------------|--|
| Bloom's Level | Continuous Assessment | | | | | Final Examination (Theory) [50 marks] |
| | Theory Marks | | | | Practical | |
| | IAE-I [7.5] | IAE-II [7.5] | IAE -III [10] | Attendance [5] | Rubric based CIA [20 Marks] | |
| Remember | 20 | 20 | 20 | | 40 | 40 |
| Understand | 20 | 20 | 20 | | 40 | 40 |
| Apply | 10 | 10 | 10 | | 20 | 20 |
| Analyse | | | | | | |
| Evaluate | | | | | | |
| Create | | | | | | |



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III- SEMESTER

| | | | | | |
|------------------|---|---|---|---|---|
| 20MA301 | TRANSFORMS AND BOUNDARY VALUE PROBLEMS (Common to Aero, Mech, S&F, Civil, FT and Agri) | L | T | P | C |
| | | 3 | 2 | 0 | 4 |
| Nature of Course | Basic Sciences | | | | |
| Pre requisites | Mathematics-I & II for Mechanical Sciences | | | | |

Course Objectives

The course is intended to

1. Familiarize linear and non-linear partial differential equations with different methods.
2. Acquire the knowledge of Fourier series.
3. Acquaint with the Fourier series techniques in solving one dimensional wave and heat equations.
4. Learn the concept of Fourier transforms and it's inverse.
5. Introduce the concept of Z-transforms and difference equations.

Course Outcomes

On successful completion of the course the students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|--|---------------|
| CO1. | Classify the linear and non-linear partial differential equations. | Understand |
| CO2. | Determine the Fourier series expansion. | Apply |
| CO3. | Interpret the solution of boundary value problems. | Understand |
| CO4. | Apply transform techniques to solve engineering problems. | Apply |
| CO5. | Illustrate the Z-transforms and difference equations. | Understand |

Course Contents:**UNIT I Partial Differential Equations****12**

Solution of standard types of first order non-linear partial differential equations: (i) $f(p,q)=0$, (ii) Clairaut's type - Lagrange's linear equation - Homogeneous linear partial differential equations of second and higher order with constant coefficients (R.H.S =Constant, e^{ax+by} , $\cos(ax+by)$, $\sin(ax+by)$).

UNITII Fourier Analysis**12**

Condition for Fourier expansion -Fourier series for periodic functions- Determination of Fourier coefficients - Expansion of periodic functions with Period $(0, 2L)$ and period $(0, 2\pi)$ -Root mean square value on Fourier coefficients - Parseval's identity

UNIT III Boundary Value Problems**12**

Classification of Partial differential equations—Method of separation of variables – Solutions of one dimensional wave equation – Solutions of one dimensional heat equation

UNIT IV Fourier Transforms**12**

Statement of Fourier integral theorem – Fourier transforms pair: Fourier transforms and Inverse Fourier transforms – Fourier sine transforms -Fourier cosine transforms – Transforms of simple functions – Parseval's identity.

UNIT V Z - Transforms and Difference Equations**12**

Z-transforms - Properties – Inverse Z-transform: partial fraction and Convolution theorem - Formation of difference equations –Solution of difference equations using Z – transform.

Total: 60 Periods

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Text Books:

1. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., 3rd edition, 2016.
2. Grewal B.S, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2017.

Reference Books:

1. Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", Lakshmi Publications Pvt Ltd, 9th Edition, 2016.
2. Ramana.B.V,"Higher Engineering Mathematics", Tata Mc-Graw Hill Publishing Company Limited, 4th Edition, 2016.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India Publications, 10th Edition, 2015.

Additional References:

1. <https://pvpsitrealm.blogspot.com/2016/09/higher-engineering-mathematics-by-bs.html>
2. <https://reference.wolfram.com/language/tutorial/DSolvePartialDifferentialEquations.html>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| Cos | Pos | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 2 | - | - | - | - | - | - | - | - | 1 | 2 | - | - |
| CO2 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | 1 | 2 | - | - |
| CO3 | 3 | 2 | 1 | - | - | - | - | - | - | - | - | 1 | 2 | - | - |
| CO4 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | 1 | 1 | - | - |
| CO5 | 3 | 3 | 2 | - | - | - | - | - | - | - | - | 1 | 2 | - | - |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Bloom's Level | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

Summative Assessment

| Bloom's Category | Internal Assessment Examinations | | | Final Examination (60) |
|------------------|----------------------------------|-------------------|-------------------|---------------------------|
| | IAE- I (7.5) | IAE - II (7.5) | IAE - III (10) | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

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| 20ME301 | Engineering Thermodynamics | L | T | P | C |
|-------------------------|---|---|---|---|---|
| | | 3 | 2 | 0 | 4 |
| Nature of course | Engineering Sciences | | | | |
| Pre requisites | Mathematics I & II for mechanical sciences, Physics for mechanical sciences | | | | |

Course Objectives

The course is intended to

1. Acquire knowledge on thermodynamic systems, properties, laws of thermodynamics, entropy.
2. Understand the limitations of different energy conversion processes
3. Learn to solve problems of thermodynamic systems using thermodynamic relations.
4. Introduce the first and second laws of Thermodynamics to various thermal systems.
5. Learn about steam power cycles and properties of gas mixtures

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|--|---------------|
| CO 1 | Identify the thermodynamic properties and solve the problems related to closed and open systems. | Apply |
| CO 2 | Apply the Second law of thermodynamics and entropy principle to various thermodynamic cycles. | Apply |
| CO 3 | Compare the available and unavailable energy and interpret the various thermodynamic relations. | Understand |
| CO 4 | Determine the performance steam power cycle by using P-V, T-S, H-S diagrams. | Evaluate |
| CO 5 | Select the properties of gas mixtures through gas laws for various applications. | Apply |

Course Contents

Unit – I Basic Concepts and First Law of Thermodynamics

12

Basic concepts - concept of continuum, macroscopic approach. Thermodynamic systems - closed, open and isolated. Property, state, path and process, work, modes of work, Zeroth law of thermodynamics – concept of temperature and heat. First law of thermodynamics – application to closed and open systems, steady flow process with reference to various thermal equipment.

Unit – II Second Law of Thermodynamics

12

Second law of thermodynamics – Kelvin-Planck and Clausius statements, Reversibility and Irreversibility. Carnot theorem, Carnot cycle, reversed Carnot cycle, Efficiency, Coefficient of Performance. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy.

Unit – III Availability and Thermodynamic Relations

12

Available and unavailable energy, concept of availability, irreversibility, Maximum Work in a Reversible Process, Availability in Non - Flow and Flow Processes. Maxwell relations - Tds Equations - heat capacities relations - Energy equation, Joule-Thomson experiment - Clausius Clapeyron equation.

Unit – IV Properties of Pure Substance and Rankine Cycle

12

Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart. Basic Rankine cycle – Rankine cycle with reheating and regeneration.


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Unit – V Ideal and Real Gases, Gas Mixtures**12**

Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases
Reduced properties. Compressibility factor, Generalized Compressibility Chart and its use. Mole
and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture – Molar mass,
gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function.

Total : 60 Periods**Text Books**

1. P. K. Nag, "Engineering Thermodynamics", Tata-McGraw Hill Pub, 6th Edition, 2018.
2. Yunus A. Cengel and Michael A. Boles, "Thermodynamics: An Engineering Approach", Tata-McGraw Hill Pub, 9th Edition, 2019.

Reference Books

1. Rajput, "Engineering Thermodynamics", Laxmi Publications, 4th Edition 2010
2. Gordon J. Van Wylen & Richard E. Sonntag, "Fundamentals of Thermodynamics" Wiley Eastern Ltd, 7th Edition, 2009.
3. Dr.R.Yadav, Fundamentals of Engineering Thermodynamics, Central publishing House, 7th Edition, 2004.

Additional / Web References

1. <http://nptel.ac.in/courses/112104113/>
2. <http://nptel.ac.in/courses/112108148/>
3. <http://nptel.ac.in/courses/112105123/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO 1 | 3 | 2 | | 1 | | | | | | | | | 1 | 3 | |
| CO 2 | 2 | 3 | | 1 | | | | | | | | | 1 | 3 | |
| CO 3 | 3 | 2 | | 1 | | | | | | | | | 1 | 3 | |
| CO 4 | 3 | 2 | | 1 | | | | | | | | | 1 | 3 | |
| CO 5 | 2 | 3 | | 1 | | | | | | | | | 1 | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |


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| Formative assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Bloom's Level | Assessment Component | Marks | Total marks |
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|----------------------------------|-------------------|-------------------|---------------------------|
| Bloom's Category | Internal Assessment Examinations | | | Final Examination (60) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | |
| Remember | 10 | 10 | | 20 |
| Understand | 10 | 20 | 10 | 20 |
| Apply | 30 | 20 | 20 | 40 |
| Analyze | | | | |
| Evaluate | | | 20 | 20 |
| Create | | | | |


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| | | | | | |
|-------------------------|--|----------|----------|----------|----------|
| 20ME302 | Engineering Materials and Metallurgy (Common to Aero & Mech) | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of course | Professional Core | | | | |
| Pre requisites | Physics for Mechanical sciences | | | | |

Course Objectives

The course is intended to

1. Impart knowledge on the phase diagram of Iron and Steel.
2. Provide knowledge on Heat treatments of Steels.
3. Impart knowledge on ferrous and non ferrous alloys.
4. Provide knowledge on non metallic materials
5. Select suitable testing methods to determine the Engineering properties of materials.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|----------------|--|----------------------|
| CO 1 | Relate the phase changes, structures, properties and applications of steel and cast iron | Understand |
| CO 2 | Classify the process of heat treatment of steels | Understand |
| CO 3 | Relate the behaviour of Ferrous and Non Ferrous Alloys. | Understand |
| CO 4 | Demonstrate the process, structure and applications of Non metals and Composites. | Understand |
| CO 5 | Identify the behaviour of materials under Various loading conditions. | Apply |

Course Contents**Unit –I Alloys and Phase Diagrams****9**

Constitution of alloys – Phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – Carbon equilibrium diagram. Classification of steel and cast Iron - White, Malleable, Grey, Spheroidal, microstructure, properties and applications.

Unit –II Heat Treatment of Steel**9**

Definition – Full annealing, stress relief, recrystallization and spheroidising – normalising, hardening and Tempering of steel. Hardenability-Jominy end quench test - Austempering, martempering – case hardening, carburizing, nitriding and cyaniding – Flame and Induction hardening.

Unit –III Ferrous and Nonferrous Alloys**9**

Effect of alloying additions on steel - Stainless and tool steels – HSLA, Maraging steels --- alloy cast irons, Copper alloys – Al-Cu alloys – precipitation strengthening treatment – Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys.

Unit –IV Non Metallic Materials**9**

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymer–PE, PP,PVC, ABS, PMMA, PS, Urea and Phenol formaldehydes- Engineering Ceramics - Al_2O_3 , SiC, Si_3N_4 and SIALON –Introduction to smart and composite materials.

Unit –V Mechanical Properties and Testing**9**

Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Brinell and Vickers Hardness tests, Impact test - Izod and Charpy, fatigue and creep tests.

Total : 45 Periods

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Text Books

1. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 9th Indian Reprint 2009.
2. Williams D Callister, "Material Science and Engineering" 2nd edition Wiley India Pvt Ltd, Revised Indian Edition 2014.

Reference Books

1. Dieter, G.E. "Mechanical Metallurgy", 3rd Edition McGraw-Hill, 2017.
2. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd., 6th Edition 2015.
3. Upadhyay. G.S. and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd., New Delhi, 9th Edition, 2013.

Additional / Web References

1. <https://nptel.ac.in/courses/112/108/112108150/#>
2. http://www.issp.ac.ru/ebooks/books/open/Materials_Science_and_Technology.pdf
3. <https://drive.google.com/file/d/1rtZisK2pKpi8JCFzg4Pboo7Kf5fKyjwa/view>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO 1 | 2 | 3 | 2 | | | | | | | | | | 2 | 2 | |
| CO 2 | 2 | 3 | 2 | | | | | | | | | | 2 | 2 | |
| CO 3 | 2 | 3 | 2 | | | | | | | | | | 2 | 2 | |
| CO 4 | 2 | 3 | 2 | | | | | | | | | | 2 | 2 | |
| CO 5 | 2 | 3 | 2 | | | | | | | | | | 2 | 2 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Bloom's Level | Assessment Component | Marks | Total marks |
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|----------------------------------|----------------|----------------|------------------------|
| Bloom's Category | Internal Assessment Examinations | | | Final Examination (60) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 40 | 40 | 20 | 60 |
| Apply | | | 20 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

| 20ME303 | Fluid Mechanics and Machinery | L | T | P | C |
|------------------|-------------------------------|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| Nature of course | Professional Core | | | | |
| Pre requisites | Engineering mechanics | | | | |

Course Objectives

The course is intended to

1. Know the properties of fluids and concept of control volume.
2. Learn the conservation laws of flow through pipes.
3. Understand the importance of dimensional analysis
4. Understand the importance of various types of flow in pumps.
5. Understand the importance of various types of flow in turbines.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO 1 | Identify the fluid properties and measure the flow characteristics | Apply |
| CO 2 | Evaluate the loss of energy in flow through pipes | Evaluate |
| CO 3 | Model the relationships for the flow parameters of fluids. | Apply |
| CO 4 | Examine the performance of pumps for a given application | Analyse |
| CO 5 | Select suitable turbine for given application and evaluate the operating characteristics | Apply |

Course Contents

Unit –I Fluid Properties and Flow Characteristics

9

Units and dimensions- Properties of fluids, Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation.

Unit –II Flow Through Circular Conduits

9

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli Boundary layer concepts – Darcy Weisbach equation –friction factor- Moody diagram- commercial pipes- minor losses – Flow through pipes in series and parallel.

Unit –III Dimensional Analysis

9

Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.

Unit –IV Pumps

9

Impact of jets - Euler's equation - Theory of roto-dynamic machines – various efficiencies– velocity components at entry and exit of the rotor- velocity triangles - pumps– working principle - work done- performance curves.

Unit –V Turbines

9

Classification of turbines – heads and efficiencies – velocity triangles. working principles - work done by water on the runner – draft tube. Specific speed - unit quantities – performance curves for turbines – governing of turbines.

Total : 45 Periods

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Text Books

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 22nd edition, 2019.
2. Kumar K. L., "Engineering Fluid Mechanics", Tata-McGraw Hill, 4th Edition, 2017.

Reference Books

1. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
2. Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery", 2011.
3. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co., 9th edition 2017

Additional / Web References

1. <http://www.efluids.com/>
2. <https://www.quora.com/What-is-fluid-machines>
3. <https://nptel.ac.in/courses/112104117/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|-----|------|---|---|
| Cos | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO 1 | 3 | 2 | 3 | | | | | | | | | | 1 | 2 | |
| CO 2 | 3 | 2 | 3 | | | | | | | | | | 1 | 2 | |
| CO 3 | 3 | 2 | 3 | | | | | | | | | | 1 | 2 | |
| CO 4 | 3 | 3 | 2 | | | | | | | | | | 1 | 2 | |
| CO 5 | 3 | 2 | 3 | | | | | | | | | | 1 | 2 | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Formative assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Bloom's Level | Assessment Component | Marks | Total marks |
| Understand | Online Quiz | 5 | 15 |
| Apply | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|----------------------------------|----------------|----------------|------------------------|
| Bloom's Category | Internal Assessment Examinations | | | Final Examination (60) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | |
| Remember | | | | |
| Understand | 20 | 20 | 20 | 40 |
| Apply | 30 | 30 | 30 | 60 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

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| | | | | | |
|-------------------------|--------------------------------|----------|----------|----------|----------|
| 20ME304 | Kinematics of Machinery | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of course | Professional Core | | | | |
| Pre requisites | Engineering Mechanics | | | | |

Course Objectives

The course is intended to

1. Understand the basic components and layout of linkages in the assembly of a system/ machine
2. Understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
3. Understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
4. Understand the basic concepts of toothed gearing and kinematics of gear trains.
5. Understand the role of friction in drives and brakes.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|----------------|--|----------------------|
| CO 1 | Analyze the concepts of mechanisms, machines and their motions | Analyze |
| CO 2 | Evaluate the displacement, velocity and acceleration of simple mechanism | Evaluate |
| CO 3 | Construct different cam profiles for given conditions using graphical & theoretical methods. | Apply |
| CO 4 | Estimate basic terminologies of gears and gear trains | Evaluate |
| CO 5 | Choose friction drives in various mechanical components under different situations | Apply |

Course Contents

Unit –I Basics of Mechanisms

9

Introduction- resistant bodies- mechanism- structure – Grashof's law - Kutzbach criterion simple mechanism. Inversion of mechanisms. Synthesis of planar linkages.

Unit –II Kinematics of Linkage Mechanisms

9

Displacement, velocity and acceleration, Coriolis acceleration analysis of simple mechanisms - Velocities and accelerations using analytical & graphical method.

Unit–III Kinematics of Cam Mechanisms

9

Introduction of cams and followers – Displacement, velocity and acceleration diagrams using graphical & analytical methods– specified contour cams – circular arc and tangent cams-sizing of cams.

Unit–IV Gears and Gear Trains

9

Introduction to gear– Spur, Helical, Bevel, Worm, Rack and Pinion gears terminology and definitions, Involute and cycloidal tooth profiles Gear tooth actions – Gear trains, Epicyclic gear trains, Differentials, Automobile gearbox

Unit –V Friction in Machine Elements

9

Friction drives - Friction in screw threads - Bearings and lubrication - Friction clutches - Belt and rope drives – Friction aspects in brakes – Friction in vehicle propulsion and braking.

Total : 45 Periods


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Text Books

1. Rattan, S.S, "Theory of Machines", Tata McGraw-Hill, 5th Edition, 2019.
2. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 3rd Edition, 2009.

Reference Books

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 3rd Edition, 2005.
2. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2017.
3. Khurmi, R.S. "Theory of Machines", S Chand Publications, 14th Edition, 2015.

Additional / Web References

1. nptel.ac.in/courses/Webcourse-contents/.../Kinematics%20of%20Machine/index.html
2. <http://kmoddl.library.cornell.edu/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO 1 | 2 | 3 | 2 | | 2 | | | | | | | | 1 | 2 | |
| CO 2 | 2 | 3 | 2 | | 2 | | | | | | | | 1 | 2 | |
| CO 3 | 2 | 3 | 2 | | 2 | | | | | | | | 1 | 2 | |
| CO 4 | 2 | 3 | 2 | | 2 | | | | | | | | 1 | 2 | |
| CO 5 | 2 | 3 | 2 | | 2 | | | | | | | | 1 | 2 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Bloom's Level | Assessment Component | Marks | Total marks |
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|----------------------------------|----------------|----------------|------------------------|
| Bloom's Category | Internal Assessment Examinations | | | Final Examination (60) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | |
| Remember | 10 | | 10 | 10 |
| Understand | | 10 | | 10 |
| Apply | | 20 | 20 | 30 |
| Analyze | 20 | | | 20 |
| Evaluate | 20 | 20 | 20 | 30 |
| Create | | | | |


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| 20ME305 | Manufacturing Technology - I | L | T | P | C |
|------------------|--|---|---|---|---|
| | | 3 | 0 | 2 | 4 |
| Nature of course | Professional Core | | | | |
| Pre requisites | Fundamentals of Mechanical Engineering | | | | |

Course Objectives

The course is intended to

1. Learn various aspects of different manufacturing techniques such as various casting methods and Techniques.
2. Have a broad knowledge on welding methods for making various joints.
3. Differentiate various metal forming processes such as Hot and Cold Working, Rolling, Forging, Extrusion and Drawing Processes.
4. Acquire knowledge about the various tools, equipment, machinery and operations required for these metal forming processes.
5. Introduce the basic concepts of plastic components manufacturing processes.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|---|---------------|
| CO 1 | Explain different metal casting processes, associated defects, merits and demerits. | Understand |
| CO 2 | Compare different metal joining processes | Understand |
| CO 3 | Summarize various hot working and cold working methods of metals. | Apply |
| CO 4 | Explain various sheet metal making processes. | Understand |
| CO 5 | Distinguish various methods of manufacturing plastic components. | Understand |

Course Contents

Unit – I Special Casting Processes

9

Principles of special casting processes; shell moulding, investment casting, pressure die casting, centrifugal casting, CO₂ process, stir casting, induction furnace, testing of castings.

Unit – II Special Welding Processes

9

Gas tungsten arc welding, gas metal arc welding, submerged arc welding, resistance welding, plasma arc welding, thermit welding, friction stir welding, brazing and soldering, welding defects, causes and remedies, automation of welding processes.

Unit – III Metal Forming Process

9

Forging: Classification of forging processes – forging defects and inspection. Rolling-Hot and cold rolling, process parameters, drawing and extrusion.

Unit – IV Sheet Metal Processes

9

Sheet metal forming methods - Shearing, Blanking, Bending, Stretch Forming, deep forming. Spinning. High Velocity Forming, Explosive forming, Electro hydraulic forming - magnetic pulse forming, pneumatic and mechanical high velocity forming.

Unit – V Manufacture of Plastic Components

9

Plastic moulding processes– introduction to blow moulding, Rotational moulding, Film blowing, injection moulding, extrusion, Thermoforming, bonding of thermoplastics- Typical industrial applications

Total : 45 Periods

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Laboratory Component

| S.No. | Name of the Experiment | CO Mapping | RBT |
|-------|--|------------|-------|
| 1 | Preparation of greensand mould for solid pattern | CO1 | Apply |
| 2 | Preparation of greensand mould for split pattern | CO1 | Apply |
| 3 | Joining of T shaped plates using Metal Arc Welding | CO2 | Apply |
| 4 | Joining of plates using butt Welding | CO2 | Apply |
| 5 | Cold forming of round into square | CO3 | Apply |
| 6 | Cold forming of round into hexagon | CO3 | Apply |
| 7 | Preparation of tray using sheet metal | CO4 | Apply |
| 8 | Preparation of funnel using sheet metal | CO4 | Apply |
| 9 | Preparation of joint in plastics | CO5 | Apply |
| 10 | Preparation of T-Joint in plastics | CO5 | Apply |

Total: 30 Periods**Text Books**

1. P.C. Sharma, "A Text Book of Production Technology (Manufacturing Processes)", S. Chand & Company Ltd., New Delhi, 7th Reprint, 2012.
2. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India, 7th Edition, 2014.

Reference Books

1. Mikell P. Groover "Fundamental of Modern Manufacturing", Wiley India Edition, Third Edition, Reprint, 2012.
2. P.L.Jain, "Principles of Foundry Technology", Tata McGraw Hill, 5th edition, 2017.
3. P.N.Rao, "Manufacturing Technology", Tata McGraw Hill, New Delhi, Volume-1, 5th edition, 2018.

Additional / Web References

1. <https://nptel.ac.in/courses/112107144/13>
2. <https://nptel.ac.in/courses/112107145/17>
3. <https://nptel.ac.in/courses/112107083/>


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| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| Cos | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO 1 | 3 | 3 | 2 | | | | | | | | | | 1 | 2 | |
| CO 2 | 3 | 3 | 2 | | | | | | | | | | 1 | 2 | |
| CO 3 | 3 | 3 | 2 | | | | | | | | | | 1 | 2 | |
| CO 4 | 3 | 3 | 2 | | | | | | | | | | 1 | 2 | |
| CO 5 | 3 | 3 | 2 | | | | | | | | | | 1 | 2 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Summative Assessment | | | | | | |
|----------------------|-----------------------|----------------|----------------|----------------|-----------------------|---------------------------------|
| Bloom's Level | Continuous Assessment | | | | | Final Examination (Theory) (50) |
| | Theory | | | | Practical | |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | Attendance (5) | Rubric based CIA (20) | |
| Remember | 20 | 10 | 20 | | 20 | 20 |
| Understand | 30 | 20 | 30 | | 20 | 40 |
| Apply | | 20 | | | 60 | 40 |
| Analyze | | | | | | |
| Evaluate | | | | | | |
| Create | | | | | | |


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| | | | | | |
|-------------------------|--|----------|----------|----------|----------|
| 20ME306 | Computer Aided Machine Drawing Laboratory | L | T | P | C |
| | | 0 | 0 | 2 | 1 |
| Nature of course | PC | | | | |
| Pre requisites | Engineering Graphics | | | | |

Course Objectives

The course is intended to

1. Familiarize the Indian Standards on drawing practices and impart knowledge of thread forms, fasteners, keys, joints and couplings.
2. Understand drawing the machine components leading to preparation of Geometric Dimensioning and Tolerance (GD&T) Assembly drawings manually and using CAD.
3. Outline the basic principles associated with CAD and to demonstrate common drafting techniques and shortcuts used by professionals.
4. Introduce the advanced capabilities of CAD and how they can be used to increase productivity.
5. Provide information about the CAD industry resources.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|----------------|---|----------------------|
| CO1 | Interpret the drawings of machine components as to prepare assembly drawings using manual and Computer Aided Drafting (CAD). | Apply |
| CO2 | Sketch part drawings, sectional views and assembly drawings as per standards using manual and Computer Aided Drafting (CAD). | Apply |
| CO3 | Model the 3-D geometric information of machine components including assemblies and automatically generate Orthographic projection production drawings using manual and Computer Aided Drafting (CAD). | Apply |
| CO4 | Understand the basic graphical (free hand sketch) fundamentals that are used to create and manipulate geometric models using manual and Computer Aided Drafting (CAD). | Apply |
| CO5 | Improve visualization ability of machine components and assemblies before their actual fabrication through modeling, animation, shading, rendering, lighting and coloring using manual and Computer Aided Drafting (CAD). | Apply |

Contents to be covered for manual drawing

Introduction to GD&T- Size (S)- Form (F)- Datums Control-Location (L)-Location (L)-Orientation (O)- Material Modifiers- Profile Tolerances- Run out Tolerances- Outcast Symbols to Avoid Concentricity, Symmetry

Contents to be covered for Computer Aided Drafting

To understand the fundamentals of CAD tools used in CAD software


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| Exercises (Manual and CAD) | | | |
|----------------------------|--------------------------------------|-----|-------|
| 1. | Assembly of Flange Couplings | CO1 | Apply |
| 2. | Assembly and Sleeve and Cotter Joint | CO2 | Apply |
| 3. | Assembly of Connecting rod | CO3 | Apply |
| 4. | Assembly of Plummer Block | CO4 | Apply |
| 5. | Assembly of Screw Jack | CO5 | Apply |
| Total : 30 Periods | | | |

Text Books

1. Gopalakrishna K.R., "Machine Drawing", Subhas Stores Books Corner, Bangalore, 22nd Edition, 2013.
2. N. D. Bhatt and V.M. Panchal, "Machine Drawing", Charotar Publishers, 50th Edition, 2014.

Reference Books

1. Junnarkar, N.D., "Machine Drawing", Pearson Education, 1st Edition, 2004.
2. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing", published by Tata McGrawHill, 2006.
3. S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 2008.

Additional / Web References

1. <http://www.nptel.ac.in/>
2. <http://www.sigmetrix.com/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO 1 | 2 | 3 | 2 | | | | | | 1 | 1 | | 1 | 1 | 3 | |
| CO 2 | 2 | 3 | 2 | | | | | | 1 | 1 | | 1 | 1 | 3 | |
| CO 3 | 2 | 3 | 2 | | | | | | 1 | 1 | | 1 | 1 | 3 | |
| CO 4 | 2 | 3 | 2 | | | | | | 1 | 1 | | 1 | 1 | 3 | |
| CO 5 | 2 | 3 | 2 | | | | | | 1 | 1 | | 1 | 1 | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |


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| Assessment based on Continuous and Final Examination | | | |
|--|--|------------------------------------|------------------------------------|
| Bloom's Level | Continuous Assessment (50 marks) (Attendance – 5 marks) | | Final Examination [50 marks] |
| | Rubric based Continuous Assessment [25 marks] | Model Examination [20 marks] | |
| Remember | | | |
| Understand | 40 | 40 | 40 |
| Apply | 60 | 60 | 60 |
| Analyze | | | |
| Evaluate | | | |
| Create | | | |


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| | | | | | |
|-------------------------|---|----------|----------|----------|----------|
| 20ME307 | Fluid Mechanics and Strength of Materials Laboratory | L | T | P | C |
| | | 0 | 0 | 2 | 1 |
| Nature of course | Professional core | | | | |
| Pre requisites | Fluid mechanics and machinery, Engineering materials and metallurgy | | | | |

Course Objectives

The course is intended to

1. Learn the principles studied in Fluid Mechanics theory by performing experiments in lab.
2. Study the mechanical properties of materials when subjected to different types of loading.
3. Know the principles studied in Fluid Mechanics theory by performing experiments in lab.
4. Experiment the fundamental principles of mechanics of materials (strength of materials)
5. Measure mechanical properties of deformable bodies.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---------------|---|----------------------|
| CO 1 | Select the measurement equipments for flow measurement. | Apply |
| CO 2 | Examine the performance of different fluid machineries. | Analysis |
| CO3 | Experiment with Tensile and double shear tests | Apply |
| CO4 | Utilize torsion and Impact tests. | Apply |
| CO5 | Make use of Hardness and Deflection tests. | Apply |

| S.No. | Fluid Mechanics - List of Experiments | CO Mapping | Revised Bloom's Taxonomy |
|---------------------------|--|-------------------|---------------------------------|
| 1 | Determination of the Coefficient of discharge of given Orifice meter and Venturi meter. | CO 1 | Apply |
| 2 | Calculation of the rate of flow using Rota meter | CO 1 | Apply |
| 3 | Determination of friction factor for a given set of pipes. | CO 1 | Apply |
| 4 | Conducting experiments and drawing the characteristic curves of centrifugal pump/ submergible pump | CO 2 | Analysis |
| 5 | Conducting experiments and drawing the characteristic curves of reciprocating pump | CO 2 | Analysis |
| 6 | Conducting experiments and drawing the characteristic curves of Pelton wheel. | CO 2 | Apply |
| Total : 30 Periods | | | |


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| S.No. | Strength of Materials - List of Experiments | CO Mapping | Revised Bloom's Taxonomy |
|---------------------------|---|------------|--------------------------|
| 1. | Tension test on a mild steel rod | CO3 | Apply |
| 2. | Double shear test on Mild steel and Aluminium rods | CO3 | Apply |
| 3. | Torsion test on mild steel rod | CO4 | Analysis |
| 4. | Impact test on metal specimen | CO4 | Analysis |
| 5. | Hardness test on metals - Brinnell and Rockwell Hardness Number | CO5 | Analysis |
| 6. | Deflection test on beams | CO5 | Apply |
| Total : 30 Periods | | | |

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO 1 | 1 | 2 | | 3 | | | | | | | | 1 | 1 | 2 | |
| CO 2 | 1 | 2 | | 3 | | | | | | | | 1 | 1 | 2 | |
| CO 3 | 1 | 2 | | 3 | | | | | | | | 1 | 1 | 2 | |
| CO 4 | 1 | 2 | | 3 | | | | | | | | 1 | 1 | 2 | |
| CO 5 | 1 | 2 | | 3 | | | | | | | | 1 | 1 | 2 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Assessment based on Continuous and Final Examination | | | |
|--|--|---------------------------------|---------------------------------|
| Bloom's Level | Continuous Assessment (50 marks) (Attendance – 5 marks) | | Final Examination [50 marks] |
| | Rubric based Continuous Assessment [25 marks] | Model Examination [20 marks] | |
| Remember | | | |
| Understand | 40 | 40 | 40 |
| Apply | 60 | 60 | 60 |
| Analyze | | | |
| Evaluate | | | |
| Create | | | |


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| | | | | | |
|-------------------------|-----------------------------|----------|----------|----------|----------|
| 20MC302 | Interpersonal Skills | L | T | P | C |
| | | 0 | 0 | 2 | 0 |
| Nature of Course | Mandatory, Non Credit | | | | |
| Pre requisites | Nil | | | | |

Course Objectives

The course is intended to

1. Use interpersonal communication skills to influence and build good relationships.
2. Identify and pursue personal learning goals.
3. Obtain feedback skills in service of evolving learning goals.
4. Learn about group dynamics, behaviors and feelings
5. Enhance the communication process in both formal and informal contexts

Course Outcomes

On successful completion of the course, students will be able to

| CO.No | Course Outcome | Bloom's Level |
|--------------|---|----------------------|
| CO1 | Practice interpersonal communication skills to influence and build good relationships | Understand |
| CO2 | Identify and pursue personal learning goals. | Understand |
| CO3 | Give evident feedback | Understand |
| CO4 | Reveal group dynamics and amiable behavior | Understand |
| CO5 | Emphasis the communication process | Understand |

Course Contents:**Unit – I Fundamentals of Interpersonal Communication****6**

Facts of communication and Interpersonal communication – culture and gender – Communication and Self disclosure – Presentation of Interpersonal perception - Learning goals – Feeling and feedback

Unit – II Interpersonal communication in action**6**

Nature of language – language and culture – usage and abuse of language –Positive communication -Non verbal communication - Listening strategies – Barriers of listening.

Unit– III Emotional Intelligence**6**

Influence of emotional experience and expressions – Accepting the responsibilities and changes - Negotiation tactics - Dealing with criticism and appreciation - Collaborative Problem Solving - Resilience Building.

Unit – IV Transactions**6**

Different types of transactions - Building Positive Relationship - Managing Conflict – Connecting across Difference –Factors hampering Interpersonal interactions – Assertiveness in communication

Unit – V Essential Interpersonal Competencies**6**

Behaviour – Understanding limiting behaviour - Interpersonal and small group behavior – Critical and lateral thinking-Win –Win attitude – Positive thinking – Stress management – Assertive feedback - Personal Evaluation of Interpersonal Relationship Skills

Total 30 Periods

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Activity Component

| S.No | Name of the Exercises | CO Mapping | RBT |
|------|---|------------|------------|
| 1 | Self Introduction | CO1 | Understand |
| 2 | Presentation of Individual perception | CO2 | Understand |
| 3 | Role play - Non verbal communication - Body language | CO 4 | Understand |
| 4 | Role play - Interpersonal interactions & Assertive feedback | CO 3 | Understand |
| 5 | Group Discussion | CO 4 | Understand |
| 6 | Role play - Situational conversation (On spot) | CO5 | Understand |

Text Books

1. Bozeman, Jeanine C and Argile Smith, "Interpersonal Relationship Skills for Ministers" Gretna, LA: Pelican Publishing Company, 1st Edition, 2004.

2. Floyd, Kory, "Interpersonal Communication", 4th edition McGraw-Hill, 2nd Edition, 2020.

Reference Books:

1. Augsburg, David, "Caring Enough to Confront How to Understand and Express Your Deepest Feelings Towards Others", updated ed. Ventura, CA: Regal Books, 2nd Edition, 2009.

2. Vohs, Kathleen D., and Eli J., Finkel, eds, "Self and Relationships: Connecting Intrapersonal and Interpersonal Processes", New York: Guilford Press, 1st Edition, 2006.

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

| COs | Pos | | | | | | | | | | | | PSOs | | |
|-----|-----|------|---|---|---|---|--------|---|---|----|----|-----|------|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | | | | | | | | | | 1 | 3 | |
| CO2 | 3 | 3 | 3 | | | | | | | | | | 1 | 3 | |
| CO3 | 3 | 3 | 3 | | | | | | | | | | 1 | 3 | |
| CO4 | 3 | 3 | 3 | | | | | | | | | | 1 | 3 | |
| CO5 | 3 | 3 | 3 | | | | | | | | | | 1 | 3 | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Bloom's Level | Summative Assessment (Internal Mode) | |
|---------------|--------------------------------------|--------------|
| | Assessment 1 | Assessment 2 |
| Remember | 20 | 20 |
| Understand | 10 | 10 |
| Apply | 20 | 20 |
| Analyze | | |
| Evaluate | | |
| Create | | |


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IV SEMESTER

| | | | | | |
|-------------------------|---|---|---|---|---|
| 20MA401 | NUMERICAL ANALYSIS AND STATISTICS (Common to Aero, Mech, S&F, Civil and Agri) | L | T | P | C |
| | | 3 | 2 | 0 | 4 |
| Nature of Course | Basic Sciences | | | | |
| Pre requisites | Mathematics –I & II for Mechanical Sciences | | | | |

Course Objectives

The course is intended to

1. Introduce the basic concepts of algebraic and transcendental equations.
2. Acquire the concept of numerical techniques of differentiation and integration.
3. Study the numerical techniques in solving ordinary differential equations.
4. Acquaint with the knowledge of testing of hypothesis for small and large samples.
5. Familiarize with the basic concept on types of design of experiments used in the field of engineering.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|--|---------------|
| CO1 | Illustrate the algebraic and transcendental equations. | Understand |
| CO2 | Apply the numerical techniques of interpolation and error approximations in various intervals in real life situations. | Apply |
| CO3 | Classify the numerical techniques for solving first and second order ordinary differential equations. | Understand |
| CO4 | Interpret the testing of hypothesis for small and large samples. | Apply |
| CO5 | Explain the basic concepts of classifications of design of experiments in the field of engineering | Understand |

Course Contents:**UNIT - I Solution of Equations and Eigen value problems**

12

Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method - Iterative methods of Gauss Jacobi method and Gauss Seidel method– Eigen values of a matrix by Power method.

UNIT - II Numerical differentiation and integration

12

Lagrange's interpolations- Newton's divided difference interpolations – Newton's forward difference and backward difference formulae – Numerical integration using Trapezoidal and Simpson's 1/3 rules-Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules

UNIT - III Numerical solution of Ordinary Differential Equations

12

Single step methods: Euler's method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations – Multi step methods: Milne's – Bash forth predictor corrector methods for solving first order equations.

UNIT - IV Testing of hypothesis

12

Sampling distributions – Estimation of parameters – Statistical hypothesis – Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square for mean, variance and proportion - Contingency table (test for independent) -Goodness of fit.

Unit - V Design of Experiments

12

One way and two way classifications – Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

Total: 60 Periods

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Text Books:

1. Grewal B.S, and Grewal J.S "" Numerical methods in engineering and science "Khanna Publishers, 10th Edition, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund"s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

Reference Books:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", Cengage Learning, 9th Edition, 2016.
2. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.
3. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, New Delhi, 3rd Edition, 2007.

Additional References:

3. <https://pvpsitrealm.blogspot.com/2016/09/higher-engineering-mathematics-by-bs.html>
4. [https://reference.wolfram.com/language/tutorial/Numerical methods.html](https://reference.wolfram.com/language/tutorial/Numerical%20methods.html)

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|
| Cos | Pos | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 3 | 3 | 2 | - | - | - | - | - | - | - | - | 1 | 1 | |
| CO2 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | 1 | 2 | |
| CO3 | 3 | 3 | 1 | - | - | - | - | - | - | - | - | 1 | 1 | |
| CO4 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | 1 | 2 | |
| CO5 | 3 | 3 | 2 | - | - | - | - | - | - | - | - | 1 | 2 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | |

| Formative assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Bloom's Level | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

Summative Assessment

| Bloom's Category | Internal Assessment Examinations | | | Final Examination (60) |
|------------------|----------------------------------|-----------------|-----------------|---------------------------|
| | IAE -I (7.5) | IAE-II (7.5) | IAE-III (10) | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| 20ME401 | Strength of Materials | L | T | P | C |
|------------------|-----------------------|---|---|---|---|
| | | 3 | 2 | 0 | 4 |
| Nature of course | Engineering Sciences | | | | |
| Pre requisites | Engineering Mechanics | | | | |

Course Objectives

The course is intended to

1. Understand the concepts of stress, strain, principal stresses and principal planes.
2. Study the concept of shear force and bending moment due to external loads in determinate beams and their effect on stresses.
3. Learn the stresses and deformation in circular shafts and helical spring due to torsion.
4. Know the slopes and deflections in determinate beams by various methods.
5. Study the stresses and deformations induced in thin and thick shells

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|---|---------------|
| CO 1 | Solve the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes. | Apply |
| CO 2 | Develop the load transferring mechanism in beams and stress distribution due to shear force and bending moment | Apply |
| CO 3 | Apply basic equation of simple torsion in designing of shafts and helical spring | Apply |
| CO 4 | Construct the slope and deflection in beams using different methods | Apply |
| CO 5 | Model thin and thick shells for the applied internal and external pressures | Apply |

Course Contents

Unit – I Stress, Strain and Deformation of Solids

12

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains – Stresses on inclined planes – principal stresses and principal planes.

Unit – II Transverse Loading on Beams and Stresses in Beam

12

Beams – types transverse loading on beams – Shear force and bending moment in beams – Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

Unit – III Torsion & Springs

12

Torsion formulation, stresses and deformation in circular and hollow shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs

Unit – IV Deflection of Beams

12

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems.

Unit – V Thin Cylinders, Spheres and Thick Cylinders

12

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lamé's theorem.

Total : 60 Periods

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Text Books

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 6th edition, 2018.
2. R. S. Khurmi, N. Khurmi "Strength of Materials", S.Chand & Co., Ram Nagar, New Delhi, 26th edition, 2018.

Reference Books

1. Ferdinand P. Beer, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing „co. Ltd., New Delhi, 8th edition, 2020.
2. Hibbeler, R.C., "Mechanics of Materials" Pearson Education, Low Price Edition, 9th edition 2013
3. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 3rd edition, 2016

Additional References:

1. nptel.ac.in/courses/Webcoursecontents/.../strength%20of%20materials/homepage.htm
2. <http://em2.yolasite.com/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO 1 | 3 | 3 | 3 | 1 | | | | | | | | | 2 | 1 | |
| CO 2 | 3 | 3 | 3 | 1 | | | | | | | | | 2 | 1 | |
| CO 3 | 3 | 3 | 3 | 1 | | | | | | | | | 2 | 1 | |
| CO 4 | 3 | 3 | 3 | 1 | | | | | | | | | 2 | 1 | |
| CO 5 | 3 | 3 | 3 | 1 | | | | | | | | | 2 | 1 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | | | |
|----------------------|----------------------------------|-------------------|-------------------|---------------------------|-------------|
| Bloom's Level | Assessment Component | | | Marks | Total marks |
| Remember | Online Quiz | | | 5 | 15 |
| Understand | Tutorial | | | 5 | |
| | Assignment | | | 5 | |
| Summative Assessment | | | | | |
| Bloom's Category | Internal Assessment Examinations | | | Final Examination (60) | |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | | |
| Remember | | | | | |
| Understand | 20 | 20 | 20 | 40 | |
| Apply | 30 | 30 | 30 | 60 | |
| Analyze | | | | | |
| Evaluate | | | | | |
| Create | | | | | |

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| | | | | | |
|-------------------------|----------------------------|----------|----------|----------|----------|
| 20ME402 | Thermal Engineering | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of course | Professional Core | | | | |
| Pre requisites | Thermodynamics | | | | |

Course Objectives

The course is intended to

1. Learn the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes
2. Know the thermodynamic concepts into various thermal application like Air Compressor
3. Introduce the thermodynamic concepts into various thermal application like IC engines.
4. Study the performance testing of IC engines
5. Learn the thermodynamic concepts into various thermal application like Gas Turbine

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|----------------|--|----------------------|
| CO 1 | Apply thermodynamic concepts to different air standard cycles and solve problems | Apply |
| CO 2 | Solve problems in single stage and multistage air compressors | Apply |
| CO 3 | Explain the functioning and features of IC engines, components and auxiliaries. | Apply |
| CO 4 | Calculate performance parameters of IC Engines. | Apply |
| CO 5 | Explain the flow in Gas turbines and solve problems. | Apply |

Course Contents**Unit – I Gas and Steam Power Cycles****9**

Air Standard Cycles – Assumptions, Otto, Diesel, Dual and Brayton – Cycle Performance Analysis and Comparisons.

Unit – II Reciprocating Air Compressor**9**

Classification and comparison, working principle, work of compression - with and without clearance, efficiency. Multistage air compressor with Inter-cooling. Working principle and comparison of Rotary compressors with reciprocating air compressors.

Unit – III Internal Combustion Engines and Combustion**9**

IC engine – Classification, working, components and their functions. Theoretical and actual : Valve and port timing diagrams, p-v diagrams. Desirable properties and qualities of fuels. – Lean and rich mixtures. Combustion–Knocking – phenomena and control.

Unit – IV Internal Combustion Engine Performance and Systems**9**

Performance parameters and calculations- Morse and Heat Balance tests. Fuel Injection system. Lubrication and Cooling systems. Concepts of Supercharging and Turbo-charging.

Unit – V Gas Turbines**9**

Gas turbine cycle analysis – open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combinations.

Total : 45 Periods


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Text Books

1. Rajput, "Thermal Engineering", Laxmi Publications, 10th edition, 2018
2. Rudramoorthy R, "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2003.

Reference Books

1. Holman. J.P., "Thermodynamics", McGraw-Hill, 4th edition, 1985.
2. Kothandaraman.C.P., Domkundwar.S. and A.V.Domkundwar., "A course in Thermal Engineering", Dhanpat Rai & Sons, Fifth edition, 2002.
3. Arora.C.P, "Refrigeration and Air conditioning", McGraw Hill publication, 4th edition, 2021

Additional References:

1. <https://ocw.mit.edu/courses/mechanical-engineering/>
2. <http://nptel.ac.in/courses/112104033/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO 1 | 2 | 3 | 2 | | | | | | | | | | 2 | 3 | |
| CO 2 | 2 | 3 | 2 | | | | | | | | | | 2 | 3 | |
| CO 3 | 2 | 3 | 2 | | | | | | | | | | 2 | 3 | |
| CO 4 | 2 | 3 | 2 | | | | | | | | | | 2 | 3 | |
| CO 5 | 2 | 3 | 2 | | | | | | | | | | 2 | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Bloom's Level | Assessment Component | Marks | Total marks |
| Understand | Online Quiz | 5 | 15 |
| Apply | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|----------------------------------|----------------|----------------|------------------------|
| Bloom's Category | Internal Assessment Examinations | | | Final Examination (60) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | |
| Remember | | | | |
| Understand | 20 | 20 | 20 | 40 |
| Apply | 30 | 30 | 30 | 60 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

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| | | | | | |
|-------------------------|--------------------------------------|----------|----------|----------|----------|
| 20ME403 | Manufacturing Technology – II | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of course | Professional Core | | | | |
| Pre requisites | Manufacturing Technology-I | | | | |

Course Objectives

The course is intended to

1. Understand the various metal casting processes.
2. Gain knowledge on various operations of lathe machine.
3. Understand the process of making special components using special purpose machines.
4. Expose the students to various finishing processes.
5. Understand the basic concepts of Computer Numerical Control (CNC) of machine tools and CNC Programming

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|----------------|--|----------------------|
| CO 1 | Explain the mechanism of material removal processes | Understand |
| CO 2 | Constructional and operational features of special purpose machines. | Apply |
| CO 3 | Construct the operational features of super finishing machines. | Apply |
| CO 4 | Explain the types of computer numerical control machines and part programming. | Understand |
| CO 5 | Summarize 3D printing methods and materials. | Understand |

Course Contents**Unit – I Theory of Metal Cutting and Lathe****9**

Metal removal processes-Theory of metal cutting-Merchant's circle, chip formation Lathe: Specifications and parts of lathe - operations performed on lathe, accessories and Attachments.

Unit – II Special Purpose Machines**9**

Working principles of shaper, planer, slotting machine, Drilling machine - Drilling, Boring, Reaming and Tapping, Milling machines -gear milling, shaping and gear hobbing – Finishing of gears.

Unit – III Surface Finishing Processes**9**

Grinding wheel - specifications and selection, types of grinding process - cylindrical grinding, surface grinding, and centre less grinding, honing, lapping, super finishing, polishing and buffing.

Unit – IV Computer Numerical Controlled Machines**9**

Computer numerical control (CNC) of machine tools -: types, constructional details. Part programming – manual and computer aided part programming.

UNIT- V Additive Manufacturing Processes**9**

Introduction, Fused deposition modelling (FDM)- Selective Laser Sintering (SLS)- Stereolithography (SLA)- Selective Laser Melting (SLM) - Laminated object manufacturing. Merits, demerits and applications.

Total : 45 Periods

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Text Books

- 1) Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", Tata McGraw-Hill, New Delhi, 4th Edition, 2018.
- 2) Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters, 2014.

Reference Books

- 1) R.K. Jain, "Production Technology" Khanna Publishers, New Delhi, 2015.
- 2) Rajput, R.K., "A Textbook of Manufacturing Technology", Laxmi publications Ltd, New Delhi, 2nd edition, 2017.
- 3) Serope Kalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", , Pearson publication, London, 4th edition, 2014.

Additional / Web References

4. <https://nptel.ac.in/courses/112/105/112105126/>
5. <https://nptel.ac.in/courses/112/104/112104204/>
6. <https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-me03/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO 1 | 2 | 3 | 1 | | | | | | | | | | 1 | 3 | |
| CO 2 | 2 | 3 | 1 | | | | | | | | | | 1 | 3 | |
| CO 3 | 2 | 3 | 1 | | | | | | | | | | 1 | 3 | |
| CO 4 | 2 | 3 | 1 | | | | | | | | | | 1 | 3 | |
| CO 5 | 2 | 3 | 1 | | | | | | | | | | 1 | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|----------------------|----------------------|-------|-------------|
| Bloom's Level | Assessment Component | Marks | Total marks |
| Remember | Online Quiz | 5 | 15 |
| Understand | Assignment | 5 | |
| | Tutorial | 5 | |

| Summative Assessment | | | | |
|----------------------|----------------------------------|------------------|-----------------|---------------------------|
| Bloom's Category | Internal Assessment Examinations | | | Final Examination (50) |
| | IAE – 1 (7.5) | IAE – 2 (7.5) | IAE – 3 (10) | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 20 | 20 | 40 | 50 |
| Apply | 20 | 20 | | 30 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

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| | | | | | |
|-------------------------|---------------------------------|----------|----------|----------|----------|
| 20ME404 | Engineering Metrology | L | T | P | C |
| | | 3 | 0 | 2 | 4 |
| Nature of course | Professional Core | | | | |
| Pre requisites | Physics for Mechanical Sciences | | | | |

Course Objectives

The course is intended to

1. Learn the basics of measurement system and experimental errors.
2. Differentiate about linear, angular and optical measuring instruments.
3. Familiarize with surface roughness measurement and limits and fits.
4. Study about measurement of Displacement, Stress and Strain, and Force and Torque.
5. Know about measurement of Pressure, Fluid flow and Temperature

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---------------|---|----------------------|
| CO 1 | Express the fundamentals concepts of Measuring system and Errors in Measurement. | Understand |
| CO 2 | Outline the principles of linear and angular measurement tools used for industrial applications | Understand |
| CO 3 | Summarize the working procedure of Laser Interferometer and Coordinate Measuring Machine (CMM). | Understand |
| CO 4 | Demonstrate the techniques of form measurement used for industrial components | Understand |
| CO 5 | Classify the various measuring instruments used to measure the power, flow and temperature. | Understand |

Course Contents**Unit – I Basics of Metrology****9**

Introduction to Metrology – Need – Elements – Work piece, Instruments –Persons – Environment – their effect on Precision and Accuracy – Errors –Errors in Measurements – Types – Control – Types of standards

Unit – II Linear and angular Measurements**9**

Linear Measuring Instruments- Limit gauges – gauge design – terminology –concepts of interchange ability and selective assembly – Angular measuring instruments –Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator.

Unit – III Advances in Metrology**9**

Basic concept of lasers Advantages of lasers – laser Interferometers – types –DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of Coordinate Measuring Machine(CMM), Machine Vision System.

Unit – IV Form Measurements**9**

Principles and Methods of straightness measurement, Flatness measurement, Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications

Unit – V Measurement of power, flow and temperature**9**

Force, torque, power - mechanical , Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer – Reliability and Calibration.

Total : 45 Periods

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Laboratory Component

| S.No. | Name of the Experiment | CO Mapping | RBT |
|-------|--|------------|-------|
| 1 | Calibration of vernier caliper and screw gauge | CO1 | Apply |
| 2 | Calibration of height gage | CO1 | Apply |
| 3 | Calibration of depth micrometer and bore gauge | CO2 | Apply |
| 4 | Measurement of angles using bevel protractor | CO2 | Apply |
| 5 | Calibration using sine bar | CO3 | Apply |
| 6 | Measurement of gear parameters | CO3 | Apply |
| 7 | Measurement of surface finish (machined) | CO4 | Apply |
| 8 | Measurement of surface finish (polished) | CO4 | Apply |
| 9 | Measurement of force and torque | CO5 | Apply |
| 10 | Measurement of temperature | CO5 | Apply |

Total:30 Periods**Text Books**

1. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2018.
2. Jain R.K. "Engineering Metrology", Khanna Publishers, 2021.

Reference Books

1. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, 6th edition 2020.
2. Charles Reginald Shotbolt, "Metrology for Engineers", Cengage Learning EMEA, 5th edition 1990.
3. Raghavendra ,Krishnamurthy "Engineering Metrology & Measurements", Oxford university press, 2016

Additional / Web References

1. <https://www.mek.dtu.dk/english/Sections/MPP/Research/Manufacturing-metrology>
2. <https://tint.edu.in/tict-me-dept-laboratories/metrology-measurement-lab.html>
3. <http://www.metrology.wat.edu.pl/index.php/links/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO 1 | 3 | | | 2 | | | | | | | | 1 | 1 | 3 | |
| CO 2 | 3 | | | 2 | | | | | | | | 1 | 1 | 3 | |
| CO 3 | 3 | | | 2 | | | | | | | | 1 | 1 | 3 | |
| CO 4 | 3 | | | 2 | | | | | | | | 1 | 1 | 3 | |
| CO 5 | 3 | | | 2 | | | | | | | | 1 | 1 | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |


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| Summative assessment | | | | | | |
|----------------------|-----------------------|---------------|--------------|----------------|-----------------------------|---------------------------------------|
| Bloom's Level | Continuous Assessment | | | | | Final Examination (Theory) [50 marks] |
| | Theory | | | | Practical | |
| | IAE-I [7.5] | IAE-II [7.5] | IAE-III [10] | Attendance [5] | Rubric based CIA [20 Marks] | |
| Remember | 20 | 10 | 10 | | 20 | 20 |
| Understand | 30 | 40 | 40 | | 80 | 80 |
| Apply | | | | | | |
| Analyse | | | | | | |
| Evaluate | | | | | | |
| Create | | | | | | |


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| | | | | | |
|-------------------------|--|----------|----------|----------|----------|
| 20EE409 | Electrical Drives and Microprocessor | L | T | P | C |
| | | 3 | 0 | 2 | 4 |
| Nature of course | Engineering Sciences | | | | |
| Pre requisites | Basics of Electrical and Electronics Engineering | | | | |

Course Objectives

The course is intended to

1. Learn steady state operation and transient dynamics of a motor load system
2. Study the different methods of starting and characteristics of drive motors
3. Learn the conventional speed control concepts of drive motors
4. Know solid state control of drive motors
5. Learn the industrial applications in drive motor control.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---------------|---|----------------------|
| CO 1 | Summarize the basic drive system and interpret it for different types of loads. | Understand |
| CO 2 | Show the motor situation during starting and braking. | Understand |
| CO 3 | Develop control circuitry and devices for control of motor. | Apply |
| CO 4 | Construct the circuit for control purpose along with its different configuration. | Apply |
| CO 5 | Develop the Digital control system for drive applications. | Apply |

Course Contents**Unit – I Dynamics of Electric Drives****9**

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – Heating and cooling curves – classes of duty- Selection of drive motors with Load variation factors- Multi quadrant operation- Load equalization.

Unit – II Static Control and Characteristics of Motors**9**

Typical control circuits for motors – Types of AC and DC Starters- characteristics of various types of load and drive motors- Braking of Electrical motors.

Unit – III Conventional Speed Control of DC and AC Motors**9**

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system- Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme.

Unit – IV Solid State Speed Control of DC and AC Motors**9**

Thyristor converter fed dc drives: - Single and Three phase operations- Chopper fed DC drives- Inverter fed AC drives- Cyclo converter fed AC drives.

Unit – V Digital Control and Drive Applications**9**

Digital techniques in speed control - Advantages and limitations –Microprocessor and PLC based control of drives- Solar and battery powered Drives- Introduction to traction Drives.

Total : 45 Periods

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Laboratory components

| S.No | List of Experiments | CO Mapping | Revised Blooms Taxonomy |
|------|---|------------|-------------------------|
| 1 | Load test on DC Shunt motor | CO1 | Understand |
| 2 | Load test on Three phase Squirrel cage induction motor | CO1 | Understand |
| 3 | Four Quadrant operation of DC motor | CO2 | Understand |
| 4 | Speed control of DC Shunt Motor | CO3 | Understand |
| 5 | Speed Control of Three phase slip ring induction motor | CO3 | Understand |
| 6 | Speed control of DC motor using 3 ϕ Rectifier | CO4 | Apply |
| 7 | chopper control of D.C. Motor for motoring and generating control | CO4 | Apply |
| 8 | Speed control of 3 ϕ induction motor using PWM inverter | CO4 | Apply |
| 9 | PLC based drives | CO5 | Apply |
| 10 | DSP based chopper fed DC motor drive | CO5 | Apply |

Total : 30 Periods**Text Books**

1. J. Gnanavadeivel, "Electrical Drives and Control", Anuradha Publications, 2004.
2. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall International, 1989.

Reference Books

1. Werner Leonhard, "Control of Electrical Drives", Springer (India) Pvt. Ltd., 2006.
2. Bimal K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, 2015.
3. Ion Boldea and S. A. Nasar, "Electric Drives", CRC Press LLC, New York, 3rd edition, 2016.

Additional / Web References

1. <http://electrical-engineering-portal.com/download-center/books-and-guides/siemens-basics-of-energy/basics-of-dc-drives>.
2. <https://www.joliettech.com/products/dc-variable-speed-drives/dc-drive-fundamentals/>


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| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO 1 | 3 | 2 | 1 | | | | | | 1 | 1 | | 1 | 2 | - | - |
| CO 2 | 3 | 2 | 1 | | | | | | 1 | 1 | | 1 | 2 | - | - |
| CO 3 | 3 | 2 | 1 | | | | | | 1 | 1 | | 1 | 2 | - | - |
| CO 4 | 3 | 2 | 1 | | | | | | 1 | 1 | | 1 | 2 | - | - |
| CO 5 | 3 | 2 | 1 | | | | | | 1 | 1 | | 1 | 2 | - | - |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Summative assessment | | | | | | |
|----------------------|-----------------------|--------------|--------------|----------------|-----------------------------|---------------------------------------|
| Bloom's Level | Continuous Assessment | | | | | Final Examination (Theory) [50 marks] |
| | Theory | | | | Practical | |
| | IAE-I [7.5] | IAE-II [7.5] | IAE-III [10] | Attendance [5] | Rubric based CIA [20 Marks] | |
| Remember | 20 | 10 | 10 | | 20 | 20 |
| Understand | 30 | 20 | 20 | | 40 | 40 |
| Apply | | 20 | 20 | | 40 | 40 |
| Analyze | | | | | | |
| Evaluate | | | | | | |
| Create | | | | | | |


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| | | | | | |
|------------------|--|---|---|---|---|
| 20ME405 | Thermal Engineering Laboratory-I | L | T | P | C |
| | | 0 | 0 | 2 | 1 |
| Nature of course | Professional Core | | | | |
| Pre requisites | Engineering Thermodynamics and Thermal Engineering | | | | |

Course Objectives

The course is intended to

1. Study the value timing-V diagram and performance of IC Engines
2. Conduct the performance test on IC Engines
3. Examine the Flash Point and Fire Point of various fuels / lubricants.
4. Study the air compressor and blower along with factors influencing its performance
5. Study the performance of refrigeration cycle / Air conditioning systems

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|---|---------------|
| CO 1 | Classify the IC engines and explain its working principle | Understand |
| CO 2 | Determine the performance of I.C engines. | Apply |
| CO 3 | Find the Flash Point and Fire Point of various fuels / lubricants. | Remember |
| CO 4 | Explain the working of air compressor and blower along with factors influencing its performance | Understand |
| CO 5 | Determine the cooling load for air conditioning and refrigeration systems. | Apply |

| S.No | List of Experiments | CO Mapping | Revised Blooms Taxonomy |
|------|--|------------|-------------------------|
| 1 | Valve Timing and Port Timing diagrams. | CO 1 | understand |
| 2 | Performance Test on 4 – stroke Diesel Engine. | CO 2 | Apply |
| 3 | Heat Balance Test on 4 – stroke Diesel Engine. | CO 2 | Apply |
| 4 | Morse Test on Multi-cylinder Petrol Engine. | CO 2 | Apply |
| 4 | Retardation test to find Frictional Power of a Diesel Engine. | CO 2 | Apply |
| 5 | Performance test on four stroke computerized diesel engine | CO 2 | Apply |
| 6 | Find the Flash Point and Fire Point of various fuels / lubricants. | CO 3 | Remember |
| 7 | Performance test on Air blower | CO 4 | Apply |
| 8 | Performance test on a reciprocating air compressor | CO 4 | Apply |
| 9 | Determination of COP of a refrigeration system | CO 5 | Apply |
| 10 | Performance test on Air conditioning System | CO 5 | Apply |

Total : 30 Periods

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| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO 1 | 3 | 2 | 1 | | | | | | 1 | 1 | | 1 | 1 | 3 | |
| CO 2 | 3 | 2 | 1 | | | | | | 1 | 1 | | 1 | 1 | 3 | |
| CO 3 | 3 | 2 | 1 | | | | | | 1 | 1 | | 1 | 1 | 3 | |
| CO 4 | 3 | 2 | 1 | | | | | | 1 | 1 | | 1 | 1 | 3 | |
| CO 5 | 3 | 2 | 1 | | | | | | 1 | 1 | | 1 | 1 | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Assessment based on Continuous and Final Examination | | | |
|--|--|---------------------------------|---------------------------------|
| Bloom's Level | Continuous Assessment (50 marks) (Attendance – 5 marks) | | Final Examination [50 marks] |
| | Rubric based Continuous Assessment [25 marks] | Model Examination [20 marks] | |
| Remember | | | |
| Understand | 40 | 40 | 40 |
| Apply | 60 | 60 | 60 |
| Analyze | | | |
| Evaluate | | | |
| Create | | | |


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| 20ME406 | Manufacturing Technology Laboratory | L | T | P | C |
|-------------------------|-------------------------------------|---|---|---|---|
| | | 0 | 0 | 2 | 1 |
| Nature of course | Professional Core | | | | |
| Pre requisites | Manufacturing Technology - I | | | | |

Course Objectives

The course is intended to

1. Study and acquire knowledge on various basic machining operations in special purpose machines and its applications in real life manufacture of components in the industry
2. Learn the main objective of this course is to emphasize the importance manufacturing sciences in the day-to-day life, and to study the basic manufacturing processes and tools used.
3. Know the course is delineated particularly to understand the conventional manufacturing processes like casting, metal forming, and welding process.
4. Study competency in understanding of machine tools and its working principles.
5. Know the design of machine tool structures and special features of machine tool design

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO 1 | Select suitable process in lathe machine | Apply |
| CO 2 | Choose different machine tools to manufacturing gears. | Apply |
| CO 3 | Utilize different machine tools for finishing operations | Apply |
| CO 4 | Make use of cutter grinder for sharpening of tools | Apply |
| CO 5 | Select s suitable process for making key holes | Apply |

| S.No | List of Exercises | CO Mapping | Revised Blooms Taxonomy |
|---------------------------|--|------------|-------------------------|
| 1. | Facing and Step turning in lathe machine | CO 1 | Apply |
| 2. | Taper turning in lathe machine | CO 1 | Apply |
| 3. | Thread cutting in lathe machine | CO 1 | Apply |
| 4. | Contour milling using vertical milling machine | CO 2 | Apply |
| 5. | Spur gear cutting in milling machine | CO 2 | Apply |
| 6. | Helical Gear Cutting in milling machine | CO 2 | Apply |
| 7. | Plain Surface grinding | CO 3 | Apply |
| 8. | Cylindrical grinding | CO 3 | Apply |
| 9. | Tool angle grinding with tool and Cutter Grinder | CO 4 | Apply |
| 10. | Machining key hole in a slotting machine | CO 5 | Apply |
| 11. | Machining slot using a shaping machine | CO 5 | Apply |
| Total : 60 Periods | | | |

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| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO 1 | 3 | 2 | 1 | | 2 | | | | 1 | 1 | | 1 | 1 | 3 | |
| CO 2 | 3 | 2 | 1 | | 2 | | | | 1 | 1 | | 1 | 1 | 3 | |
| CO 3 | 3 | 2 | 1 | | 2 | | | | 1 | 1 | | 1 | 1 | 3 | |
| CO 4 | 3 | 2 | 1 | | 2 | | | | 1 | 1 | | 1 | 1 | 3 | |
| CO 5 | 3 | 2 | 1 | | 2 | | | | 1 | 1 | | 1 | 1 | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Assessment based on Continuous and Final Examination | | | |
|--|--|---------------------------------|---------------------------------|
| Bloom's Level | Continuous Assessment (50 marks) (Attendance – 5 marks) | | Final Examination [50 marks] |
| | Rubric based Continuous Assessment [25 marks] | Model Examination [20 marks] | |
| Remember | | | |
| Understand | 40 | 40 | 40 |
| Apply | 60 | 60 | 60 |
| Analyze | | | |
| Evaluate | | | |
| Create | | | |


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| | | | | | |
|------------------|--|---|---|---|---|
| 20MC401 | Soft Skill (Common to All Branches of B.E., / B.Tech.) | L | T | P | C |
| | | 2 | 0 | 0 | 0 |
| Nature of Course | Mandatory Course | | | | |
| Pre requisites | Nil | | | | |

Course Objectives

The course is intended to

1. Improve language skills in personal and professional life.
2. Equip students with the vital communication and soft skills to succeed in the highly competitive international arena.
3. Focus on the fundamental soft skills and of their practical social and work place usage.
4. Learn to identify and overcome the barriers in interpersonal relationships.
5. Enhance employability skills and ensure career success.

Course Outcomes

On successful completion of the course, students will be able to

| CO.No. | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO1 | Relate the significance and fundamental nature of soft skills. | Remember |
| CO2 | Take part in a wide range of Public speaking and professional group discussions. | Understand |
| CO3 | Plan one's time effectively and productively, especially at work. | Apply |
| CO4 | Make use of leadership skills to manage stress & conflict. | Apply |
| CO5 | Organize presentation effectively and participate in interview with confidence. | Apply |

Course Contents

Unit - I Introduction to soft skills and Interpersonal Communication 6

An Introduction – Definition and Significance of Soft Skills; Interpersonal communication-types of interpersonal communication.

Unit - II Public Speaking and Oral Communication skills 6

Public Speaking: Skills, Methods, Strategies Group Discussion: Importance, Planning, Elements.

Unit – III Time Management and Personality Development 6

Time Management – concepts and essentials tips. Personality-development – meaning, SWOT analysis & goal setting- Stress and conflict management.

Unit – IV Leadership skills and Emotional intelligence 6

Leadership skills: Concept of Leadership and honing Leadership skills- Problem-Solving Skills - Group and Ethical Decision-Making. Emotional Intelligence: Strategies to enhance Emotional Intelligence.

Unit-V Interview Skills 6

Interviewer - Interviewee perspectives - Self Introduction and Presentation: Types, Content and Essential Tips-before, during and after a presentation, Overcoming Nervousness - Mock Interview.

Total:30 Periods

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Text Books

1. Managing Soft Skills for Personality Development—edited by B.N.Ghosh, McGraw Hill India, 2018.
2. English and Soft Skills—S.P. Dhanavel, Orient Black swan India, 2017

Reference Books:

1. Soft Skill Business and Professional Communication Book by Sutapa Banerjee, 2016
2. Communication Skills Book by PushpLata and Sanjay Kumar, 2015

WEB REFERENCE:

<https://nptel.ac.in/courses/109/107/109107121/>

| Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO) | | | | | | | | | | | | | | | |
|--|-----|------|---|---|---|---|--------|---|---|----|----|-----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | | | | | | | | 1 | 2 | 3 | | 2 | | | |
| CO2 | | | | | | | | 1 | 2 | 3 | | 2 | | | |
| CO3 | | | | | | | | 1 | 2 | 3 | | 2 | | | |
| CO4 | | | | | | | | 1 | 2 | 3 | | 2 | | | |
| CO5 | | | | | | | | 1 | 2 | 3 | | 2 | | | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Bloom's Level | Summative Assessment (Internal Mode) | |
|---------------|--------------------------------------|-------------------------|
| | Assessment 1 (50 Marks) | Assessment 2 (50 Marks) |
| Remember | 10 | 10 |
| Understand | 10 | 10 |
| Apply | 30 | 30 |
| Analyze | | |
| Evaluate | | |
| Create | | |

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| | | | | | |
|------------------|--|---|---|---|---|
| 20MEA01 | Lean Manufacturing | L | T | P | C |
| | | 1 | 0 | 0 | 1 |
| Nature of course | Employability Enhancement Course | | | | |
| Pre requisites | Fundamentals of Mechanical Engineering | | | | |

Course Objectives

The course is intended to

1. Know the concepts of lean manufacturing and Tools.
2. Learn the total preventive maintenance and value stream mapping

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO 1 | Make use of principles of lean manufacturing and lean tools | Apply |
| CO 2 | Select the total preventive methods and value stream mapping | Apply |

Course Contents**Unit I - Introduction to Lean Manufacturing & Lean Tools**

7

Introduction to seven waste and their narration; Global competition, Lean Manufacturing, Value flow and Muda, Muri and Mura, Need for Lean Manufacturing - Lean tool and techniques - Various tool of Lean Manufacturing, Fundamental blocks of Lean, 5S, Kaizen, Poka-yoke, Kanban, Line balancing

Unit II - Total Productive Maintenance (TPM) & Value Stream Mapping

8

Need for TPM, Pillars of TPM, Implementation of TPM, Overall Equipment Effectiveness (OEE), OEE improvement- Sections of VSM - symbols of VSM- Current state mapping, Future state mapping, and application of VSM for an industrial process.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO 1 | | | | 2 | 3 | | | | | | | 2 | 1 | 3 | |
| CO 2 | | | | 2 | 3 | | | | | | | 2 | 1 | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Bloom's Level | Summative Assessment (Internal Mode) | |
|---------------|--------------------------------------|-------------------------|
| | Assessment 1 (50 Marks) | Assessment 2 (50 Marks) |
| Remember | 10 | 10 |
| Understand | 10 | 10 |
| Apply | 30 | 30 |
| Analyze | | |
| Evaluate | | |
| Create | | |


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| | | | | | |
|-------------------------|---|---|---|---|---|
| 20MEA03 | Plastics - Processing Tooling Assembly and Testing | L | T | P | C |
| | | 1 | 0 | 0 | 1 |
| Nature of course | Employability Enhancement Course | | | | |
| Pre requisites | Fundamentals of Mechanical Engineering | | | | |

Course Objectives

The course is intended to

1. To know the various plastic materials used in Automotive, home appliance and Medical fields
2. To understand the basic and advanced methods of plastic processing and the tooling and equipment used for it.
3. To learn various post processing requirements such as painting, foiling and pad painting.
4. To learn the various plastic joining processes
5. To learn about various plastic testing methods.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|---|---------------|
| CO 1 | Understand the types of plastics, processing methods and tooling. | Understand |
| CO 2 | Understand plastic assembly and testing methods | Understand |

Course Contents**Unit I – Plastics - Processing and Tooling****8**

Introduction on plastics, Types of plastics - Thermo plastics, Thermo setting plastics, Applications in Automobiles, Home appliances etc. Basic concepts on plastics design, Mould flow analysis, Plastic processing - Preheating, Molding, Molding types - Injection molding, compression molding, Rot molding, 2K molding, Tooling - Core, cavity, inserts, Heating and cooling circuits, Tool materials, Molding machines - Types, tonnage and other specifications.

Unit II – Molding Defects Assembly and Testing**7**

Molding defects – War page, Catching, Weld line, burning, Sink marks etc., Method of avoiding defects, Post molding process - Annealing, Texturing, color foiling, pad painting, Painting, etc., Assembly of plastics - Ultrasonic welding, Heat sinking, Vibration welding. Testing of plastics - UV Testing, Scratch resistance, Flammability, resistance against chemicals, impact test.

Total: 15 Hours


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| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO 1 | | | | 2 | 3 | | | | | | | 2 | 1 | 3 | |
| CO 2 | | | | 2 | 3 | | | | | | | 2 | 1 | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Bloom's Level | Summative Assessment (Internal Mode) | |
|---------------|--------------------------------------|-------------------------|
| | Assessment 1 (50 Marks) | Assessment 2 (50 Marks) |
| Remember | 10 | 10 |
| Understand | 10 | 10 |
| Apply | 30 | 30 |
| Analyze | | |
| Evaluate | | |
| Create | | |


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| 20ME501 | DESIGN OF MACHINE ELEMENTS | L | T | P | C |
|------------------|----------------------------|---|---|---|---|
| | | 3 | 2 | 0 | 4 |
| Nature of Course | Professional Core (PC) | | | | |
| Pre requisites | Strength of Materials | | | | |

Course Objectives**The course is intended to**

- Familiarize with various steps involved in the design process
- Teach students how to apply the concepts of stress analysis, theories of failure and material selection
- Analyze, design and/or select commonly used machine components
- Familiarize principles involved in evaluating the shape and dimensions of a component
- Satisfy functional and strength requirements, standard practices and standard data and use catalogues and standard machine components

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO 1 | Classify and explain the various steps involved in the design process, steady stresses and variable stresses in machine members. | Remembering |
| CO 2 | Explain the Procedures involved in the design of shafts keys, splines and couplings. | Understand |
| CO 3 | Demonstrate the knowledge on the designs of threaded fasteners, Knuckle joints, Cotter joints, welded and riveted joints. | Understand |
| CO 4 | Design and optimize energy storing elements for the specific applications. | Applying |
| CO 5 | Select appropriate rolling contact bearing, gasket and seal from the standard catalogue based on loads. | Understand |

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

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

UNIT II DESIGN OF SHAFTS, KEYS AND COUPLINGS**12**

Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys and keyways - Rigid and flexible couplings. Introduction to gear and shock absorbing couplings.

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

Threaded fasteners: Design of bolted joints including eccentric loading. Welded joints, riveted joints for structures - theory of bonded joints - Power screws.

UNIT IV DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS**12**

Types of springs – Design of helical and leaf springs. Rubber springs, theory of disc and torsional springs, Flywheels considering stresses in rims and arms for engines - Connecting Rods and crank shafts.

UNIT V DESIGN OF BEARINGS**12**

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi and Boyd graphs, McKee's equation- Selection of Rolling Contact bearings.

Total : 45+15(Tutorial)=60 Periods**Note: Use of approved Design Data book is permitted for examination.**

1. P.S.G. Tech., "Design Data", Data book for Engineers, Kalaikathir Achchagam, Coimbatore, 2018.

Text Books

1. A Textbook of Machine Design, RS Khurmi, S.Chand Publications.
2. Bhandari, V.B., "Design of Machine Elements", Tata McGraw-Hill education Pvt. Ltd., 3rd Edition, 2010.
3. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", Tata McGraw-Hill, 8th Edition, 2008.

Reference Books

1. Khurmi R S., Gupta J K., "A Text book of Machine Design", Eurasia Pub. House Pvt. Ltd., 14th Ed., 2005.
2. Norton R.L, "Design of Machinery", McGraw-Hill Book co, 3rd Edition, 2004.
3. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
4. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2003.
5. Sadhu singh, "Mechanical Machine Design", OBI Publishers, New Delhi, 2013

Additional References

1. **NPTEL:** <http://nptel.ac.in/courses/112105124/>
Prof.B.Maitietal, IIT kharagpur, Design of Machine Elements
2. <https://www.coursera.org/learn/machine-design1>
Dr. Kathryn Wingateetal., Woodruff School of Mechanical Engineering, Machine Design Part I
3. **MOOC Courses** - [https://www.mooc-list.com/tags/machine design](https://www.mooc-list.com/tags/machine%20design)

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|----------|----------|----------|-----------------|----------|----------|----------|--------------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | 3 | | | | | | | | | 3 | 3 | |
| CO 2 | 3 | 2 | 3 | | | | | | | | | 3 | 3 | |
| CO 3 | 3 | 2 | 3 | | | | | | | | | 3 | 3 | |
| CO 4 | 3 | 2 | 3 | | | | | | | | | 3 | 3 | |
| CO 5 | 3 | 2 | 3 | | | | | | | | | 3 | 3 | |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|---------------------------------|---|---|---|---|
| 20ME502 | HEAT AND MASS TRANSFER | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Core (PC) | | | | |
| Pre requisites | Thermodynamics, Fluid Mechanics | | | | |

Course Objectives

The course is intended to

1. Familiarize conduction heat transfer mechanisms
2. Expose the mechanisms of free and forced convection
3. Develop the shape factor algebra for black body radiation and grey body radiation
4. Demonstrate the phase change heat transfer and calculate the performance of heat exchanging devices
5. Explain diffusion and convective mass transfer

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|-------|---|---------------|
| CO 6 | Apply the principles of heat transfer in steady state conduction and determine the heat transfer characteristics. | Apply |
| CO 7 | Analyze fluid flow systems and find heat transfer characteristics in forced and free convection processes. | Analyse |
| CO 8 | Apply the principles of radiation in the heat exchange between black and grey bodies and establish heat transfer characteristics. | Apply |
| CO 9 | Design heat exchangers and find the Heat transfer coefficient for boiling and condensation. | Analyse |
| CO 10 | Find the mass transfer rate in diffusion and convective heat transfer coefficient or different applications. | Understand |

Course Contents

UNIT I CONDUCTION HEAT TRANSFER 9

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.

UNIT II CONVECTION HEAT TRANSFER 9

Basic concepts - Heat transfer coefficients, boundary layer concept. Forced convection – non dimensional numbers, external flow- flow over plates, cylinders and spheres, internal flow- flow through Horizontal pipe, laminar and turbulent flow. Free convection- non-dimensional numbers, flow over vertical plate, horizontal plate.

UNIT III RADIATION HEAT TRANSFER 9

Fundamentals of Radiation, Emission Characteristics - Irradiation, Total and Monochromatic radiation, Laws of Radiation - Planck, Wien's displacement, Kirchhoff, Lambert's cosine, Stefan-Boltzmann, Heat Exchange between Two Black Bodies and Gray Bodies, Concepts of Shape Factor, Emissivity, Radiation Shields.

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UNIT IV PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS**9**

Boiling: Pool Boiling Regimes, Determination of Heat Transfer Coefficient in Nucleate Boiling. Condensation: Film wise and Drop wise Condensation, Nusselt's Theory of Condensation on a Vertical Plate. Heat Exchangers: Classification of Heat Exchangers, Overall Heat Transfer Coefficient and Fouling Factor, Log Mean Temperature Difference (LMTD): parallel & counter flow, Effectiveness - NTU methods of analysis of heat exchangers.

UNIT V MASS TRANSFER**9**

Basic concepts - Diffusion mass transfer - Fick's law of diffusion, Steady state molecular diffusion. Convective mass transfer- correlations. Heat and mass transfer analogy.

Note: Use of Standard Heat and Mass Transfer data book permitted

Total : 45 Periods**Text Books:**

1. R.C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age International, 5th Edition, 2017.
2. Heat transfer, a practical approach, Yunus A- Cengel, 5th Edition, Tata Mc Graw Hill, 2015.

Reference Books:

1. P.K.Nag, Heat Transfer, McGraw Hill Education, 3rd Edition, 2011.
2. Holman.J.P, Heat Transfer, TMH, 10th Edition, 2017.
3. Fundamentals of heat and mass transfer, Frank P. Incropera and David P. Dewitt, John Wiley and Son's, 2005.
4. C.P Kothandaraman and S.Subramanyan, Heat and Mass Transfer data book, New Age International, 9th Edition, 2018.

Additional References

1. A Text book of Heat Transfer, John H Lienhard, 4th Edition.
2. NPTEL Heat Transfer course for Mechanical Engineering, <http://nptel.ac.in/courses/112101097/>
3. Heat Transfer, Chris Long & Naser Sayma, Bookboon.com, <https://legacy.saylor.org/me204/Intro>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 6 | 3 | 2 | 1 | | | | | | | | | | | 3 |
| CO 7 | | 3 | 2 | | | | | | | | | | | 3 |
| CO 8 | 2 | 3 | 1 | | | | | | | | | | | 3 |
| CO 9 | 1 | 2 | 3 | | | | | | | | | | | 3 |
| CO 10 | 3 | 2 | | | | | | 1 | | | | | | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | | 10 | 20 |
| Understand | 10 | 10 | 20 | 20 |
| Apply | 30 | 20 | | 30 |
| Analyse | | 20 | 20 | 30 |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|---|----------|----------|----------|----------|
| 20ME503 | COMPUTER AIDED MANUFACTURING | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of course | Professional Core (PC) | | | | |
| Pre requisites | Manufacturing Technology - I, II | | | | |

Course Objectives

The course is intended to

1. Educate students by covering different aspects of computer Aided Manufacturing.
2. Understand the different advances in manufacturing system like: GT and CAPP.
3. Summaries the different integrated production management system.
4. educate students to understand different advances in manufacturing system like: GT, CAPP and FMS
5. Familiarize the students by covering robotics and different material handling system required in manufacturing shop floor.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---------------|--|----------------------|
| CO 1 | Recall about the classical production system, the components of CIM | Remembering |
| CO 2 | Explain the concept of Computer Aided Process Planning (CAPP) and Material Requirements Planning (MRP) | Understand |
| CO 3 | Illustrate the cellular manufacturing using Rank order, Clustering and Hollier method | Understand |
| CO 4 | Explain Flexible Manufacturing system and applications of Automated Guided Vehicles in the implementation of CIM.. | Understand |
| CO 5 | Identify the configurations of Industrial Robots, and their part programming | Apply |

Course Contents

Unit – I INTRODUCTION

9

Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerized elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production

Unit – II PRODUCTION PLANNING AND CONTROL AND COMPUTER AIDED PROCESS PLANNING

9

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

Unit – III CELLULAR MANUFACTURING

9

Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

Unit – IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)

9

Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety

Unit – V INDUSTRIAL ROBOTICS

9

Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

Total : 45 Periods
Text Books

1. Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2008
2. Radhakrishnan P, Subramanyan S.and Raju V., “CAD/CAM/CIM”, 2nd Edition, New Age International (P) Ltd, New Delhi, 2004.

Reference Books

1. Gideon Halevi and Roland Weill, “Principles of Process Planning – A Logical Approach” Chapman & Hall, London, 1995.
2. Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall India, 2003.
3. Rao. P, N Tewari &T.K. Kundra, “Computer Aided Manufacturing”, Tata McGraw Hill Publishing Company, 2000.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|------------|-------------|----------|----------|----------|----------|---------------|----------|----------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | | | 2 | | | | | | | 2 | | 3 |
| CO 2 | 3 | 2 | | | 2 | | | | | | | 2 | | 3 |
| CO 3 | 3 | 2 | | | 2 | | | | | | | 2 | | 3 |
| CO 4 | 3 | 2 | | | 2 | | | | | | | 2 | | 3 |
| CO 5 | 3 | 2 | | | 2 | | | | | | | 2 | | 3 |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | |

| Formative Assessment | | | |
|-----------------------------|-----------------------------|--------------|--------------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|------------------------------|----------|----------|----------|----------|
| 20ME504 | DYNAMICS OF MACHINERY | L | T | P | C |
| | | 3 | 0 | 2 | 4 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Kinematics of Machinery | | | | |

Course Objectives

The course is intended to

1. Understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms. Design the Gate and Riser System
2. Understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
3. Understand the effect of Dynamics of undesirable vibrations
4. Understand the principles in mechanisms used for speed control and stability control.
5. Understand the fundamentals of the theory of kinematics and dynamics of machines

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---------------|--|----------------------|
| CO 1 | Calculate static and dynamic forces of mechanisms. | Remembering |
| CO 2 | Calculate the balancing masses and their locations of reciprocating and rotating masses. | Understand |
| CO 3 | Compute the frequency of free vibration. | Understand |
| CO 4 | Compute the frequency of forced vibration and damping coefficient. | Understand |
| CO 5 | Calculate the speed and lift of the governor and estimate the gyroscopic effect on automobiles, ships and airplanes. | Applying |

Course Contents

UNIT I FORCE ANALYSIS

9

Dynamic force analysis – Inertia force and Inertia torque– D'Alembert's principle –Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams –Fly Wheels – Flywheels of punching presses- Dynamics of Cam- follower mechanism.

UNIT II BALANCING

9

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines – Balancing of linkages – Balancing machines-Field balancing of discs and rotors.

UNIT III FREE VIBRATION

9

Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration– Equations of motion – Natural frequency – Types of Damping – Damped vibration– Torsional vibration of shaft – Critical speeds of shafts – Torsional vibration – Two and three rotor torsional systems.

UNIT IV FORCED VIBRATION

9

Response of one degree freedom systems to periodic forcing – Harmonic disturbances – Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation vibration measurement.

UNIT V MECHANISM FOR CONTROL

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force curves. Gyroscopes – Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes

Total : 45 Periods**Laboratory Components**

| S.No | Name of the Exercises | CO mapping | RBT |
|------|--|------------|------------|
| 1. | Study of different type of Gears and Gear Mechanisms | CO1 | Understand |
| 2. | Study of various Kinematic mechanisms.-Oscillating cylinder, reciprocating engine mechanism, With worth quick return | CO1 | Understand |
| 3. | Study various CAM and Follower mechanism | CO1 | Understand |
| 4. | Balancing of reciprocating masses | CO2 | Apply |
| 5. | Balancing of rotating masses | CO2 | Apply |
| 6. | Determine the vibration frequency of beams | CO3 | Apply |
| 7. | Vibration of Spring mass system | CO3 | Apply |
| 8. | Determine whirling speed of shaft | CO4 | Apply |
| 9. | Determine range sensitivity of Governor apparatus - Watt, Porter, Proell and Hartnell governors. | CO5 | Apply |
| 10. | Study of gyroscopic effect and couple | CO | Apply |

Text Books

1. F. B. Sayyad, "Dynamics of Machinery", McMillan Publishers India Ltd., Tech-Max Educational resources, 2019.
2. Rattan, S.S, "Theory of Machines", 5th Edition, Tata McGraw-Hill, 2019.
3. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 5th Edition, Oxford University Press, 2016.

Reference Books

1. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2014
2. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2008.
3. Khurmi, R.S., "Theory of Machines", 15th Edition, S Chand Publications, 2006.
4. Rao.J.S. and Duggipati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 2008.
5. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 3 | 3 | 3 | 3 | | | | | | | 2 | 3 | 3 |
| CO 2 | 3 | 3 | 3 | 3 | 3 | | | | | | | 2 | 3 | 3 |
| CO 3 | 3 | 3 | 3 | 3 | 3 | | | | | | | 2 | 3 | 3 |
| CO 4 | 3 | 3 | 3 | 3 | 3 | | | | | | | 2 | 3 | 3 |
| CO 5 | 3 | 3 | 3 | 3 | 3 | | | | | | | 2 | 3 | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|-------------------------------|---|---|---|---|
| 20ME505 | HEAT TRANSFER LABORATORY | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Thermodynamics, Heat Transfer | | | | |

Course Objectives

The course is intended to

1. Understand the various forms of heat transfer and their applications in real life problems.
2. Analyze the theoretical knowledge and apply it in conducting experiments in the forms of heat transfer.
3. Analyze different methods to calculate the heat transfer coefficient in various heat transfer problems.
4. Study the Radiation heat transfer for black body and grey body radiation.
5. Express the phase change heat transfer and calculate the performance of heat exchanging devices and refrigeration system.

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|-------|--|---------------|
| CO 1 | Perform steady state conduction experiments to estimate thermal conductivity of different materials for plane, cylindrical and spherical geometries. | Apply |
| CO 2 | Estimate heat transfer coefficients in forced convection, free convection. | Apply |
| CO 3 | Perform radiation experiments: determine surface emissivity and Stefan-Boltzmann's constant and compare with theoretical values. | Apply |
| CO 4 | Apply the heat transfer principle in heat exchangers and determine effectiveness of Parallel and Counter flow Heat Exchanger. | Apply |
| CO 5 | Estimate heat transfer coefficient of Performance in Air Conditioning and Refrigeration System | Apply |

Course Contents

| S.No | List of Experiments | CO Mapping | Revised Blooms Taxonomy |
|----------------------------------|---|------------|-------------------------|
| Experiments on Conduction | | | |
| 1. | Determination of overall heat transfer coefficient of Composite Wall. | CO1 | Apply |
| 2. | Determination of overall heat transfer coefficient of Lagged Pipe. | CO1 | Apply |
| 3. | Determination of Thermal Conductivity of given Metal Rod. | CO1 | Apply |
| Experiments on Convection | | | |

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| | | | |
|---|---|-----|-------|
| 4. | Determination of heat transfer coefficient of Natural Convection in horizontal Cylinder | CO2 | Apply |
| 5. | Determination of heat transfer coefficient of Forced Convection. | CO2 | Apply |
| 6. | Determine the convective heat transfer coefficient in natural convection In Vertical Cylinder | CO2 | Apply |
| 7. | Determination of heat transfer coefficient of Pin-Fin (Natural and Forced Convection) | CO2 | Apply |
| Experiments on Radiation | | | |
| 8. | Determination of Stefan Boltzman Constant. | CO3 | Apply |
| 9. | Determination of Emissivity of test plate. | CO3 | Apply |
| Experiments on Applications of heat transfer | | | |
| 10. | Determination of effectiveness and overall heat transfer coefficient using Parallel and Counter flow Heat Exchanger | CO4 | Apply |
| 11. | Determine The Coefficient Of Performance In Air Conditioning Test Rig. | CO5 | Apply |
| 12. | Determine the Experimental Coefficient of Performance in Vapour Compression Refrigeration System | CO5 | Apply |

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|---|---|---|-----------------|---|---|---|--------------|----|----|----|-------------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 3 | 2 | | | | | 2 | 1 | 2 | | 2 | 2 | 3 |
| CO 2 | 1 | 3 | 2 | | | | | 2 | 1 | 2 | | 2 | 2 | 3 |
| CO 3 | 1 | 3 | 2 | | | | | 2 | 1 | 2 | | 2 | 2 | 3 |
| CO 4 | 3 | 3 | 2 | | | | | 2 | 1 | 2 | | 2 | 2 | 3 |
| CO 5 | 3 | 3 | 2 | | | | | 2 | 1 | 2 | | 2 | 2 | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| | | | | | |
|-------------------------|--|----------|----------|----------|----------|
| 20ME506 | COMPUTER AIDED MANUFACTURING LABORATORY | L | T | P | C |
| | | 0 | 0 | 2 | 1 |
| Nature of Course | Professional Core (PC) | | | | |
| Pre requisites | Manufacturing Technology Laboratory – II | | | | |

Course Objectives**The course is intended to**

1. Study the features of CNC Machine Tool.
2. Expose students to modern control systems (Fanuc, Siemens etc.,)
3. Know the application of various CNC machines like CNC lathe, CNC Vertical Machining centre,
4. Understand the operations CNC milling machine and explore its applications
5. Study the advancement of Rapid prototyping by using the CAM tools

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|---|---------------|
| CO 1 | Familiarize CNC machines, tools and working conditions along with programming | Understand |
| CO 2 | Write external turning CNC Programs (Including Threading and Grooving) | Apply |
| CO 3 | Write external turning CNC Programs (Including Drilling, Boring and Internal Threading) | Apply |
| CO 4 | Write external milling CNC Programs (Including Contouring and Pocketing) | Apply |
| CO 5 | Execute the Mirroring command and demo with real time applications , Rapid Prototyping | Apply |

Courses to be covered for CAM

Introduction to CNC Machines and its operations

| Lecture No | Descriptions | Course Outcomes | Blooms taxonomy |
|------------|---|-----------------|-----------------|
| 1. | Lathe Coordinate system & Operations | CO1 | Understand |
| 2. | G & M codes | CO1 | Understand |
| 3. | CNC lathe – facing & Turning operation | CO1 | Understand |
| 4. | Taper & Step Turning operation | CO2 | Apply |
| 5. | External Threading Operation | CO2 | Apply |
| 6. | Grooving Operation | CO2 | Apply |
| 7. | Drilling operation & Boring Operation | CO3 | Apply |
| 8. | Internal Threading Operation | CO3 | Apply |
| 9. | CNC Milling Coordinates & Operation introduction | CO3 | Apply |
| 10. | Contouring operation | CO4 | Apply |
| 11. | Pocketing operation | CO4 | Apply |
| 12. | Drilling operation | CO4 | Apply |
| 13. | Mirroring command | CO5 | Apply |
| 14. | CNC lathe and Milling Demo | CO5 | Apply |
| 15. | Study of advanced CAM Software, Rapid Prototyping | CO5 | Apply |

Total: 30 Periods

Mapping of Course Outcomes

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 11 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 |
| CO 12 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 |
| CO 13 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 |
| CO 14 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 |
| CO 15 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Assessment based on Continuous and Final Examination | | | |
|--|--|------------------------------------|----------------------------|
| Bloom's Category | Continuous Assessment (50 marks) (Attendance – 5 marks) | | Final Examinations (FE) |
| | Rubric based Continuous Assessment [25 marks] | Model Examination [20 marks] | 50 |
| Remember | | | |
| Understand | 20 | 20 | 20 |
| Apply | 80 | 80 | 80 |
| Analyse | | | |
| Evaluate | | | |
| Create | | | |


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VI SEMESTER

| | | | | | |
|-------------------------|---|----------|----------|----------|----------|
| 20ME601 | DESIGN OF TRANSMISSION SYSTEMS | L | T | P | C |
| | | 3 | 2 | 0 | 4 |
| Nature of Course | Professional Core (PC) | | | | |
| Pre requisites | Strength of Materials, Design of Machine Elements | | | | |

Course Objectives**The course is intended to**

1. Apply the principles and procedure for the design of power transmission components.
2. Apply the standard procedure available for design of transmission system terms.
3. Learn to use standard data and catalogues.
4. Select / design / manufacture drive systems for a wide variety of driven loads to a given performance specification.
5. Design, manufacturing and quality assurance of selected power transmission components.

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---------------|---|----------------------|
| CO 1 | Select, design and analyze flexible drives | Remembering |
| CO 2 | Design of spur and Helical gears based on Lewis and Buckingham equation and gear life | Understand |
| CO 3 | Design of bevel and Worm gears based on Lewis and Buckingham equation and gear life | Understand |
| CO 4 | Design and analyze the multi speed gear box | Applying |
| CO 5 | Design and analyze the frictional drives. | Applying |

Course Contents**UNIT I SELECTION OF FLAT ,V BELTS AND CHAINS****12**

Selection of flat belts and pulleys, selection of V belt and pulleys, wire ropes and pulleys, selection of Transmission chains and Sprockets. Design of pulleys and sprockets.

UNIT II DESIGN OF SPUR AND HELICAL GEARS**12**

Review of gear fundamentals, interference, force analysis in gears, determining dimensions of a spur gear pair. Design of helical gears-parallel axis helical gear, normal and transverse planes, helix angles, equivalent number of teeth, determining dimension of helical gear pair.

UNIT III DESIGN OF BEVEL AND WORM GEARS**12**

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


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UNIT IV DESIGN OF GEARBOXES**12**

Geometric progression – Standard step ratio – Ray diagram, kinematics layout –Design of sliding mesh gear box – Design of multi speed gear box for machine tool applications – Constant mesh gear box – Speed reducer unit – Variable speed gear box.

UNIT V DESIGN OF FRICTIONAL DRIVES**12**

Clutches – role of clutches, positive and gradually engaged clutches, toothed claw clutches, design of single plate and multiple plate clutches, variable speed drives, types and selection. Role of brakes-types of brakes self-energizing and de-energizing brakes. Design of internally expanding shoe brakes – calculation of heat generation and heat dissipation in brakes.

Total : 45+15 (Tutorial)=60 Periods

Note: Use of approved Design Data book is permitted for examination.

1. P.S.G. Tech., “Design Data”, Data book for Engineers, Kalakathir Achchagam, Coimbatore, 2018.

Text Books

1. Bhandari, V.B., “Design of Machine Elements”, Tata McGraw-Hill education Pvt. Ltd., 3rd Edition, 2010.
2. Richard Bundya and Shigley, “Mechanical Engineering Design”, McGraw Hill Book Company.
3. Richard G. Budynas, J.Keith Nisbett, “Shigley’s Mechanical Engineering Design”, McGraw-Hill Education (India) P Ltd., 9th Edition, 2011.

Reference Books

1. Khurmi R S., Gupta J K., “A Text book of Machine Design”, Eurasia Pub. House Pvt. Ltd., 14th Ed., 2005.
2. Norton R.L., “Design of Machinery”, McGraw-Hill Book co, 3rd Edition, 2004.
3. Orthwein W., “Machine Component Design”, Jaico Publishing Co, 2003.
4. Maitra G.M., Prasad L.V., “Hand book of Mechanical Design”, 2nd Edition, Tata McGraw-Hill, 2010.
5. Sadhu singh, “Mechanical Machine Design”, OBI Publishers, New Delhi, 2013.

Additional References

1. **NPTTEL:** <http://www.nptelvideos.in/2012/12/design-of-machine-elements.html>
Prof.G. Chakraborty, Department of Mechanical Engineering, IIT Kharagpur, Design of Brakes.
2. <http://freevidelectures.com/Course/2353/Power-Systems-Analysis/11>, Prof. A.K. Sinha, IIT Kharagpur, Transmission Systems.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | 3 | | | | | | | | | 3 | 3 | |
| CO 2 | 3 | 2 | 3 | | | | | | | | | 3 | 3 | |
| CO 3 | 3 | 2 | 3 | | | | | | | | | 3 | 3 | |
| CO 4 | 3 | 2 | 3 | | | | | | | | | 3 | 3 | |
| CO 5 | 3 | 2 | 3 | | | | | | | | | 3 | 3 | |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|--|----------|----------|----------|----------|
| 20ME602 | FINITE ELEMENT ANALYSIS | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Core (PC) | | | | |
| Pre requisites | Strength of Materials, Numerical Methods | | | | |

Course Objectives

The course is intended to

1. Understand the basic concepts of FEA and Analytical methods
2. Formulate stiffness matrix problems for rod, beam and truss.
3. Formulate 2D plane stress, strain and axisymmetric problems
4. Write the shape function for 1D,2D elements and apply Gauss quadrature methods
5. Solve various heat transfer problems

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|--------------|---|----------------------|
| CO 1 | Explain the various applications of FEA and basic methods | Understand |
| CO 2 | Solve linear 1D structural rod, beams and Truss problems | Applying |
| CO 3 | Solve two dimensional Structural problems FEM method | Applying |
| CO 4 | Derive shape functions for 4 and 8 node quadrilateral, 6 node triangle elements and apply numerical integration to solve; 1D and 2D; stiffness integrations | Applying |
| CO 5 | Analyse heat conduction and convection heat transfer problems and familiarize FEA software | Applying |

Course Contents

UNIT I INTRODUCTION TO FINITE ELEMENT ANALYSIS 9

History, Applications, merits, demerits, and steps followed in FEA, Engineering Analysis, Convergence criteria, Governing Equations, Boundary and Initial Conditions, Weak and Variational formulation, Gauss Elimination method.

UNIT II ONE DIMENSIONAL PROBLEMS 9

Stiffness matrix methods, One dimensional elements, Derivation of stiffness equation of problems (Rod, BEAM, Truss) and problems, Vibration problems (Rod, BEAM)

UNIT III TWO DIMENSIONAL PROBLEMS 9

Two dimensional Elements (Plane stress, plane strain, Axisymmetric), Derivation of shape function, strain, stress for CST element and simple Problems.

UNIT IV ISOPARAMETRIC ELEMENTS**9**

Shape function for 1D ,2D elements , Sub parametric, super parametric and Isoparametric elements, Numerical Integration with Gauss quadrature.

UNIT V FIELD PROBLEMS AND FEA SOFTWARES**9**

Heat transfer problems, conduction, convection, thermal fin, Thermal stress, heat generation problems. Various Features of FEM Software.

Total : 45 Periods**Text Books**

1. J. N. Reddy, " An Introduction to Finite Element Methods", 4e, McGraw Hill, 2015
2. S.S.Rao , "The finite element method in Engineering", 3e, Butterworth and Heinemann, 2015

Reference Books

1. Robert Cook , "Concepts and applications of finite element analysis", 4e, John Wiley and sons, 2009
2. Tirupathi K. Chandrupatla and Ashok D. Belegundu, "Introduction to finite elements in engineering", 3e, Pearson Education, 201

Additional References

1. **NPTTEL** - <https://nptel.ac.in/courses/112/104/112104193/>
2. <https://ocw.mit.edu/courses/mechanical-engineering/2-092-finite-element-analysis-of-solids-and-fluids-i-fall-2009/>
3. **MOOC Courses** - <https://www.mooc-list.com/tags/finite-element>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|----------|----------|----------|-----------------|----------|----------|----------|--------------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 3 | 2 | 2 | 2 | | | | | | 2 | | 3 | 3 |
| CO 2 | 2 | 3 | 2 | 2 | 2 | | | | | | 2 | | 3 | 3 |
| CO 3 | 3 | 3 | 2 | 2 | 2 | | | | | | 2 | | 3 | 3 |
| CO 4 | 3 | 3 | 2 | 2 | 2 | | | | | | 2 | | 3 | 3 |
| CO 5 | 3 | 3 | 2 | 2 | 3 | | | | | | 2 | | 3 | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|--------------------------------------|----------|----------|----------|----------|
| 20ME603 | MECHATRONICS ENGINEERING | L | T | P | C |
| | | 3 | 0 | 2 | 4 |
| Nature of Course | Professional Core (PC) | | | | |
| Pre requisites | Electrical Drives and Microprocessor | | | | |

Course Objectives

The course is intended to

1. Understand the various stages of mechatronics system and sensors.
2. Familiarize Microprocessor and its components
3. Interface microprocessor with various input and output devices
4. Learn various PLC components and its Functions
5. Study the various applications of Mechatronics system

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---------------|--|----------------------|
| CO 1 | Discuss the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology | Understand |
| CO 2 | Discuss the architecture of Microprocessor and Microcontroller, Pin Diagram, Addressing Modes of Microprocessor and Microcontroller. | Understand |
| CO 3 | Discuss Programmable Peripheral Interface, Architecture of 8255 PPI, and various device interfacing | Understand |
| CO 4 | Explain the architecture, programming and application of programmable logic controllers to problems and challenges in the areas of Mechatronic engineering | Understand |
| CO 5 | Discuss various Actuators and Mechatronics system using the knowledge and skills acquired through the course and also from the given case studies | Applying |

Course Contents

UNIT I INTRODUCTION

9

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 MICROPROCESSOR AND MICROCONTROLLER

9

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes – Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram

UNIT III PROGRAMMABLE PERIPHERAL INTERFACE

9

Introduction – Architecture of 8255, Keyboard interfacing, LED display –interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface.

UNIT IV PROGRAMMABLE LOGIC CONTROLLER**9**

Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.

UNIT V ACTUATORS AND MECHATRONICS SYSTEM DESIGN**9**

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

Total : 45 Periods**Laboratory Components**

| S.No | Name of the Exercises | CO mapping | RBT |
|------|--|------------|------------|
| 1. | Study of various sensors and Transducers | CO1 | Understand |
| 2. | 8085 Microprocessor 8 bit Addition and subtraction | CO2 | Understand |
| 3. | 8085 Microprocessor 8 bit Multiplication and Division | CO2 | Understand |
| 4. | 8085 Microprocessor 8 bit ascending and descending order | CO2 | Apply |
| 5. | 8085 Microprocessor 8 bit binary to hexadecimal conversion | CO2 | Apply |
| 6. | 8085 Microprocessor 8 bit hexadecimal to binary conversion | CO2 | Apply |
| 7. | 8085 interfacing to stepper motor | CO3 | Apply |
| 8. | 8085 interfacing to Traffic light Control | CO3 | Apply |
| 9. | Study of simple PLC programme | CO4 | Apply |
| 10. | Study of various mechatronics applications | CO5 | Apply |

Text Books

1. William Bolton, "Mechatronics", Prentice Hall, 2016
2. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 6th Edition, Prentice Hall, 2014.

Reference Books

1. Bradley D.A, Dawson D, Buru N.C and Loader A.J, "Mechatronics", Chapman and Hall, 2018.
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.
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.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 3 | 3 | | 3 | | | | | | | 2 | 3 | 3 |
| CO 2 | 3 | 3 | 3 | | 3 | | | | | | | 2 | 3 | 3 |
| CO 3 | 3 | 3 | 3 | | 3 | | | | | | | 2 | 3 | 3 |
| CO 4 | 3 | 3 | 3 | | 3 | | | | | | | 2 | 3 | 3 |
| CO 5 | 3 | 3 | 3 | | 3 | | | | | | | 2 | 3 | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|---|---|---|---|---|
| 20ME604 | MODELLING LABORATORY | L | T | P | C |
| | | 0 | 0 | 2 | 1 |
| Nature of Course | Professional Core (PC) | | | | |
| Pre requisites | Computer Aided Machine Drawing Laboratory | | | | |

Course Objectives

The course is intended to

1. Understand the fundamentals of 3D modelling software systems
2. model the machine components
3. Invent a mechanical components such bearing, gear ,piston, connecting rod
4. Analysis various components Wind Turbine, pump and Motor bike.
5. Model the Car and aircraft components

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|---|---------------|
| CO 1 | Familiarize 3D Modelling Software | Understand |
| CO 2 | Model basic machine Components | Apply |
| CO 3 | Design a mechanical components such bearing, gear ,piston, connecting rod | Apply |
| CO 4 | Create various construction , Turbine components | Apply |
| CO 5 | Create Automobile and aircraft components | Apply |

Courses to be covered

Creation of 3D assembly model of following machine elements using 3D Modelling software

| Lecture No | Descriptions | Course Outcomes | Blooms taxonomy |
|------------|---------------------------------------|-----------------|-----------------|
| 11. | Introduction of 3D Modelling software | CO1 | Understand |
| 12. | Flange Coupling | CO1 | Understand |
| 13. | Plummer Block | CO1 | Understand |
| 14. | Screw Jack | CO2 | Apply |
| 15. | Lathe Tailstock | CO2 | Apply |
| 16. | Universal Joint | CO2 | Apply |
| 17. | Bearing roller, ball | CO3 | Apply |
| 18. | Gear design (spur, helical, etc.) | CO3 | Apply |
| 19. | Different valve design | CO3 | Apply |
| 20. | Connecting rod, Piston | CO3 | Apply |
| 21. | Sheet metal design | CO4 | Apply |

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| | | | |
|-----|-------------------------------|-----|-------|
| 22. | Construction equipment design | CO4 | Apply |
| 23. | Wind Turbine blade design | CO4 | Apply |
| 24. | Motor bike design | CO5 | Apply |
| 25. | 3D Car Modelling | CO5 | Apply |
| 26. | 3D Aircraft Modelling | CO5 | Apply |
| 27. | Pump | CO5 | Apply |

Total: 30 Periods

Mapping of Course Outcomes

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 |
| CO 2 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 |
| CO 3 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 |
| CO 4 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 |
| CO 5 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Assessment based on Continuous and Final Examination | | | |
|--|--|------------------------------|-------------------------|
| Bloom's Category | Continuous Assessment (50 marks) (Attendance – 5 marks) | | Final Examinations (FE) |
| | Rubric based Continuous Assessment [25 marks] | Model Examination [20 marks] | 50 |
| Remember | | | |
| Understand | 20 | 20 | 20 |
| Apply | 80 | 80 | 80 |
| Analyse | | | |
| Evaluate | | | |
| Create | | | |

| 20ME605 | MINI PROJECT | L | T | P | C |
|-------------------------|-------------------------------------|---|---|---|---|
| | | 0 | 0 | 2 | 1 |
| Nature of Course | Employability Enhancement Course | | | | |
| Pre requisites | Knowledge in Mechanical Engineering | | | | |

Course Objectives

The course is intended to

1. Develop skills to formulate a technical project.
2. Give guidance on the various tasks of the project and standard procedures.
3. Give guidance on the various procedures for validation of the product and analyse the cost effectiveness.
4. To get hands on training in the fabrication of one or more components of a complete working model, this is designed by them.
5. Provide guidelines to prepare technical report of the project.

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|---|---------------|
| CO 1 | Demonstrate the working model of the machine element or the mechanical product. | Understand |
| CO 2 | Identify technical ideas, strategies and methodologies. | Apply |
| CO 3 | Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project. | Apply |
| CO 4 | Test and validate through conformance of the developed prototype and analysis the cost effectiveness. | Analyse |
| CO 5 | Prepare technical report and oral presentations. | Understand |

Guideline for Review and Evaluation

1. The students may be grouped into 2 to 4 and work under a project supervisor.
2. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry.
3. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department.
4. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 30 PERIODS


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| | Continuous Assessment [50 marks] | | | | | | Final Viva Voce Examination [50 marks] |
|--------------|----------------------------------|-------------------|--------------------|---------------------|----------------------|---------------|---|
| | Review I [10] | Review II [10] | Review III [10] | Publication [10] | Report [10 Marks] | Total [50] | |
| Marks | 100 | 100 | 100 | 10 | 10 | 50 | 50 |

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 6 | 3 | 3 | 1 | | 1 | | 1 | 2 | 2 | 2 | 2 | 1 | 3 | 3 |
| 1. | 3 | 3 | 1 | | 2 | | 1 | 2 | 2 | 2 | 2 | 1 | 3 | 3 |
| 2. | 3 | 3 | 1 | | 2 | | 1 | 1 | 2 | 2 | 2 | 1 | 3 | 3 |
| 3. | 3 | 3 | 1 | | 2 | | 1 | 1 | 2 | 2 | 2 | 1 | 3 | 3 |
| 4. | 3 | 3 | 1 | | 1 | | 1 | 1 | 2 | 2 | 2 | 1 | 3 | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |


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| 20ME606 | INTERNSHIP | L | T | P | C |
|------------------|-----------------------------------|---|---|---|---|
| | | 0 | 0 | 2 | 1 |
| Nature of Course | Employability Enhancement Courses | | | | |
| Pre requisites | Nil | | | | |

Course Objectives

1. To encourage the students to study advanced engineering developments
2. To prepare and present technical reports.
3. To encourage the students to use various teaching aids such as overhead projectors, power point presentation and demonstrative models.
4. To understand work ethic and commitment in a work-based environment
5. To gain practical experience in the workplace before receiving their undergraduate degrees

Course Outcomes

Upon successful completion of the internship, students should be able to:

1. Communicate a practical understanding of how a business actually operates
2. Demonstrate the ability to integrate and apply theoretical knowledge and skills develop in various courses to real-world situations in a business organization
3. Exhibit the ability to effectively work in a professional environment and demonstrate work ethic and commitment in a work-based environment
4. Demonstrate the ability to successfully complete internship assignments.
5. Develop the technology with sustainability long through societal relevance.

Guidelines for Internship

1. All the students need to go for internship for minimum of **2 weeks**.
2. Students can take mini projects, assignments, case studies by discussing it with concerned authority from industry and can work on it during internship.
3. All students should compulsorily follow the rules and regulations as laid by industry.
4. Every student should take prior permissions from concerned industrial authority if they want to use any drawings, photographs or any other document from industry.
5. Student should follow all ethical practices and SOP of industry
6. Students have to take necessary health and safety precautions as laid by the industry.
7. Student should contact his /her academic guide from college on weekly basis to communicate the progress.
8. Each student has to prepare internship report in consultation with the faculty.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|---|
| Cos | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 3 | 3 | 3 | | | | 3 | 3 | 2 | 1 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | | | | 3 | 3 | 2 | 1 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | | | | 3 | 3 | 2 | 1 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | | | | 3 | 3 | 2 | 1 | 3 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | | | | 3 | 3 | 2 | 1 | 3 | 2 | 2 |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |


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One Credit Course

| | | | | | |
|------------------|--|---|---|---|---|
| 20MEA05 | CNC PROGRAMMING | L | T | P | C |
| | | 1 | 0 | 0 | 1 |
| Nature of course | Employability Enhancement Course | | | | |
| Pre requisites | Fundamentals of Mechanical Engineering | | | | |

Course Objectives

The course is intended to

1. Learn the CNC lathe Programming and machine
2. Learn the CNC milling programming and Machine

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|---|---------------|
| CO 1 | Write the CNC lathe program and operate the machine | Apply |
| CO 2 | Write the CNC Milling program and operate the machine | Apply |

Course Contents**Unit I - Introduction to CNC lathe Programming****8**

Lathe Coordinate system & Operations, G & M codes, CNC lathe – facing & Turning operation Taper & Step turning operation, External Threading Operation, Grooving Operation, Drilling operation & Boring Operation, Internal Threading Operation, machine Practice

Unit II - Introduction to CNC Milling Programming**7**

CNC Milling Coordinates & Operation introduction, contouring operation, pocketing operation Drilling operation, Mirroring command, sub program, machine Practice

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|-----|------|---|---|
| COs | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO 1 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 | |
| CO 2 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Bloom's Level | Summative Assessment (Internal Mode) | |
|---------------|--------------------------------------|-------------------------|
| | Assessment 1 (50 Marks) | Assessment 2 (50 Marks) |
| Remember | 10 | 10 |
| Understand | 10 | 10 |
| Apply | 30 | 30 |
| Analyze | | |
| Evaluate | | |
| Create | | |


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Stream - I

Design Engineering

| | | | | | |
|------------------|----------------------------|---|---|---|---|
| 20MEE01 | DESIGN THINKING | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Engineering Graphics | | | | |

Course Objectives

The course is intended to

1. Familiarize design thinking process
2. Understand the concepts of personas
3. Create idea generation
4. Apply the concepts of design thinking in firm
5. Implement design thinking specific contexts

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|-------|---|---------------|
| CO 1 | Explain the design thinking process | Understand |
| CO 2 | Use various mapping tools | Applying |
| CO 3 | Build design thinking ideas | Applying |
| CO 4 | Apply design thinking ideas to the firm | Applying |
| CO 5 | Execute design thinking for specific contexts | Applying |

Course Contents

UNIT I INTRODUCTION TO DESIGN THINKING

9

The Concept of Design Thinking and Its Role within NPD and Innovation, A Framework of Design Thinking, Design Thinking as a Nonlinear Process, The Principles and the “Mindset” of Design Thinking. Nine Criteria of an Inspirational Design Brief, Writing the Inspirational Design Brief, Research Findings about Inspirational Design Briefs.

UNIT II POWERFUL TOOL FOR DESIGNERS

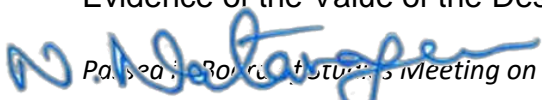
9

Defining Personas, The Importance of Personas, Creating Personas, Illustrative Application of Personas, Customer Experience Mapping, Inputs to the Experience Map, The Experience Mapping Process, The Experience Map as a Springboard to Innovative Solutions.

UNIT III DESIGN THINKING TO BRIDGE RESEARCH AND CONCEPT DESIGN

9

Challenges in Idea Generation, The Need for a Systematic Method to Connect to the User, The Visualize, Empathize, and Ideate Method, The Importance of Visualizing and Empathizing before Ideating, Design Heuristics, Design Heuristics for Idea Generation, Evidence of the Value of the Design Heuristics Tool.


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UNIT IV DESIGN THINKING WITHIN THE FIRM**9**

Integrating Design into the Fuzzy Front End of the Innovation Process , Challenges in the FFE, Design Practices and Tools for Assisting in Problem Definition, Design Practices and Tools for Assisting in Information Management, How to Integrate Design Professionals in FFE.

UNIT V DESIGN THINKING FOR SPECIFIC CONTEXTS**9**

Products, Services, and Experiences, How to Design for Compelling Service Experiences, Services that Sing and Dance, Designing a Service Experience Is Never Finished

Total : 45 Periods**Text Books**

1. Michael G.Luchs, Scott swan, abbie griffin, "Design Thinking: New Product Development Essentials from the PDMA", John Wiley & Sons, 2016.
2. Moritz Gekeler, "A practical guide to design thinking", Friedrich-Ebert-Stiftung India Office, 2019.

Reference Books

1. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand –Improve –Apply", Springer, 2011
2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press , 2009.
3. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.

Additional References

1. **NPTEL** - <https://nptel.ac.in/courses/110/106/110106124/>
2. **MOOC Courses** - <https://www.mooc-list.com/tags/design-thinking>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 3 | 3 | | 3 | | | | | | | 3 | 3 | 3 |
| CO 2 | 3 | 3 | 3 | | 3 | | | | | | | 3 | 3 | 3 |
| CO 3 | 3 | 3 | 3 | | 3 | | | | | | | 3 | 3 | 3 |
| CO 4 | 3 | 3 | 3 | | 3 | | | | | | | 3 | 3 | 3 |
| CO 5 | 3 | 3 | 3 | | 3 | | | | | | | 3 | 3 | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|------------------------|----------|----------|----------|----------|
| 20MEE02 | PRODUCT DESIGN | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Core (PE) | | | | |
| Pre requisites | NIL | | | | |

Course Objectives

1. This course aims at introducing the students to the basic concepts of engineering design and product development with focus on the front end processes
2. The student is expected to demonstrate an understanding of the overview of all the product development processes and knowledge of concept generation and selection tools, demonstrate technical competency in practice Function effectively in an industrial and academic environments.
3. Engage in professional ethics and development.
4. Enrich their society and environment through their skills.

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---------------|--|----------------------|
| CO 6 | Discuss the concept and stages involved in a generic product development process | Remembering |
| CO 7 | Identify the customer needs and establish the product specifications. | Understand |
| CO 8 | Identify concept generation activities and apply design for manufacturing concepts in estimating manufacturing costs | Understand |
| CO 9 | Explain the concepts of product architecture and identify the ways to reduce the product cost | Understand |
| CO 10 | Apply principles of prototyping in product development economics and effectively manage the product development projects | Applying |

Course Contents

UNIT I BASICS OF PRODUCT DESIGN

9

Introduction – Classification, Specifications of Products, Product life cycle. Introduction to product design & development, A generic development process, concept development: the front-end process, adapting the generic product development process, the AMF development process, the AMF organization

UNIT II IDENTIFYING CUSTOMER NEEDS - PRODUCT SPECIFICATIONS

9

Gathering raw data from customers, interpreting raw data in terms of customer needs, organizing the needs into a hierarchy, establishing the relative importance of the needs and reflecting on the results and the process. Specifications, establish specifications, establishing target specifications, setting the final specifications

UNIT III CONCEPT GENERATION, SELECTION & TESTING

9

Overview of methodology, concept screening, concept scoring, caveats. Purpose of concept test, choosing a survey population and a survey format, communicate the concept, measuring customer response, interpreting the result, reflecting on the results and the process.

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UNIT IV PRODUCT ARCHITECTURE -DESIGN FOR MANUFACTURING & ASSEMBLY**9**

Meaning of product architecture, establishing the architecture, platform planning, related system level design issues. Assessing the need for industrial design, industrial design process, managing the industrial design process. Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors.

UNIT V PROTOTYPING , PRODUCT DEVELOPMENT ECONOMICS**9**

Prototyping basics, principles of prototyping technologies, planning for prototypes, Elements of economic analysis. Sensitive analysis, project trade-offs, qualitative analysis. Understanding and representing task, baseline project planning, accelerating projects, project execution, project evaluation.

Total : 45 Periods**Text Books**

1. Karl T Ulrich, Steven D Eppinger , “ Product Design & Development.” Tata McGrawhill New Delhi 2011
2. Kevin Otto & Kristin Wood Product Design: “Techniques in Reverse Engineering and new Product Development.” 1 / e 2004 , Pearson Education New Delhi.

Reference Books

1. David G Ullman, “The Mechanical Design Process.” McGrawhill Inc Singapore 2017 N J M Roozenberg , J Ekels , N F M Roozenberg “ Product Design Fundamentals and Methods .” John Willey & Sons 1995
2. L D Miles “Value Engineering.”
3. Hollins B & Pugh S “Successful Product Design.” Butter worths London.

Additional References

1. NPTEL: https://onlinecourses.nptel.ac.in/noc17_me16/preview
2. <https://nptel.ac.in/courses/112107078/37>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|----------|----------|----------|-----------------|----------|----------|----------|--------------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 6 | 3 | 2 | 2 | | 2 | | | | | | | 3 | 3 | 3 |
| CO 7 | 3 | 2 | 2 | | 2 | | | | | | | 3 | 3 | 3 |
| CO 8 | 3 | 2 | 2 | | 2 | | | | | | | 3 | 3 | 3 |
| CO 9 | 3 | 2 | 2 | | 2 | | | | | | | 3 | 3 | 3 |
| CO 10 | 3 | 2 | 2 | | 2 | | | | | | | 3 | 3 | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|------------------------------|---|---|---|---|
| 20MEE03 | TOOL AND DIE DESIGN | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Manufacturing Technology 1&2 | | | | |

Course Objectives

The course is intended to

1. Develop capability to design and select single point and multipoint cutting tools for various machining operations.
2. Exposure to variety of locating and clamping methods available.
3. Enable the students to design jigs and fixtures for simple components.
4. Expose the students to the design/selection procedure of press tools and die casting dies.
5. Learn the inputs, concepts and requirements for die design.

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|---|---------------|
| CO 1 | The knowledge of tool design and The concepts and principles used in Tool Design. | Understand |
| CO 2 | Design a single point or multi point cutting tool to machine a required job. | Understand |
| CO 3 | Design a location and clamping system for a given component. | Applying |
| CO 4 | Design die and punch for blanking, piercing, drawing and bending operations. | Understand |
| CO 5 | Interpret the technical details based on the drawing dies and die casting | Applying |

Course Contents

UNIT I INTRODUCTION TO TOOL DESIGN

9

Tooling, requirements of a tool designer, general tool design procedure, tool engineering functions and its importance to enhance productivity and quality. Review of cutting tool materials. Tool angles and signature, Carbide inserts grades - ISO designation and applications, tool holders for turning-ISO designation. Solid type tool, brazed tip tool, throw away indexable insert types, coated carbides and chip breakers.

UNIT II DESIGN OF CUTTING TOOLS

9

Design of single point cutting tools: Design of shank dimensions using strength and rigidity considerations for rectangular, square and round cross section and selection of tool geometry. Design of Multi Point Cutting Tools: Types of drills, Drill bit design - elements like back taper, web thickness, land width, margin, flute length and cross section and selection of tool geometry. Re-sharpening of drill bit. Tool holders for milling, different tapers used for mounting tool holders in milling, ISO designation. Tool mounting systems. Design of milling cutters: Design of elements like number of teeth and height, circular pitch, body thickness, chamfer width, fillet radius and selection of tool geometry. Profile sharpened and form relieved milling cutters. Re-sharpening of side and face milling cutter and end mill.

UNIT III JIGS AND FIXTURES**9**

Functions and differences between jigs and fixtures, advantages in mass production, design principles, economics of jigs and fixtures. Location: 3-2-1 Principle of location, different types of locating elements. Clamping: Principles of clamping, types of clamping devices, and power clamping. Drill bushes; Drill jigs: different types, exercises of designing jigs for simple components. Fixture Design: Turning fixtures, milling fixtures, grinding fixtures, fixturing for CNC machining centers, and modular fixtures. Design exercises on fixtures for turning and milling for simple components

UNIT IV PRESS TOOLS& BENDING DIES**9**

Press tools: Classification and working of power presses. Concept and calculations of press tonnage and shut height of a press, components of a simple die, press tool operation, die accessories, shearing action in punch & die, clearance, shear on punch and die, Centre of pressure, and strip layout. Simple, progressive, compound, combination and inverted dies. Design problems on blanking and piercing dies for simple components. Bending dies – Introduction, bend allowance, spring back, edge bending die design.

UNIT V DRAWING DIES& DIE CASTING**9**

Drawing dies – Single action, double action and triple action dies, factors affecting drawing and drawing die design. Design of drawing dies for simple components. Die casting: Die casting alloys, terminology-core, cavity, sprue, slug, fixed and movable cores, finger cams, draft, ejector pins and plates, gate, goose nozzle, over-flow, patten, plunger, runner, vent, water-line etc. Types of Dies: Single cavity, multi cavity dies, combination dies, unit dies, advantages and disadvantages of types of dies; finishing, trimming and inspection of die casting components, safety, and modern trends in die casting dies.

Total : 45 Periods**Text Books**

1. Cyril Donaldson, George H. Lecain, V.C. Goold, "Tool Design", McGraw Hill Education, 5th edition, 2017.
2. P.N. Rao, "Manufacturing technology", McGraw Hill Education, 4th edition, 2018.

Reference Books

1. P.H. Joshi, "Jigs and Fixtures", McGraw Hill Education, 3rd edition, 2017.
2. John G. Nee, William Dufraine, John W. Evans, Mark Hill, "Fundamentals of Tool Design", Society of Manufacturing Engineers, 2010.
3. Frank W. Wilson, "Fundamentals of Tool Design", PHI publications.
4. Kempester M.H.A., "An introduction to Jig and Tool design", VIVA Books Pvt. Ltd., 2004.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 3 | 3 | | 3 | | | | | | 3 | 2 | 3 | 3 |
| CO 2 | 3 | 3 | 3 | | 3 | | | | | | 3 | 2 | 3 | 3 |
| CO 3 | 3 | 3 | 3 | | 3 | | | | | | 3 | 2 | 3 | 3 |
| CO 4 | 3 | 3 | 3 | | 3 | | | | | | 3 | 2 | 3 | 3 |
| CO 5 | 3 | 3 | 3 | | 3 | | | | | | 3 | 2 | 3 | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |


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| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|---|---|---|---|---|
| 20MEE04 | DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Nil | | | | |

Course Objectives

The course is intended to

1. Impart knowledge on the science, use and application of hydraulics system as fluid power in Industry.
2. Acquire the concept of control and regulation elements in hydraulic system
3. Learn the procedure to design hydraulic circuits for different application
4. Study the fundamentals of pneumatic system and circuits
5. Understand the procedure for installation, maintenance and design of special circuits

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO 11 | Select and apply the use of rotary and linear actuators. | Understand |
| CO 12 | Choose the different types of control and regulation elements. | Understand |
| CO 13 | Design the various industrial circuits in hydraulic systems. | Remembering |
| CO 14 | Retrieving the various pneumatic system and circuits. | Remembering |
| CO 15 | Diagnose the faults and implement the maintenance measures | Apply |

Course Contents

UNIT I OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS 9

Hydraulic Power Generators – Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics

UNIT II CONTROL AND REGULATION ELEMENTS 9

Pressure - Direction and Flow control valves - Relief valves, non-return and safety valves – actuation systems.

UNIT III HYDRAULIC CIRCUITS 9

Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits – industrial circuits – press circuits - hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuits- design and selection of components - safety and emergency mandrels.


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UNIT IV PNEUMATIC SYSTEMS AND CIRCUITS**9**

Pneumatic fundamentals - control elements, pneumatic sensors - logic circuits – switches – fluidic logic circuits- Sequential circuits – Cascade methods – K-V Mapping methods - Step counter method – Classic methods.

UNIT V INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS**9**

Pneumatic equipment's- selection of components - design calculations – application -fault finding – hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

Total : 45 Periods**Text Books**

1. Srinivasan R, "Hydraulic and Pneumatic Controls", Tata McGraw – Hill Education India, New Delhi, 2nd Edition, 2016
2. Anthony Esposito, "Fluid Power with Applications", Pearson Education Asia Delhi, New Delhi, 7th Edition, 2015.

Reference Books

1. Majumdar S.R., "Pneumatic Systems, Principles and Maintenance" Tata McGraw Hill, 2010
2. Bolton. W., "Pneumatic and Hydraulic Systems ", Butterworth –Heinemann, 1997
3. Andrew Parr, "Hydraulic and Pneumatics" (HB), Jaico Publishing House, 1999.
4. Dudley A. Pease and John J. Pippenger., "Basic fluid power", Prentice Hall, 1987

Additional References

3. NPTEL - <https://nptel.ac.in/courses/112/105/112105046/>
4. MOOC Courses - <https://www.mooc-list.com/tags/pneumatics>
5. <https://ocw.mit.edu/courses/mechanical-engineering/2-000-how-and-why-machines-work-spring->

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 11 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 |
| CO 12 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 |
| CO 13 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 |
| CO 14 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 |
| CO 15 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 20 | 20 | 20 | 40 |
| Understand | 20 | 20 | 20 | 40 |
| Apply | 10 | 10 | 10 | 20 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |

| | | | | | | |
|------------------|---------------------------------------|------------------------------|---|---|---|---|
| 20MEE05 | DESIGN FOR MANUFACTURING AND ASSEMBLY | | L | T | P | C |
| | | | 3 | 0 | 0 | 3 |
| Nature of Course | | Professional Elective (PE) | | | | |
| Pre requisites | | Manufacturing Technology 1&2 | | | | |

Course Objectives

The course is intended to

1. Know the concept of design for manufacturing, assembly.
2. Know the computer application in design for manufacturing and assembly.
3. Discuss various fundamentals of assembly and design recommendations for product development
4. Understand how DFM&A impacts product cost and quality
5. Optimize tolerances to enhance manufacturability

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|---|---------------|
| CO 1 | Outline the appropriate design for economical production and select the materials. | Remembering |
| CO 2 | Select between various machining and metal joining processes. | Understand |
| CO 3 | Apply a systematic understanding of knowledge in the field of metal casting and forging. | Applying |
| CO 4 | Fabricate basic parts and assemblies using powered and non – powered machine shop equipment in conjunction with mechanical documentation. | Understand |
| CO 5 | Integrate the knowledge of compliance analysis and interference analysis for assembly. | Applying |

Course Contents

UNIT I INTRODUCTION

9

Design philosophy – steps in design process – general design rules for manufacturability – basic principles of designing for economical production – creativity in design, application of linear & non-linear optimization techniques. Materials: Selection of materials for design – developments in material technology – criteria for material selection – material selection interrelationship with process selection – process selection charts.

UNIT II MACHINING PROCESS & METAL JOINING

9

Machining process: Overview of various machining processes – general design rules for machining - dimensional tolerance and surface roughness – design for machining – ease – redesigning of components for machining ease with suitable examples, general design recommendations for machined parts. Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines – pre and post treatment of welds – effects of thermal stresses in weld joints – design of brazed joints.

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UNIT III METAL CASTING & FORGING**9**

Metal casting: Appraisal of various casting processes, selection of casting process, - general design considerations for casting – casting tolerances – use of solidification simulation in casting design –

product design rules for sand casting.

Forging: Design factors for forging – closed die forging design –parting lines of dies – drop forging die design – general design recommendations.

UNIT IV EXTRUSION AND SHEET METAL WORK**9**

Design guidelines for extruded sections - design principles for punching, blanking, bending, and deep drawing – Keeler Goodman forming line diagram – component design for blanking.

UNIT V ASSEMBLY**9**

Compliance analysis and interference analysis for the design of assembly – design and development of features for automatic assembly – Computer Applications for DFMA

Total : 45 Periods**Text Books**

1. A K Chitale and R C Gupta, "Product Design and Manufacturing", PHI, New Delhi, 2013.

Reference Books

1. George E Deiter, "Engineering Design", Mc Graw Hill International, 2012.
2. Boothroyd G, "Product design for Manufacture and Assembly", First Edition, Marcel Dekker Inc, New York, 1994.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|----------|----------|----------|-----------------|----------|----------|----------|--------------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 3 | 3 | | 3 | | | | | | | 3 | 3 | 3 |
| CO 2 | 3 | 3 | 3 | | 3 | | | | | | | 3 | 3 | 3 |
| CO 3 | 3 | 3 | 3 | | 3 | | | | | | | 3 | 3 | 3 |
| CO 4 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 |
| CO 5 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|-----------------------------|-----------------------------|--------------|--------------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|--|----------|----------|----------|----------|
| 20MEE06 | OPTIMIZATION TECHNIQUES IN ENGINEERING DESIGN | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Numerical Methods | | | | |

Course Objectives

The course is intended to

1. Understand the various optimization parameters.
2. Classify the optimization techniques.
3. Use traditional optimization methods.
4. Demonstrate various modern optimization techniques.
5. Apply Optimization tools to solve practical problems.

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO 1 | Explain the various optimization parameters | Understand |
| CO 2 | Summarize optimization techniques | Understand |
| CO 3 | Experiment with traditional optimization methods | Applying |
| CO 4 | Choose various modern optimization techniques. | Applying |
| CO 5 | Solve the practical problems with optimization tools | Applying |

Course Contents

UNIT I INTRODUCTION TO OPTIMIZATION

9

Introduction, Historical Development, Engineering Applications of Optimization, Design Vector, Statement of an Optimization Problem, Design Constraints, Constraint Surface, Objective Function, Objective Function Surfaces, Classification of Optimization Problems.

UNIT II CLASSICAL OPTIMIZATION TECHNIQUES

9

Single-Variable Optimization, Multivariable Optimization with No Constraints, Multivariable Optimization with Equality Constraints, Multivariable Optimization with Inequality Constraints, Convex Programming Problem.

UNIT III TRADITIONAL OPTIMIZATION METHODS

9

Linear Programming, Definitions and Theorems, Simplex Algorithm, Duality in Linear Programming, Transportation Problem, Quadratic Programming, Random Search Methods, Steepest Descent (Cauchy) Method.

UNIT IV MODERN METHODS OF OPTIMIZATION**9**

Genetic Algorithms, Simulated Annealing, Particle Swarm Optimization, Ant Colony Optimization, Optimization of Fuzzy Systems, Neural-Network-Based Optimization.

UNIT V PRACTICAL APPLICATION OF OPTIMIZATION**9**

Reduction of Size of an Optimization Problem, Fast Reanalysis Techniques, Derivatives of Static Displacements and Stresses, Derivatives of Eigen values and Eigenvectors, Sensitivity of Optimum Solution to Problem Parameters.

Total : 45 Periods**Text Books**

1. S S Rao, "Engineering Optimization: Theory and Practice ", Fourth Edition , John Wiley & Sons, 2009.
2. A. Ravindran, G. V. Reklaitis, K. M. Ragsdell, "Engineering Optimization: Methods And Applications", John Wiley & Sons, 2006

Reference Books

1. G. V. Reklaitis, Gintaras Victor Reklaitis, A. Ravindran, K. M. Ragsdell, Kenneth Martin Ragsdell, "Engineering Optimization: Methods and Applications", Wiley, 1983.
2. Kalyanmoy Deb, " Multi-Objective Optimization using Evolutionary Algorithms", John Wiley & Sons, 2001.
3. Kalyanmoy Deb, "Optimization for Engineering Design: Algorithms and Examples", PHI Learning Pvt. Ltd., 2012.

Additional References

1. **NPTTEL** - <https://nptel.ac.in/courses/105/108/105108127/>
2. **MOOC Courses** - <https://www.mooc-list.com/tags/optimization>
3. [ocw.mit.edu](https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6.034-joint-optimization-in-electrical-engineering-and-computer-science/lecture-videos/) › electrical-engineering-and-computer-science › lecture-videos
4. [www.edx.org](https://www.edx.org/course/mathematical-optimization-for-engineers) › course › mathematical-optimization-for-engineers

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|----------|----------|----------|-----------------|----------|----------|----------|--------------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 3 | 2 | 2 | 3 | | | | | | | 2 | 3 | 3 |
| CO 2 | 3 | 3 | 2 | 2 | 3 | | | | | | | 2 | 3 | 3 |
| CO 3 | 3 | 3 | 2 | 2 | 3 | | | | | | | 2 | 3 | 3 |
| CO 4 | 3 | 3 | 2 | 2 | 3 | | | | | | | 2 | 3 | 3 |
| CO 5 | 3 | 3 | 3 | 3 | 3 | | | | | | | 2 | 3 | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|-------------------------------|---|---|---|---|
| 20MEE07 | COMPUTATIONAL FLUID DYNAMICS | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Fluid mechanics and machinery | | | | |

Course Objectives

The course is intended to

1. Introduce various flow equations
2. familiarize numerical modelling and its role in flow problems
3. Understand various discretization methods in finite difference methods.
4. Solve finite volume method problems for convective and diffusion
5. Interpret the different types of ignition systems of the automotive

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|-------|---|---------------|
| CO 1 | Derive the governing equations and boundary conditions for Fluid dynamics | Understand |
| CO 2 | Solve partial differential equations | Understand |
| CO 3 | Analyze Finite difference method for Explicit and Implicit problems | Understand |
| CO 4 | Analyze Finite volume method for Convective diffusion | Applying |
| CO 5 | Explain the Turbulence models and Mesh generation techniques | Applying |

Course Contents

UNIT I INTRODUCTION TO CFD 9

Introduction to computational fluid mechanics, Application, merits, demerits, Continuity, Momentum, Energy equations, Boundary Conditions, Initial Conditions.

UNIT II MATHEMATICAL MODELLING 9

Partial Differential Equations(PDEs) , Hyperbolic, Parabolic, Elliptic equations, Well-posed problems

UNIT III FINITE DIFFERENCE METHOD 9

Introduction to Finite Differences, Differential equations, Explicit and Implicit approaches, Error, Stability analysis

UNIT IV FINITE VOLUME METHOD 9

Introduction to finite volume method, 1D,2D,3D steady state diffusion with problems, 1D convection-diffusion problems, Various discretization schemes,

UNIT V GRID GENERATION AND TURBULENCE MODELLING**9**

Grid generation techniques, structured, unstructured grids, staggered and adaptive grids, SIMPLE, PISO Algorithms. Turbulence modelling Techniques, k -epsilon, k -omega, Reynolds stress equation model (RSM), SST (Shear Stress Transport) model.

Total : 45 Periods**Text Books**

1. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd. Second Edition, 2007.
2. John David Anderson, "Computational Fluid Dynamics The Basics with Applications" McGraw-Hill, 2009.

Reference Books

1. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004.
2. Chung, T.J. "Computational Fluid Dynamics", Cambridge University, Press, 2012.
3. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 2017.

Additional References

1. **NPTEL** - <https://nptel.ac.in/courses/112/105/112105045/>
2. **MOOC Courses** - <https://www.mooc-list.com/tags/fluid-dynamics>
3. <https://ocw.mit.edu/courses/mechanical-engineering/2-29-numerical-fluid-mechanics-spring-2015/>
4. **Virtual laboratory** – <http://users.metu.edu.tr/csert/virtualFlowLab/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|---------------|---|---|---|-----------------|---|---|---|--------------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 3 | 2 | 2 | 2 | | | | | | | 2 | 3 | 3 |
| CO 2 | 3 | 3 | 2 | 2 | 2 | | | | | | | 2 | 3 | 3 |
| CO 3 | 3 | 3 | 2 | 2 | 2 | | | | | | | 2 | 3 | 3 |
| CO 4 | 3 | 3 | 2 | 2 | 2 | | | | | | | 2 | 3 | 3 |
| CO 5 | 3 | 3 | 2 | 2 | 2 | | | | | | | 2 | 3 | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|---|----------|----------|----------|----------|
| 20MEE08 | ENGINEERING TRIBOLOGY | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Core (PE) | | | | |
| Pre requisites | Kinematics of Machinery, Design of Machine Elements | | | | |

Course Objectives

1. To impart knowledge on theories of friction and wear
2. To acquire the concept of surface interaction and measurement.
3. To understand the properties of bearing material and lubricants.
4. To understand the analytical behaviour of hydrostatic and squeeze film lubrication
5. To learn the different types of hydrodynamic bearings and design of bearings based on analytical /theoretical approach

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---------------|--|----------------------|
| CO 1 | Apply theories of friction and wear to various practical situations by analysing the physics of the process | Remembering |
| CO 2 | Explain the various surface measurement techniques and effect of surface texture on tribological behaviour of a surface. | Understand |
| CO 3 | Select materials and lubricants to suggest a tribological solution to particular situation | Understand |
| CO 4 | Explain the hydrostatic and squeeze film lubrication | Understand |
| CO 5 | Design a hydrodynamic bearing using various bearing charts | Applying |

Course Contents**UNIT I FRICTION AND WEAR****9**

Friction, theories of friction, Wear, types of wear, theories of wear, genesis of friction, instabilities and stick-slip motion.

UNIT II SURFACE INTERACTION AND MEASUREMENT**9**

Friction control, Surface texture and measurement, wear prevention, Surface treatments, surface modifications, surface coating.

UNIT III LUBRICATION OF BEARINGS**9**

Tribological properties of bearing materials and lubricants. Reynolds's equation and its limitations, idealized bearings, infinitely long plane pivoted and fixed show sliders, infinitely long and infinitely short (narrow) journal bearings, lightly loaded infinitely long journal bearing (Petroff's solution), Finite Bearings.

UNIT IV HYDROSTATIC AND SQUEEZE FILM LUBRICATION**9**

Hydrostatic, squeeze film Circular and rectangular flat plates, variable and alternating loads, piston pin lubrications, application to journal bearings..

UNIT V ELASTO HYDRODYNAMIC LUBRICATION**9**

Elasto-hydrodynamic lubrication – pressure viscosity term in Reynolds's equation, Hertz' theory, Ertel- Grubin equation, Design of hydrodynamic journal bearings lubrication of spheres, gear teeth and rolling element bearings, Air lubricated bearings, Tilting pad bearings.

Total : 45 Periods**Text Books**

1. Majumdar, B C., "Introduction to Tribology of Bearings", S.Chand & Company Ltd., New Delhi, 2008.
2. Basu, S K., Sengupta, S N & Ahuja, B B., "Fundamentals of Tribology", Prentice –Hall of India Pvt Ltd, New Delhi, 2005
3. Alastair, C. and Mc Ettles, C M., "Basic Lubrication Theory", Ellis Horwood, 1981

Reference Books

1. Stachowiak, G W. and Batchelor, A W., "Engineering Tribology", Butterworth- Heinemann, UK, 2005
2. Neale M.J (Editor), "The Tribology Handbook", Newnes. Butter worth Heinemann, U.K., 2016.
3. Stolarski, T A., "Tribology in Machine Design", Butterworth-Heinemann, UK, 2000.
4. Bharath Bhushan, "Introduction to Tribology", John Wiley & Sons, 2013.

Additional References

1. <https://books.google.co.in/books?isbn=1420050478>
2. <s1.downloadmienphi.net/file/downloadfile9/195/1344905.pdf>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | | 2 | | | | | | | | 3 | 3 | |
| CO 2 | 3 | 2 | | 2 | | | | | | | | 3 | 3 | |
| CO 3 | 3 | 2 | | 2 | | | | | | | | 3 | 3 | |
| CO 4 | 3 | 2 | | 2 | | | | | | | | 3 | 3 | |
| CO 5 | 3 | 2 | | 2 | | | | | | | | 3 | 3 | |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|----------------------------|---|---|---|---|
| 20MEE09 | MECHANICAL VIBRATIONS | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Nil | | | | |

Course Objectives

The course is intended to

1. Understand the Fundamentals of Vibration and its practical applications
2. Understand the sources of vibration and noise in automobiles
3. Making design modifications to reduce the vibration and noise and improve the life of the components
4. Understand the working principle and operations of various vibrations measuring instruments
5. Understand the various Vibration control strategies

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|-------|---|---------------|
| CO 1 | Select particular method of vibration measurement based on the operating condition and environment | Understand |
| CO 2 | Analyze the Single Degree, Two Degree freedom and Control the vibrations of equipment's used for various applications | Understand |
| CO 3 | Analyze the Multi degree of Freedom Systems and continuous systems. | Apply |
| CO 4 | Know the concepts of vibration control | Remembering |
| CO 5 | Study the experimental methods in vibration analysis | Remembering |

Course Contents

UNIT I FUNDAMENTALS OF VIBRATION

9

Introduction -Sources of Vibration-Mathematical Models- Displacement, velocity and Acceleration- Review of Single Degree Freedom Systems -Response to Arbitrary and non- harmonic Excitations – Transient Vibration

UNIT II TWO DEGREE FREEDOM SYSTEM

9

Introduction-Free Vibration of Un damped and Damped- Forced Vibration with Harmonic Excitation System –Coordinate Couplings and Principal Coordinates

UNIT III MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM

9

Multi Degree Freedom System –Influence Coefficients and stiffness coefficients- Flexibility Matrix and Stiffness Matrix – Eigen Values and Eigen Vectors-Matrix Iteration Method –Approximate Methods: Dunkerley, Rayleigh, and Holzer Method - Geared Systems - Continuous System: Vibration of String, Shafts and Beams

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UNIT IV VIBRATION CONTROL**9**

Specification of Vibration Limits –Vibration severity standards- Vibration as condition Monitoring tool-Vibration Isolation methods- -Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber- Damped Vibration absorbers-Static and Dynamic Balancing-Balancing machines-Field balancing – Vibration Control by Design Modification- - Active Vibration Control

UNIT V EXPERIMENTAL METHODS IN VIBRATION ANALYSIS**9**

Vibration Analysis Overview - Experimental Methods in Vibration Analysis.-Vibration Measuring Instruments -Selection of Sensors- Accelerometer Mountings. –Vibration Exciters-Mechanical, Hydraulic, Electromagnetic and Electrodynamics –Frequency Measuring Instruments-. System Identification from Frequency Response -Testing for resonance and mode shapes

Total : 45 Periods**Text Books**

1. Mechanical Vibrations, Singiresu S. Rao, Prentice Hall; 5th Edition 2011
2. Rao.S.S, “Mechanical Vibrations”, 5th Edition, Pearson Education Inc. Delhi 2010

Reference Books

1. Rao, S.S., “Mechanical Vibrations”, 5th Edition, Addison Wesley Longman, New York, 2010
2. Thomson, W.T., “Theory of Vibration with Applications”, 5th Edition, Pearson, 2008
3. Rao, J.S. and Gupta, K., “Introductory Course on Theory and Practice Mechanical Vibration”, New Age International (P) Ltd., New Delhi, 1999.
4. Den Hartog, J.P. “Mechanical Vibrations”, Dover Publications, New York, 1990.

Additional References

1. **NPTTEL** - <https://nptel.ac.in/courses/112/103/112103111/>
2. **MOOC Courses** - <https://www.mooc-list.com/tags/vibrations>
3. <https://ocw.mit.edu/courses/mechanical-engineering/2-003sc-engineering-dynamics-fall-2011/mechanical-vibration/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|---------------|---|---|---|-----------------|---|---|---|--------------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 6 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 2 |
| CO 7 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 2 |
| CO 8 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 2 |
| CO 9 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 2 |
| CO 10 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 2 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|----------------------------|---|---|---|---|
| 20MEE10 | DESIGN OF PRESSURE VESSELS | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Nil | | | | |

Course Objectives

The course is intended to

1. Educate the means of flow distribution and stress analysis in pressure vessels.
2. Student are able to understand the design consideration of pressure vessel.
3. Student are able to design the support of the pressure vessel
4. Student are able to design nozzle for pressure vessel
5. Student are able to design piping system for pressure vessel

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|-------|--|---------------|
| CO 1 | Relate the basics of Pressure vessel design. | Understand |
| CO 2 | Familiarize with different types of stresses and their effects in pressure vessel. | Understand |
| CO 3 | Equip with the Pressure vessel design | Understand |
| CO 4 | Recognizing the failure in Pressure vessel. | Remembering |
| CO 5 | Expose to the concept of piping layout and the stresses acting on it. | Remembering |

Course Contents

UNIT I INTRODUCTION 9

Methods for determining stresses – Terminology and Ligament Efficiency– Applications

UNIT II STRESSES IN PRESSURE VESSELS 9

Introduction – Stresses in a circular ring, cylinder – Membrane stress Analysis of Vessel Shell components –Cylindrical shells, spherical Heads, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.

UNIT III DESIGN OF PRESSURE VESSELS 9

Design of truss and supports for vertical vessels – stress concentration invariable Thickness sections such as cylindrical vessel, circular hole, and elliptical openings. Theory of Reinforcement – pressure vessel Design

UNIT IV BUCKLING AND FRACTURE ANALYSIS IN PRESSURE VESSELS**9**

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

UNIT V PIPING**9**

Introduction – Flow diagram – piping layout and piping stress analysis

Total : 45 Periods**Text Books**

1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors, 2001
2. Brownell L.E and Young E.D. "Process equipment design, Willey Eastern Ltd. India 2009

Reference Books

1. Smith P, "Fundamentals of Piping Design", Elsevier. 2007
2. ASME Pressure Vessel and Boiler code, Section VIII Div 1 & 2, 2003 American standard code for pressure piping, B 31.1
3. William. J., Bees, "Approximate Methods in the Design and Analysis of Pressure Vessels and Piping", Pre ASME Pressure Vessels and Piping Conference, 1997.
4. Stanley, M. Wales, "Chemical process equipment, selection and Design", Butterworths series in Chemical Engineering, 1988
5. Henry H. Bedner, "Pressure Vessels, Design Hand Book", CBS publishers and Distributors, 1987

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 2 | 1 | 1 | 3 | 3 | | | | | | | 1 | 2 | 1 |
| CO 2 | 2 | 1 | 1 | 3 | 3 | | | | | | | | 2 | 1 |
| CO 3 | 2 | 1 | 1 | 3 | 3 | | | | | | | | 2 | 1 |
| CO 4 | 2 | 1 | 1 | 3 | 3 | | | | | | | | 2 | 1 |
| CO 5 | 2 | 1 | 1 | 3 | 3 | | | | | | | | 2 | 1 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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Stream - II

Thermal Engineering

| | | | | | |
|------------------|----------------------------------|---|---|---|---|
| 20MEE21 | NON- CONVENTIONAL ENERGY SOURCES | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Nil | | | | |

Course Objectives

The course is intended to

1. Learn about solar radiation and solar thermal system application.
2. Provide knowledge on fundamentals and sizing of solar photo voltaics.
3. Study about the potential and energy conversion process of Wind Energy and Bio Energy.
4. Impart fundamental knowledge about Ocean Thermal Energy and Geothermal Energy.
5. Provide knowledge about the recent trends in Hydrogen and Fuel Cells.

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|---|---------------|
| CO 1 | Demonstrate knowledge of energy resources, energy conservation and solar energy fundamentals. | Understand |
| CO 2 | Apply the solar energy principle in solar collectors and its applications. | Apply |
| CO 3 | Explain the working concept of wind energy and bio energy conversion systems. | Understand |
| CO 4 | Express the working of Geothermal and Ocean Energy conversion systems. | Remember |
| CO 5 | Select the hydrogen and fuel cells energy field for various application | Apply |

Course Contents

UNIT I ENERGY CONSERVATION AND SOLAR ENERGY 9

Energy sources and Conservation: Introduction, Conventional energy sources, Classification, Importance of renewable energy sources, energy alternatives, need and Principles of energy conservation. Fundamentals of Solar Energy: Site selection for solar plant, Solar constant and solar radiation geometry, Solar time and day length, Measurement of solar radiation - Pyranometer, Pyrheliometer and Sunshine recorder.

UNIT II SOLAR ENERGY COLLECTION DEVICES AND APPLICATION 9

Flat plate collector and types, Losses through flat plate collector Air collectors and types, Classification of concentrating collectors. Methods of storing solar energy - sensible heat storage, latent heat storage, Applications -Solar water heating, Solar Refrigeration, Solar thermal power generation, Solar distillation. Operating principle, Photovoltaic cell.

UNIT III WIND ENERGY AND BIOMASS ENERGY CONVERSION 9

Introduction, Site selection for wind energy plant, General formula - Betz limit - classification and working of horizontal axis wind turbine - vertical axis Wind turbines, Types of blades, Wind energy conversion systems, and environmental consideration. Pyrolysis of Biomass to produce solid, liquid and gaseous fuels, Classification of biogas plants, Types of Digesters – Floating drum, fixed dome type biogas plants, comparison; variations of Biogas models – Pragati biogas model, Jwala biogas model, and Deenabandhu biogas model.

UNIT IV GEOTHERMAL AND OCEAN ENERGY CONVERSION**9**

Introduction, geothermal sources - Hydrothermal resources, geo pressurized resources, vapour dominated system, applications of geothermal energy, environmental consideration. Ocean thermal energy conversion, OTEC conversion technologies, Environmental impacts of OTEC; Tidal energy conversion - Principles of tidal and wave power generation, tidal energy conversion - single basin and double basin systems.

UNIT V HYDROGEN AND FUEL CELLS**9**

Basic properties of hydrogen. Technologies of hydrogen production. Transformation of hydrogen energy - hydrogen economy. Fuel cells - operating principle, Alkaline Fuel cells (AFC), Phosphoric Acid Fuel cells (PAFC), Polymer Electrolyte Membrane Fuel cells (PEMFC), Specific characteristics, advantages and applications.

Total : 45 Periods**Textbooks:**

1. G.D, Rai, Non-conventional Energy Sources, Khanna Publishers, 5th Edition, 2011.
2. B.H.Khan, Non-conventional Energy Sources, TMH, 3rd Edition, 2016.

Reference books:

1. S.P.Sukhatme and J.K Nayak, Solar Energy Principles of Thermal Collection and Storage, TMH, 3rd edition, 2008.
2. W.R.Murphy & G.Mckay, Energy Management, Butterworth, London, 2nd Edition, 2007.
3. Twidell, J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 2006

Additional References

1. <https://nptel.ac.in/courses/121/106/121106014/>
2. https://swayam.gov.in/nd1_noc20_ge06

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 1 | | | | | 2 | | | | | | 3 | |
| CO 2 | 2 | 3 | | | | | 1 | | | | | | 3 | |
| CO 3 | 3 | 1 | | | | | 2 | | | | | | 3 | |
| CO 4 | 3 | 1 | | | | | 2 | | | | | | 3 | |
| CO 5 | 3 | 1 | | | | | 2 | | | | | | 3 | |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |


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| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 20 | 10 | 20 | 20 |
| Understand | 30 | 20 | 10 | 40 |
| Apply | | 20 | 20 | 40 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|-------------------------|---|---|---|---|
| 20MEE22 | POWER PLANT ENGINEERING | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of course | Professional Elective | | | | |
| Pre requisites | Thermal Engineering | | | | |

Course Objectives

The course is intended to

1. Provide the knowledge on various power plants and its sub systems.
2. Develop skills in finding the performance of a gas cooled reactor and all other power plants.
3. Explain advances in nuclear and MHD power plants.
4. Understand the environmental issues related to the power plants.
5. Explain economic analysis of power plants.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO 1 | Demonstrate the knowledge on Steam power plants and its sub systems. | Understand |
| CO 2 | Identify the various systems and components in diesel and gas power plants. | Understand |
| CO 3 | Indicate the suitable components for nuclear power plants and hydel power plants | Understand |
| CO 4 | Choose the components of power plants using thermodynamic analysis to predict the performance of the power plants. | Apply |
| CO 5 | Find the capital cost and operating costs of a power plant and familiar about environmental pollution. | Understand |

Course Contents

UNIT – I STEAM POWER PLANT

9

Layout of Steam power plant - Components, Selection. Fuel and Ash Handling - Combustion Equipment for burning coal, Mechanical Stokers, Pulveriser, Electrostatic Precipitator, and Mechanical Collectors. Draught -different types. Cooling Towers.

UNIT – II DIESEL ENGINE AND GAS TURBINE POWER PLANTS

9

Diesel Power Plant: Essential components of diesel power plant, Operation of diesel power plant, Plant layout with auxiliaries. Gas Turbine Plant: Requirements, Functions, Classification, Construction, and Layout with auxiliaries.

UNI – III HYDRO ELECTRIC AND NUCLEAR POWER PLANTS

9

Hydro Electric Power Plant: Selection of site for power plant, Typical layouts, Elements of plant, Spill ways, Surge tank, Draft tube, Classification of Hydroelectric power plants, Hydrology. Nuclear Power Plants: Requirements, Functions, Nuclear fuel, Breeding and Fertile materials, Nuclear reactor, Reactor operation, Types Of Reactors - Pressurized water reactor, Boiling water reactor, Fast breeder reactor, Homogeneous reactor.


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UNI – IV NON CONVENTIONAL POWER GENERATION AND DIRECT ENERGY CONVERSION SYSTEMS**9**

Non-Conventional Power Generation: Solar, Wind, Tidal, Ocean energy conversion, Geothermal, and biogas power plants. Direct energy conversion systems: Thermoelectric conversion system, Thermionic conversion system, Magneto Hydrodynamic systems and Fuel cells

UNIT– V POWER PLANT ECONOMICS AND POLLUTIONS**9**

Load curves, Load duration curve, Definitions of connected load, Maximum demand, Demand factor, Load factor, Plant capacity factor, Plant use factor, Diversity factor, Cost Analysis, Power plant pollution- Pollutions from Thermal and Nuclear Power plants.

Total : 45 Periods**Text books:**

1. R.K.Rajput, A Text Book of Power Plant Engineering, Laxmi Publications, 3rd edition, 2014.
2. Arora and S. Domkundwar, A Course in Power Plant Engineering, Dhanpat Rai and Co, 3rd Edition, 2012.

Reference books:

1. P.K.Nag, Power Plant Engineering, TMH, 2nd edition, 2006.
2. K.K Ramalingam, Power plant Engineering, Scitech Publishers. 2nd edition, 2010.
3. Dr.P.C Sharma, power plant engineering, Sk Kataria and sons publishers, 8th Edition, 2011.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 1 | | | | | 2 | | | | | | 3 | |
| CO 2 | 3 | 1 | | | | | 2 | | | | | | 3 | |
| CO 3 | 3 | 1 | | | | | 2 | | | | | | 3 | |
| CO 4 | 2 | 3 | | | | | 1 | | | | | | 3 | |
| CO 5 | 2 | 3 | | | | | 1 | | | | | | 3 | |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |


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| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|----------------------------------|---------------|--------------|------------------------|
| Bloom's Category | Internal Assessment Examinations | | | Final Examination (60) |
| | IAE – 1 (7.5) | IAE – 2 (7.5) | IAE – 3 (10) | |
| Remember | 20 | 20 | 10 | 30 |
| Understand | 30 | 30 | 10 | 40 |
| Apply | | | 30 | 30 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|------------------------------------|---|---|---|---|
| 20MEE23 | REFRIGERATION AND AIR CONDITIONING | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Nil | | | | |

Course Objectives

The course is intended to

1. Provide the knowledge on air refrigeration systems
2. Know the refrigeration equipment and their application.
3. Impart the knowledge about Psychometrics and its applications
4. Realize the refrigeration equipment and their application.
5. Learn the parameters involved to select of air conditioning systems various applications

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|-------|---|---------------|
| CO 1 | Explain the components and working of vapour compression refrigeration systems | Understand |
| CO 2 | Study the various refrigeration equipment's and its importance. | Understand |
| CO 3 | Solve the psychometric problems in various applications | Apply |
| CO 4 | Demonstrate knowledge of air conditioning and equipment with control systems | Understand |
| CO 5 | Select the type of refrigeration and air conditioning for various applications. | Apply |

Course Contents

UNIT I REFRIGERATION CYCLES AND REFRIGERANTS

9

Review of thermodynamics, Principle of refrigeration, Reversed Carnot cycle, Air refrigeration cycles - Bell Coleman cycle, Simple vapour compression refrigeration cycle, Vapour absorption system, Refrigerants – properties and classification, Alternate refrigerants, Selection of refrigerants.

UNIT II REFRIGERATION EQUIPMENT

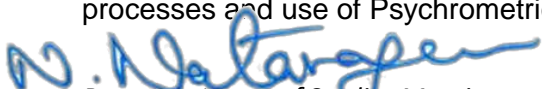
9

Refrigeration compressors - Reciprocating, rotary and centrifugal compressors, Evaporators flooded, dry expansion, shell and tube and double pipe evaporators, Condensers – air cooled, water cooled and evaporative condensers, Expansion devices - capillary tube and thermostatic expansion valve.

UNIT III AIR CONDITIONING SYSTEM AND PSYCHROMETRIC

9

The principle of air conditioning and human comfort - factors affecting human comfort, classification of air conditioning systems - Summer, winter and year-round air conditioning, working principle of window, split and central air conditioning, Psychrometric - properties, processes and use of Psychrometric charts.


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UNIT IV AIR CONDITIONING EQUIPMENT**9**

Air distribution and ventilation system, Equipment - chillers, air handling unit, air washers, filters types, Room dehumidifiers, desert coolers cooling and heating coils, Cooling tower -natural and mechanical draught system, Control system - pneumatic and electric system for air conditioning.

UNIT V APPLICATIONS OF REFRIGERATION AND AIR CONDITIONING SYSTEMS**9**

Preservation of different products - Food preservation , ice factory , domestic refrigerator, Applications of air conditioning - Commercial applications - Air conditioning of houses and offices, air conditioning of hospitals - Industrial applications - Refrigeration for liquefied natural gas - Transport Air-conditioning - Railway Air conditioning , Aircraft air conditioning.

Total : 45 Periods**Text books:**

1. C.P. Arora, "Refrigeration and Air Conditioning", The Mc Graw Hill Education, 3rd edition, New Delhi, 2008.
2. S.C. Arora and Domkundwar S., "Refrigeration and Air conditioning", 7th edition Dhanpat Rai & Sons, New Delhi, 2006.

Reference books:

1. Roy J. Dossat, "Principles of Refrigeration", 4th Edition, Pearson India, 2007.
2. Manohar Prasad, "Refrigeration and Air Conditioning", 3rd Edition, New Age International, New Delhi, 2015.
3. R. S. Khurmi, J. K. Gupta, "Textbook of Refrigeration And Air Conditioning", Revised edition, S. Chand, 2015.
4. S.S. Thipse, Refrigeration and Air Conditioning, 1st Edition, Jaico Publishing House, 2007.

Additional References

1. https://onlinecourses.nptel.ac.in/noc21_me85/preview
2. <https://nptel.ac.in/courses/112/107/112107208>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | | | | | 1 | | | | | | 3 | |
| CO 2 | 3 | 2 | | | | | 1 | | | | | | 3 | |
| CO 3 | 2 | 3 | 1 | | | | | | | | | | 3 | |
| CO 4 | 3 | 2 | | | | | 1 | | | | | | 3 | |
| CO 5 | 2 | 3 | | | | | 1 | | | | | | 3 | |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |


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| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 20 | 10 | 10 | 20 |
| Understand | 30 | 20 | 20 | 40 |
| Apply | | 20 | 20 | 40 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|----------------------------|----------|----------|----------|----------|
| 20MEE24 | TURBO MACHINES | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Nil | | | | |

Course Objectives

The course is intended to

1. Understand the basic types of Turbo Machines.
2. Understand the Working Principles of Reaction Turbines.
3. Gain some basic Concept of Reaction Turbines.
4. Know Classification and Principles of Hydraulic Turbines.
5. Learn analyze skill for Centrifugal Pumps performance.

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|-------|---|---------------|
| CO 1 | Understand the fundamental concepts of turbo machines | Understand |
| CO 2 | Apply Euler's equation for turbo machinery to analyse energy transfer in Parsons's turbines. | Apply |
| CO 3 | Understand the thermodynamic analysis of steam turbine and its types. | Understand |
| CO 4 | Evaluate the performance parameters of Hydraulic turbines by using velocity triangles. | Analyze |
| CO 5 | Familiarize the basic concepts of pumps and analyze the performance of Centrifugal Pumps . | Analyze |

Course Contents

UNIT I INTRODUCTION 9

Definition of turbo machine, parts of turbo machines, Comparison with positive displacement machines, Classification.

UNIT II REACTION TURBINE 9

Parsons's turbine, condition for maximum utilization factor, reaction staging.

UNIT III STEAM TURBINES 9

Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor.

UNIT IV HYDRAULIC TURBINES 9

Classification, various efficiencies. Pelton Wheel – Principle of working, velocity triangles, design parameters, maximum efficiency.

UNIT V CENTRIFUGAL PUMPS 9

Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Theoretical head – capacity relationship, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel.

Total : 45 Periods


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Text Books

1. An Introduction to Energy Conversion, Volume III, Turbo machinery V. Kadambi and Manohar Prasad New Age International Publishers reprint 2008.
2. Turbo machines M. S. Govinde Gowda and A. M. Nagaraj M. M. Publications 7th Ed, 2012.

Reference Books

1. S. M. Yahya, Turbines, Compressors & Fans Tata McGraw Hill Co. Ltd 2nd edition, 2002.
2. D. G. Shepherd, Principles of Turbo machines, The Macmillan Company 2001.
3. S. L. Dixon, Fluid Mechanics & Thermodynamics of Turbo machines, Elsevier 2005.

Additional References

1. Nptel - <https://nptel.ac.in/courses/112/106/112106303/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | 1 | | | | | | | | | | 3 | |
| CO 2 | 2 | 3 | 1 | | | | | | | | | | 3 | |
| CO 3 | 3 | 2 | 1 | | | | | | | | | | 3 | |
| CO 4 | 1 | 3 | 2 | | | | | | | | | | 3 | |
| CO 5 | 2 | 3 | 1 | | | | | | | | | | 3 | |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |


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| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 20 | 10 | 10 | 20 |
| Understand | 30 | 20 | 10 | 30 |
| Apply | | 20 | | 20 |
| Analyse | | | 30 | 30 |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|----------------------------------|---|---|---|---|
| 20MEE25 | GAS DYNAMICS AND JET PROPULSION | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Thermodynamics, Fluid Mechanics. | | | | |

Course Objectives

The course is intended to

1. Construct the basic Concepts of incompressible and compressible flow.
2. Learn the phenomenon of Flows through constant area ducts with heat transfer.
3. Study the flow parameters across the normal and oblique shocks.
4. Illustrate some basic knowledge about jet propulsion.
5. Explain Applications of Rocket Propulsions.

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|-------|---|---------------|
| CO 1 | Understand the concept of continuity, momentum and energy equations to compressible flows | Understand |
| CO 2 | Apply the Rayleigh and Fanno flow correlations for the compressible flow with a heat transfer condition. | Apply |
| CO 3 | Solve problems involving isentropic and non-isentropic flows including flows across normal and oblique shock waves. | Apply |
| CO 4 | Discuss the mechanism of jet propulsion and engines of aircrafts and rockets. | Understand |
| CO 5 | Analyze different types of rocket propulsion systems. | Analyse |

Course Contents

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS

9

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers

UNIT II FLOW THROUGH DUCTS

9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties – Use of tables and charts – Generalised gas dynamics.

UNIT III NORMAL AND OBLIQUE SHOCKS

9

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications.

UNIT IV JET PROPULSION

9

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

UNIT V SPACE PROPULSION**9**

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

Note: Use of Standard Gas Tables permitted

Total : 45 Periods

Text Books

1. Yahya, S.M. "Fundamentals of Compressible Flow", New Age International (P) Limited, New Delhi, 2004.
2. H. Cohen, G.E.C. Rogers and Saravanamutto, Gas Turbine Theory, Longman Group Ltd., 2001.

Reference Books

1. Sutton. G.P., "Rocket Propulsion Elements", John Wiley, New York, 2000,.
2. Ganesan. V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2010.
3. Radhakrishnan E. – 'Gas Dynamics' – Prentice-Hall of India Pvt. Ltd – 2004

Additional References

1. NPTEL - <https://nptel.ac.in/courses/112/106/112106166/>
2. Cohen. H., G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Longman Group Ltd.,

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | 1 | | | | | | | | | | 3 | |
| CO 2 | 2 | 3 | 1 | | | | | | | | | | 3 | |
| CO 3 | 2 | 3 | 1 | | | | | | | | | | 3 | |
| CO 4 | 3 | 2 | | | | | 1 | | | | | | 3 | |
| CO 5 | 2 | 3 | | | | | 1 | | | | | | 3 | |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |


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| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 20 | 10 | 10 | 10 |
| Understand | 30 | 10 | | 30 |
| Apply | | 30 | 20 | 40 |
| Analyse | | | 20 | 20 |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|-----------------------------|---|---|---|---|
| 20MEE26 | INTERNAL COMBUSTION ENGINES | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Thermal Engineering | | | | |

Course Objectives

The course is intended to

1. Learn about the combustion phenomenon in spark ignition engines.
2. Learn about the combustion phenomenon in compression ignition engines.
3. Study the causes, effects and control of pollutants from an Internal Combustion engine.
4. Provide the knowledge of alternate fuels in Internal Combustion engines.
5. Impart the knowledge on recent developments in Internal Combustion engines.

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|-------|---|---------------|
| CO 1 | Interpret the combustion phenomenon in spark ignition engines. | Understand |
| CO 2 | Explain the combustion phenomenon in compression ignition engines | Understand |
| CO 3 | Show the formation of emission and various methods to reduce emissions. | Remember |
| CO 4 | Identify the uses of alternate fuels in Internal Combustion engines. | Apply |
| CO 5 | Show the recent developments in Internal Combustion engines. | Understand |

Course Contents

UNIT I INTRODUCTION TO SPARK IGNITION ENGINES 9

Spark Ignition Engines Spark ignition engine- Mixture requirements - Feedback control - Carburetors-Fuel injection systems Mono point and Multipoint injection -Stages of combustion - Normal and Abnormal combustion Factors affecting knock-Combustion chambers.

UNIT II CI ENGINES AND TURBO CHARGING 9

Compression Ignition Engines States of combustion in C.I. Engine –Combustion knock in CI engines – Knock comparison in SI and CI Engines-Methods of controlling knock- Direct and indirect injection systems - Combustion chambers - Fuel spray behavior- spray structure, spray penetration, Turbo charging. Physical factors affecting ignition delay.

UNIT III EMISSION CONTROL 9

Pollutant Formation and Control Pollutant - Sources and types - formation of NO_x - Hydrocarbon emission mechanism - Carbon monoxide formation - Particulate emissions – Measurement of exhaust emissions-Methods of controlling emissions- Catalytic converters.

UNIT IV ALTERNATIVE FUELS 9

Alternative Fuels Bio-fuels: Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas – Properties – Suitability - Engine Modifications - Merits and Demerits as fuels. Biodiesel production process.


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UNIT V RECENT TRENDS IN IC ENGINES**9**

Recent Trends Lean Burn Engines - Stratified Charge Engines – Gasoline: Direct Injection Engine – Common rail Diesel injection system (CDRI)- Homogeneous charge compression ignition - Plasma Ignition – Ignition Measurement techniques.

Total : 45 Periods**Text Books**

1. Ganesan V., Internal Combustion Engines, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, 2007.
2. John B. Heywood, Internal Combustion Engine Fundamentals, Tata McGraw Hill Publishing Company Private limited., New Delhi, 2015.

Reference Books

1. H. N. Gupta Fundamentals of Internal Combustion Engineering, Prentice Hall of India Pvt Ltd, New Delhi, 2006.
2. R. B. Mathur and R. P. Sharmal Internal Combustion Engines, Dhanpat Rai Publications, 2008.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|---|---|---|-----------------|---|---|---|--------------|----|----|----|-------------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | | | | | 1 | | | | | | 3 | |
| CO 2 | 3 | 2 | | | | | 1 | | | | | | 3 | |
| CO 3 | 3 | 2 | | | | | 1 | | | | | | 3 | |
| CO 4 | 2 | 3 | | | | | 1 | | | | | | 3 | |
| CO 5 | 3 | 2 | | | | | 1 | | | | | | 3 | |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |


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| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 20 | 20 | 10 | 20 |
| Understand | 30 | 30 | 20 | 60 |
| Apply | | | 20 | 20 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|-----------------------------------|---|---|---|---|
| 20MEE27 | CRYOGENIC ENGINEERING | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective | | | | |
| Pre requisites | Thermodynamics, and Heat Transfer | | | | |

Course Objectives

The course is intended to

1. To understand the basic concepts of cryogenic systems
2. To gain the knowledge of air-liquefaction processes to practical situations.
3. To Interpret and analyze the separation of cryogenic gases techniques.
4. To understand the classification of Cryogenic refrigeration systems
5. To understand the various measuring flow techniques in cryogenic engineering

Course Outcomes

On successful completion of this course the student will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---------|--|---------------|
| CO1 | Illustrate the concepts of cryogenic systems. | Understand |
| CO2 | Relate air-liquefaction processes to practical situations. | Remember |
| CO3 | Interpret and analyze the separation of cryogenic gases techniques. | Apply |
| CO4 | Classify Cryogenic refrigeration systems. | Remember |
| CO5 | Apply the various measuring flow techniques in cryogenic engineering | Apply |

Course contents:

UNIT I INTRODUCTION TO CRYOGENICS 9

Insight on cryogenics - properties of cryogenic fluids - material properties at cryogenic temperatures - Applications of cryogenics in space programs, superconductivity, cryo metallurgy, biological and medical applications.

UNIT II REFRIGERATION AND LIQUEFACTION 9

Simple Linde cycle, Pre-cooled Joule-Thomson cycle, dual pressure cycle, Simon helium liquefier, classical cascade cycle, mixed-refrigerant cascade cycle.

UNIT III SEPARATION AND PURIFICATION SYSTEMS 9

Basics of Gas separation - Ideal separation of gases, characteristics of mixtures and the governing laws - T-C and H-C diagrams. Principle of Rectification - Rectification column - Theoretical plate calculations using McCabe-Thiele method, Gas purification.

UNIT IV STORAGE AND HANDLING OF CRYOGENIC REFRIGERANTS 9

Storage and Transfer systems, Insulation, Various Types of Insulation typically employed, Poly Urethane Foams (PUFs) and Polystyrene Foams (PSFs), Vacuum Insulation, and so on.

UNIT V STORAGE AND INSTRUMENTATION 9

Cryogenic Dewar vessels construction and design, cryogenic transfer Lines. Cryogenic insulation - vacuum, powder, multi layer, micro-sphere and foam-fibrous insulation - concept of vapour coated shields. Cryogenic instrumentation - temperature, flow and level measurements.

Total : 45 Periods


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Text Books

1. Traugott H.K. Frederking and S.W.K. Yuan, Cryogenics - Low Temperature Engineering and Applied Sciences, Yutopian Enterprises, 2005.
2. Arora, C.P., Refrigeration and Air-conditioning, Tata-McGraw Hill, 2008.

References

1. Robert W. Vance, Cryogenic Technology, John Wiley & Sons, Inc., New York, London.
2. A. R. Jha, Cryogenic Technology and Applications, Butterworth-Heinemann, 2005.
3. G.Venkatarathnam, Cryogenic Mixed Refrigerant Processes, Springer Publication, 2010.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|----------|----------|----------|-----------------|----------|----------|----------|--------------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | | | | | 1 | | | | | | 3 | |
| CO 2 | 3 | 2 | | | | | 1 | | | | | | 3 | |
| CO 3 | 2 | 3 | | | | | 1 | | | | | | 3 | |
| CO 4 | 3 | 2 | | | | | 1 | | | | | | 3 | |
| CO 5 | 2 | 3 | | | | | 1 | | | | | | 3 | |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|-----------------------------|---|-----------------------|-----------------------|--------------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 20 | 10 | 10 | 20 |
| Understand | 30 | 20 | 20 | 40 |
| Apply | | 20 | 20 | 40 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |

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| 20MEE28 | DESIGN OF HEAT EXCHANGERS | L | T | P | C |
|-------------------------|---------------------------|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| Nature of course | Professional Elective | | | | |
| Pre requisites | Courses on Heat Transfer. | | | | |

Course Objectives

The course is intended to

1. Complete knowledge of heat exchanger and its applications
2. Design and analyze the heat exchangers parallel flow, counter flow, multi pass and, cross flow heat exchanger
3. Design and analyze the Shell and tube heat exchanger
4. Enable to carry out the performance of heat exchanger
5. Design and analyze the cooling towers, condensers and evaporators

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|---|---------------|
| CO 1 | Understand the physics and the mathematical treatment of typical heat exchangers and types. | Understand |
| CO 2 | Employ LMTD and Effectiveness methods in the design of heat exchangers and analyze the importance of LMTD approach over AMTD approach | Apply |
| CO 3 | Analyze the performance of double-pipe and Shell & Tube heat exchangers. | Analyze |
| CO 4 | Design the cooling towers, condenser, and evaporators along with explain their technical features. | Analyze |
| CO 5 | Select and design of vaporizers and heat pipes for various application | Apply |

Course Contents

Unit – I CLASSIFICATION OF HEAT EXCHANGERS

9

Introduction, Recuperation & regeneration, Tabular heat exchangers, Double pipe, shell & tube heat exchanger, Plate heat Exchangers, Gasketed plate heat exchanger. Spiral plate heat exchanger. Introduction, Basic equations in design, Overall heat transfer coefficient, LMTD method for heat exchanger analysis, Parallel flow, Counter-flow. Multi-pass, cross flow heat exchanger design calculations.


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Unit – II DOUBLE PIPE AND SHELL & TUBE HEAT EXCHANGERS**9**

Double Pipe Heat Exchanger: Film coefficient for fluids in annulus, fouling factors, calorific temperature, Average fluid temperature, The calculation of double pipe exchanger, Double pipe exchangers in series parallel arrangements. Shell & Tube Heat Exchangers: Tube layouts for exchangers. Calculation of shell and tube heat exchangers, Shell side film coefficients, Shell side equivalent diameter.

Unit – III CONDENSER AND EVAPORATORS**9**

Condenser: Types of condenser, Estimation of heat transfer coefficient, Fouling factor, Friction factor-Design procedures, Wilson plots, Design of different types of condensers. Evaporator: Different types of evaporators, Design procedure, Factors affecting the evaporator capacity, Design of evaporative condensers.

Unit – IV COOLING TOWERS AND VAPORIZERS**9**

Cooling towers: The Lewis number and Classification of cooling towers, Cooling tower internals and the roll of fill, Design of cooling towers, Determination of the number of diffusion units, Calculation of cooling tower performance. Vaporizer: Vaporizing processes, Forced circulation vaporizing exchanger, Natural circulation vaporizing exchangers.

Unit – V HEAT PIPE**9**

Heat pipe: types and applications, operating principles, working fluids, wick structures, control techniques, pressure balance, maximum capillary pressure, liquid and vapor pressure drops, effective thermal conductivity of wick structures, determination of operating conditions. Heat pipe design – fluid selection, wick selection, material selection, preliminary design considerations, heat pipe design procedure, determination of heat pipe diameter, wick design, design problems

Total : 45 Periods**Text Books**

1. A.P.Fraas and M.N.Ozisick ,Heat Exchanger Design, John Wiely & sons, New York.2003.
2. Kakac, S., A.E. Bergles and F. Mayinger , Heat Exchangers: Selection, Rating, and Thermal Design, Second Edition - Hemisphere, 2001.

Reference Books

1. James R. Couper; W. Roy Penney, James R. Fair, Stanley M. Walas, Chemical Process Equipment: selection and design, Elsevier Inc., 2nd ed.2005.
2. Nicholas Cheremisiouff , Cooling tower , Ann Arbor Science pub. 2000.
3. Heat Pipes Dunn, P. D. and Reay, D. A., , Fourth Edition, Pergamon Press, 1994.

Additional / Web References

1. Standards of the Tubular Exchange Manufacturers Association, TMEA, New York.
2. Kern K.H., Process heat transfer, McGraw-Hill, 2002.
3. <https://nptel.ac.in/courses/112/105/112105248/>
4. <https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-me43/>
5. <https://nptel.ac.in/courses/103/103/103103027/>


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| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | |
| CO3 | 2 | 3 | 1 | | | | | | | | | | 3 | |
| CO4 | 1 | 3 | 2 | | | | | | | | | | 3 | |
| CO5 | | 3 | | | | 1 | 2 | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| blooms taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|----------------------------------|---------------|--------------|------------------------|
| Bloom's Category | Internal Assessment Examinations | | | Final Examination (60) |
| | IAE – 1 (7.5) | IAE – 2 (7.5) | IAE – 3 (10) | |
| Remember | 20 | 10 | 10 | 20 |
| Understand | 30 | | | 20 |
| Apply | | 20 | 20 | 30 |
| Analyze | | 20 | 20 | 30 |
| Evaluate | | | | |
| Create | | | | |


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| 20MEE29 | COGENERATION AND WASTE HEAT RECOVERY SYSTEMS | L | T | P | C |
|------------------|--|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| Nature of course | Professional Elective | | | | |
| Pre requisites | Thermal Engineering | | | | |

Course Objectives

The course is intended to

1. Gain fundamental knowledge in energy generation, heat transfer in thermal engineering
2. Analyze the basic energy generation cycles
3. Detail about the concept of cogeneration its types and probable areas of applications
4. Study the significance of waste heat recovery systems and carry out its economic analysis.
5. Reduce the impact global warming for betterment of living things to serve healthy life

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcomes | Bloom's Level |
|--------|---|---------------|
| CO 1 | Demonstrate the knowledge in energy generation and cogeneration technologies | Understand |
| CO 2 | Apply the energy generation principle and for various application | Apply |
| CO 3 | Understands the significance of waste heat recovery systems | Understand |
| CO 4 | Apply the concept of waste heat recovery for probable areas of applications, | Apply |
| CO 5 | Explain the economics in cogeneration, waste heat recovery systems and reduce the impact global warming | Understand |

Course Contents

UNIT – I COGENERATION AND TECHNOLOGIES

9

Introduction - Principles of Thermodynamics - Combined Cycles - Topping - Bottoming - Organic Rankine Cycles. Advantages of Cogeneration Technology- Steam turbine cogenerations systems – gas turbine cogeneration systems – reciprocating IC engines cogeneration systems.

UNIT – II COGENERATION APPLICATION

9

Cogeneration Application in various Industries like Cement, Sugar Mill, Paper Mill etc. Sizing of Waste Heat Boilers - Performance Calculations - Part Load Characteristics, Selection of Cogeneration Technologies.


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UNIT– III WASTE HEAT RECOVERY**9**

Introduction - Principles of Thermodynamics and Second Law - Sources of Waste Heat Recovery -

Systems-recuperators – Regenerators – economizers –thermic fluid heaters – Waste heat boilers – classification, location, service conditions, design Considerations, Heat pumps.

UNI – IV WASTE HEAT RECOVERY APPLICATIONS**9**

Applications in Industries - Fluidized Bed Heat Exchangers - Heat Pipe Exchangers - Heat Pumps - Thermic Fluid Heaters Selection of Waste Heat Recovery Technologies, Selection criteria for waste heat recovery technologies.

UNI – V ECONOMIC ANALYSIS**9**

Economic Analysis- Investment cost - economic concept - measure of economic performance – procedure for economic analysis – examples – Procedure for optimized system selection and design load curves – sensitivity analysis – regulatory and financial frame work for cogeneration and waste heat recovery systems.

Total : 45 Periods**Text Books:**

1. Hussam Jouhara, Waste Heat Recovery in Process Industries, Wiley-VCH; 1st edition, 2021.
2. Sengupta Subrata, Lee SS EDS, Waste Heat Utilization and Management, Hemisphere, Washington, 2002.

Reference Books:

1. De Nevers, Noel, Air Pollution Control Engineering, McGraw Hill, New York, 1995.
2. Energy Cogeneration Hand book, George Polimveros, Industrial Press Inc, New yark 2003.
3. Horlock JH., Cogeneration - Heat and Power, Thermodynamics and Economics, Oxford,1987.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|------------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | 1 | | | | | | | | | | 3 | |
| CO 2 | 2 | 3 | | | | | 1 | | | | | | 3 | |
| CO 3 | 3 | 2 | | | | | 1 | | | | | | 3 | |
| CO 4 | 3 | 1 | | | | | 2 | | | | | | 3 | |
| CO 5 | | 3 | | | | 1 | 2 | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | |


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| Formative assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Bloom's Level | Assessment Component | Marks | Total marks |
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|----------------------------------|---------------|--------------|------------------------|
| Bloom's Category | Internal Assessment Examinations | | | Final Examination (60) |
| | IAE – 1 (7.5) | IAE – 2 (7.5) | IAE – 3 (10) | |
| Remember | 20 | 10 | 10 | 30 |
| Understand | 30 | 20 | 20 | 40 |
| Apply | | 20 | 20 | 30 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|----------------------------|---|---|---|---|
| 20MEE30 | GAS TURBINES | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Nil | | | | |

Course Objectives**The course is intended to**

1. Understand the basic principles of Aircraft Applications
2. Carry out the Compressors Performance
3. Gain some basic knowledge about jet propulsion and Rocket Propulsions
4. Know about Cooling Systems and Air Pollution
5. Understand Power plant Components with Applications

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|-------|--|---------------|
| CO 1 | Illustrate to learn aircraft applications of power plant cycles | Understand |
| CO 2 | Summarize the compressors momentum and energy transfer in rotors | Understand |
| CO 3 | Calculate the performance Characteristics of axial and radial flow turbines. | Apply |
| CO 4 | Identify the combustors types and air pollution reduction | Apply |
| CO 5 | Explain matching procedure of power plant components | Understand |

Course Contents**UNIT I INTRODUCTION TO GAS TURBINES** 9

Power plant cycles for stationary and aircraft applications, component behaviors, Industrial applications, Marine and land transportation, Environmental issues, analysis of ramjet, turbojet and turbo-propeller, Inlets and nozzles.

UNIT II COMPRESSORS 9

Principle and operations of Centrifugal and axial flow compressors momentum and energy transfer in rotors, velocity diagrams, calculation of stage performance, compressibility effects, cascade testing and characteristics.

UNIT III AXIAL AND RADIAL FLOW TURBINE 9

Elementary theory of axial and radial flow turbine, Vortex theorem, choice of blade profile, Pitch and Chord Stage velocity diagrams, reaction stages, losses and coefficients, blade design principles, materials, testing and performance characteristics.

UNIT IV COMBUSTORS 9


Different types and flow pattern, material requirement and cooling systems, air pollution and reduction.

UNIT V MATCHING 9

Matching procedure of power plant components, engine off-design performance.

Total: 45 Periods


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Text Books

1. L.Cohen, H., Rogers, G.E.C., and Saravana muttoo, H.I.H., Gas Turbine Theory, Longman Group Ltd, 2009.
2. Yahya, S.H., Turbines, Compressors and Fans, Tata McGraw-Hill, 4th edition 2013.

Reference Books

1. Earl Logan, Jr., Hand book of Turbo machinery, Marcel Dekker, Inc., USA, 2 nd edition 2003.
2. Dixon, S.L., Fluid Mechanics and Thermodynamics of Turbo machinery, Pergamon Press, 7th edition 2014

Additional References

1. Meherwan p. Boyce ,Gas turbine engineering hand book, (2nd edition)
2. Nptel - <https://nptel.ac.in/courses/112/103/112103262/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | 1 | | | | | | | | | | 3 | |
| CO 2 | 2 | 3 | 1 | | | | | | | | | | 3 | |
| CO 3 | 2 | 3 | 1 | | | | | | | | | | 3 | |
| CO 4 | 3 | 2 | 1 | | | | | | | | | | 3 | |
| CO 5 | 3 | 2 | 1 | | | | | | | | | | 3 | |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |


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| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 20 | 10 | 10 | 20 |
| Understand | 30 | 20 | 20 | 40 |
| Apply | | 20 | 20 | 40 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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Stream - III

Manufacturing
Engineering

| | | | | | |
|------------------|----------------------------|---|---|---|---|
| 20MEE41 | ADDITIVE MANUFACTURING | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Nil | | | | |

Course Objectives

The course is intended to

1. Understand the concept of liquid, solid and powder based rapid prototyping techniques for rapid product development
2. Study the basic principle of Additive manufacturing processes.
3. Examine the extrusion and sheet lamination based of engineering process and its applications of AM
4. Understand the basic procedure of polyhedral B-rep modeling processes.
5. Know the principle, methods, possibilities and limitations as well as environmental effects of Additive Tooling Processes.

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|---|---------------|
| CO 1 | Apply the concept of liquid, solid and powder based rapid prototyping techniques for rapid product development. | Apply |
| CO 2 | Explain the basic Principle of AM technologies and their classification of additive manufacturing Processes. | Understand |
| CO 3 | Classify the extrusion and sheet lamination based of engineering process and its applications of AM | Understand |
| CO 4 | Illustrate the procedure of polyhedral B-Rep modeling and processing of STL files. | Understand |
| CO 5 | Execute the rapid tooling and software for rapid manufacturing to meet international needs. | Understand |

Course Contents

UNIT I INTRODUCTION

9

Rapid Product Development (RPD) –Product Development Cycle – Detail design– Prototype and tooling.

UNIT II ADDITIVE MANUFACTURING (AM)

9

Principle of AM technologies and their classification of AM systems–Stereo lithography systems – Selection of AM process; Issues in AM ; Emerging trends–Direct Metal Laser Sintering (DMLS) system – Principle – process parameters – process details – Applications.

UNIT III ENGINEERING PROCESS

9

Fusion Deposition Modeling –Laminated Object Manufacturing –Selective Laser Sintering- Three dimensional Printing-Reverse Engineering -Engineering applications–Medical applications.

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UNIT IV PROCESSING POLYHEDRAL DATA**9**

Polyhedral B-Rep modeling–STL format– Defects and repair of STL files– Processing STL files; Overview of the algorithms required for RP/ADT- slicing, support generation, feature recognition

UNIT V ADDITIVE TOOLING (AT)**9**

Introduction to AT–Indirect AT processes – Silicon rubber molding, Epoxy tooling, Spray metal tooling and Investment Casting; Direct AT processes – Laminated Tooling, Powder Metallurgy based technologies, Welding based technologies, Direct pattern making (Quick Cast, Full Mold Casting); Emerging Trends in AT

Total : 45 Periods**Text Books**

1. Ian Gibson, David W. Rosen, Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing” Springer, 2017
2. Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third edition, World Scientific Publishers, 2015.

Reference Books

1. C K Chua, K F Leong, C S Lim, Rapid Prototyping Principles and Applications, World Scientific, New Delhi, 2015.
2. Frank W.Liou, Rapid Prototyping and Engineering Applications, CRC Press, UK, 2017.
3. Terry Wohlers, Wohlers Report 2000, Wohlers Associates, USA, 2015.
4. Pham, D.T. and Dimov . S.S., “Rapid Manufacturing”, Springer-Verlag, London, 2017.

Additional References

1. <http://www.learnerstv.com/free-engineering-video-lectures- ltv234-page1.htm>
2. <http://www.learnerstv.com/free-engineering-video-lectures- ltv530-page1.htm>
3. NPTEL – <https://nptel.ac.in/courses/112/103/112103306/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|----------|----------|----------|-----------------|----------|----------|----------|--------------|-----------|-----------|-----------|-------------|----------|
| Cos | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 2 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 3 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 4 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 5 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|-----------------------------|-----------------------------|--------------|--------------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|------------------------------|----------|----------|----------|----------|
| 20MEE42 | INDUSTRIAL AUTOMATION | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Nil | | | | |

Course Objectives

The course is intended to

1. Understand the Fundamental concepts in manufacturing and automation
2. Identify the performance of assembly systems
3. Explain the automated material handling and features
4. Understand the basic structure of PLC
5. Describe the data acquisitions system

Course Outcome

After the successful completion of this course, the student will be able to:

| CO. No | Course Outcome | Bloom's Level |
|---------------|--|----------------------|
| CO 1 | Identify the various types and levels of automation strategy | Understand |
| CO 2 | Describe the Automated Assemble parts | Understand |
| CO 3 | Construct a program using PLC to problems pertaining to automation industries. | Understand |
| CO 4 | To introduce the PLC for Automation | Understand |
| CO 5 | Explain the applications of SCADA | Understand |

Course Contents

UNIT I MANUFACTURING AND AUTOMATION

9

Fundamental concepts in manufacturing and automation - Types and Levels of automation - automation strategies - automation migration strategy - Introduction to CIM - components of CIM - process design for CIM - Automated flow lines - methods of work transport - automated flow lines with and without storage buffers.

UNIT II AUTOMATED ASSEMBLY

9

Parts feeding devices - single and multi-station assembly machines - Performance and Economics of assembly systems - Feasibility study for assembly automation.

UNIT III AUTOMATED MATERIAL HANDLING AND INSPECTION

9

Automated guided vehicle system - components of AGVS - control system - routing - design features - AS/RS components - design of an AS/RS - Automated Inspection.

UNIT IV INTRODUCTION TO PROGRAMMABLE LOGIC CONTROLLERS

9

Definitions of PLC, basic structure of PLC, working principles, data storage methods, inputs / outputs flag processing's, types of variables, definition of firmware, software, programming software tool and interfacing with PC (RS232 & TCP-IP), methods of PLC programming (LD, ST, FBD & SFC),

UNIT V MODULE SUPERVISORY CONTROL & DATA ACQUISITIONS

9

Introduction to Supervisory control & data Acquisitions, distributed Control System (DCS): computer networks and communication in DCS. different BUS configurations used for industrial automation – GPIB, HART and OLE protocol, Industrial field bus –FIP (Factory Instrumentation Protocol),

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PROFIBUS (Process field bus), Bit bus. Interfacing of SCADA with controllers, Basic programming of SCADA, SCADA in PC based Controller / HMI

Total : 45 Periods

Text Books

1. Mikell P Groover, "Automation, Production Systems and Computer - Integrated Manufacturing", Pearson India Education Services, 2016.
2. Programmable Logic Controllers by W.Bolton

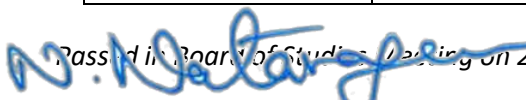
References Books

1. Roger Hannam, "Computer Integrated Manufacturing: From Concepts to Realisation", Prentice Hall, 1997.
2. Nanua Singh, "Systems Approach to Computer Integrated Design and Manufacturing", John Wiley and Sons, New York, 1996.
3. Introduction to Programmable Logic Controllers by Garry Dunning, 2nd edition, Thomson, ISBN:981-240-625-5

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | | | | 3 | | | 3 | | | | | | |
| CO 2 | 3 | | | | 3 | | | 3 | | | | | | |
| CO 3 | 3 | | | | 3 | | | 3 | | | | | | |
| CO 4 | 3 | | | | 3 | | | 3 | | | | | | |
| CO 5 | 3 | | | | 3 | | | 3 | | | | | | |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | 5 | |
| | Attendance | 5 | |

| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
|------------------|--|----------------|----------------|-------------------------|
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

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| | | | | | |
|-------------------------|---------------------------------------|----------|----------|----------|----------|
| 20MEE43 | MODERN MANUFACTURING PROCESSES | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Unconventional Machining Process | | | | |

Course Objectives

The course is intended to

1. Understand the classification of Various modern manufacturing processes
2. Study the different Mechanical Machining Processes
3. Familiarize the students In the field of Thermoelectric Machining Processes
4. Make the students to learn the various Electrochemical and Chemical Manufacturing Processes
5. Able the students to Understand the Micro Electro Mechanical Systems(MEMS) and Nanotechnology

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---------------|---|----------------------|
| CO 1 | Recall the classification of Various modern manufacturing processes | Remembering |
| CO 2 | Explain the Mechanical Machining Processes | Understand |
| CO 3 | Classify the Thermoelectric Machining Processes | Understand |
| CO 4 | Illustrate the various Electrochemical and Chemical Manufacturing Processes | Understand |
| CO 5 | Outline the Micro Electro Mechanical Systems and Nanotechnology. | Understand |

Course Contents

UNIT I INTRODUCTION

9

Need for modern manufacturing methods-Classification of Various modern manufacturing processes– Their selection for processing of different materials and the range of applications.

UNIT II MECHANICAL MACHINING PROCESSES

9

Abrasive Jet Machining (AJM) - Abrasive Finishing Processes – Magnetic Abrasive Finishing (MAF) - Water Jet Machining (WJM) - Abrasive Water Jet Machining (AWJM) - Process principle, Process equipment, Process Parameters, Process Capabilities, Applications, Limitations.

UNIT III THERMOELECTRIC MACHINING PROCESSES

9

Electric Discharge Machining (EDM), Electric Discharge Grinding, Wire Electric Discharge Machining, Laser Beam Machining (LBM), Plasma Arc Machining, (PAM), Electron Beam Machining(EBM) - Process principle, Process equipment, Process Parameters; Process Capabilities; Applications; Limitations.

UNIT IV ELECTROCHEMICAL AND CHEMICAL MANUFACTURING PROCESSES**9**

Fundamentals of Electrochemical Machining (ECM), Electromechanical Grinding (ECG) - Metal Removal rate in ECM, tooling, process variable applications, economic aspects of ECM. Fundamentals of Chemical Machining (CHM) - Principle of material removal-mask ants – etchants - process variables, advantages and applications.

UNIT V MEMS AND NANOTECHNOLOGY**9**

MEMS (Micro Electro Mechanical Systems) - Development and need of MEMS, overview of MEMS Technology with relevant non-conventional processes. Nano materials, Nano tubes and Nano wires, Nanofabrication.

Total : 45 Periods**Text Books**

1. V.K.Jain – Advanced Machining Processes, Allied Publishers Pvt. Limited, India 2017
2. P.K.Misra - Non-conventional Machining, Narosa Publishers, 2018
3. Mikell P. Groover – Fundamental of Modern Manufacturing: Materials, Processes and Systems, 2016
4. Pandey & Shan - Modern Machining Processes, Tata McGraw Hill 2015

Reference Books

1. Manufacturing processes for engineering materials by seropekalpakjian and Steven R schmid 2018
2. Manufacturing Technology, Kalpakzian, person 2016
3. New technology, Bhattacharya, the institution of engineers, India 2015

Additional References

1. <http://www.learnerstv.com/free-engineering-video-lectures-ltv234-page1.htm>
2. <http://www.learnerstv.com/free-engineering-video-lectures-ltv530-page1.htm>
3. NPTEL – <https://nptel.ac.in/courses/112/107/112107078/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 2 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 3 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 4 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 5 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |
| | | | | |


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| | | | | | |
|-------------------------|----------------------------|----------|----------|----------|----------|
| 20MEE44 | INDUSTRIAL ROBOTICS | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Manufacturing Process | | | | |

Course Objectives

The course is intended to

1. Introduce the basic concepts, parts of robots and types of robots.
2. Study the use of various types of robot drive systems and End Effectors
3. Study the robotic control using the principle behind sensors and machine vision systems.
4. Impart knowledge in Robot Kinematics and Programming
5. Discuss about the various applications of robots, justification and implementation of robot economics

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---------------|--|----------------------|
| CO 1 | Classify the various robot configuration and components | Understand |
| CO 2 | Explain the various types of drive systems and end effectors | Understand |
| CO 3 | Select appropriate sensors and end effectors for a robot based on specific application | Remembering |
| CO 4 | Execute the concepts of robot kinematics and robot programming | Understand |
| CO 5 | List the various applications of robots, implementation and economics | Remembering |

Course Contents

UNIT I FUNDAMENTALS OF ROBOT 9

Robot - Definition - Robot Anatomy - Co-ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion. Need for Robots-Different Applications.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III ROBOT SENSORS AND MACHINE VISION 9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), -Derivations and problems.

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Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), -Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), -Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

Total : 45 Periods

Text Books

1. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2016.
2. K I after R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall, 2015.

References Books

1. Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company, 2016.
2. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co.,2014
3. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2012.
4. Koren Y., "Robotics for Engineers", McGraw Hill Book Co., 2010.

Additional References

NPTEL COURSES

<https://nptel.ac.in/courses/112/101/112101098/>

<https://nptel.ac.in/courses/112/105/112105249/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | | 3 | | 2 | | | 3 | | | | 2 | 3 | 3 |
| CO 2 | 3 | | 3 | | 2 | | | 3 | | | | 2 | 3 | 3 |
| CO 3 | 3 | | 3 | | 2 | | | 3 | | | | 2 | 3 | 3 |
| CO 4 | 3 | | 3 | | 2 | | | 3 | | | | 2 | 3 | 3 |
| CO 5 | 3 | | 3 | | 2 | | | 3 | | | | 2 | 3 | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 40 | 40 | 40 | 80 |
| Apply | | | | |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|------------------------------------|----------|----------|----------|----------|
| 20MEE45 | ADVANCED CASTING TECHNIQUES | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Manufacturing Technology - I | | | | |

Course Objectives

The course is intended to

1. Understand the Casting processes
2. Design the Gate and Riser System
3. Examine the Metallurgical properties of Casting
4. Know the recent trends in Foundry
5. Study and analyze Quality on Casting

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---------------|---|----------------------|
| CO 1 | Recall the characteristics of Casting | Remembering |
| CO 2 | Discourse the design considerations in casting | Understand |
| CO 3 | Study the Casting metallurgy properties | Understand |
| CO 4 | Illustrate the various advanced Casting processes | Understand |
| CO 5 | Predict possible ways of Quality improvement on Casting | Applying |

Course Contents

UNIT I CASTING PROCESSES 9

Casting Processes, classification, characteristics of sand casting processes, core making materials and their characteristics, Sand additives and mould coatings. Metal mould casting processes, rheo casting.

UNIT II CASTING DESIGN 9

Heat transfer between metal and mould, Design considerations in casting, Designing for directional solidification and minimum stresses, principles and design of gating and riser, Melting and casting quality, Gating and Riser design & analysis

UNIT III CASTING METALLURGY 9

Solidification of pure metal and alloys Rate of solidification, – shrinkage in cast metals – progressive and directional solidification — Degasification of the melt-casting defects – Castability of steel, Cast Iron, Al alloys, Babbitt alloy and Cu alloy.

UNIT IV RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT 9

Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry — Computer aided design of casting

UNIT V MELTING AND QUALITY CONTROL**9**

Melting furnaces and refractories, Melting and quality control of various steels and non-ferrous alloys, casting defects - fettling, inspection and testing of castings. Design for castability- castability analysis and collaborative engineering.

Total : 45 Periods**Text Books**

1. Scrope Kalpakjian, "Manufacturing processes for Engineering Materials", Addison, Wesley, 2015
2. P N Rao Manufacturing Technology , Vol 1, 3rd edition ,2011

Reference Books

1. Mikell P. Groover "Fundamental of Modern Manufacturing", Wiley India Edition, Third Edition, Reprint, 2017.
2. Jain P.L., "Principles of Foundry Technology", Tata McGraw Hill Publishers, 2016
3. P.C. Sharma, "A Text Book of Production Technology (Manufacturing Processes)", S.Chand & Company Ltd., New Delhi, 7th Reprint, 2015.

Additional References

1. **Automotive Research Association of India** -
<https://www.araiindia.com/services/technology-and-products>
2. **NPTEL** –<https://nptel.ac.in/courses/112107144/13>
<https://nptel.ac.in/courses/112107145/17>
<https://nptel.ac.in/courses/112107083/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|----------|----------|----------|-----------------|----------|----------|----------|--------------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 2 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 3 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 4 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 5 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|-----------------------------|-----------------------------|--------------|--------------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|------------------------------------|----------|----------|----------|----------|
| 20MEE46 | ADVANCED WELDING TECHNIQUES | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Manufacturing Technology - I | | | | |

Course Objectives

The course is intended to

1. Understand the working principle of Welding processes
2. Study the properties of welding
3. study the various welding methods
4. Calculate the heat flow on welded area
5. Analyze the weld joints as per standards

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO 1 | Recall the various types of welding processes | Remembering |
| CO 2 | Understand and analyze the material structures after welding | Understand |
| CO 3 | Apply the welding techniques for various metal joining | Understand |
| CO 4 | Examine the weldments for various materials. | Understand |
| CO 5 | Attain the knowledge about various welding defects and inspection methods. | Applying |

Course Contents

UNIT I WELDING AND JOINING PROCESSES 9

Introduction to consolidation processes, Classification of welding processes, Design considerations, Heat effects, Weldability and join ability. Welding positions, elements of and construction of welding symbols.

UNIT II WELDING METALLURGY 9

Need, phase diagrams: Fe-C, Al-Cu, Cu-Zn system, Principle and modes of solidification of weld metal, grain refinement principle of weld metal, method of weld metal refinement, factors affecting changes in microstructure and mechanical properties of HAZ, reactions in weld pool- gas metal reaction, slag metal reaction. Mechanisms, causes and remedy of cold cracking, solidification cracking, nonmetallic inclusions, lamellar tearing, hydrogen damage, banding, segregation.

UNIT III RECENT IN TRENDS IN WELDING 9

Electro gas and Electro slag, Flux Cored Arc Welding, Explosive welding, Laser beam welding, Electron beam welding, Ultrasonic welding, Explosive welding, Underwater welding & Microwave welding

UNIT IV HEAT FLOW WELDING 9

Calculation of peak temperature, Width of Heat Affected Zone (HAZ), cooling rate and solidification rates, weld thermal cycles, residual stresses and their measurement, weld distortion and its prevention

UNIT V WELDMENT INSPECTION AND TESTING 9

Structural welding code, duties of the inspector, ASTM standards, API standards Chemical, Metallurgical, and Mechanical testing of weldments, Comparison of destructive and non-destructive

tests, chemical tests, Selection of NDT method, Liquid penetrant test, Magnetic particle and Radiographic inspection, Ultrasonic inspection:

Total : 45 Periods

Text Books

1. Parmer R.S., "Welding Engineering and Technology", Khanna Publishers, 2015
2. Srinivasan N.K., "Welding Technology", Khanna Tech Publishers, 2017

Reference Books

1. Carry B., "Modern Welding Technology", Prentice Hall Pvt Ltd., 2012
2. Sindokou, "Welding Metallurgy", A John Wiley & Sons, Inc., Publication, 2nd edition 2016
3. Edward R. Bohnart, "Welding Principles and Practices", McGraw Hill, 4th Edition.
ASM Handbook vol.6 2012

Additional References

1. **India Welding Society**- <http://www.iws.org.in/relatedwebsites.php>
2. **NPTEL** -<https://nptel.ac.in/courses/112/107/112107090/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 2 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 3 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 4 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 5 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|---|----------|----------|----------|----------|
| 20MEE47 | PROCESS PLANNING AND COST ESTIMATION | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Manufacturing Technology II | | | | |

Course Objectives

The course is intended to

1. Define the process planning concepts
2. Identify the process planning activities
3. Estimate the labor cost, material cost and depreciation cost.
4. Determine the production cost estimation
5. Identify the cost estimation for various products after process planning

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO 6 | Select the process, equipment and tools for various industrial products. | Remembering |
| CO 7 | Prepare the process planning activity chart. | Remembering |
| CO 8 | Explain the concept of cost estimation. | Understand |
| CO 9 | Compute the job order cost for different type of shop floor. | Understand |
| CO 10 | Calculate the machining time for various machining operations | Understand |

Course Contents

UNIT I PROCESS PLANNING 9

Introduction- methods of process planning – Drawing interpretation – Material evaluation – steps in process selection - Production equipment and tooling selection

UNIT II PROCESS PLANNING ACTIVITIES 9

Process parameters calculation for various production processes-Selection jigs and fixtures selection of quality assurance methods - Set of documents for process planning - Economics of process planning - case studies.

UNIT III INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation – methods of costing-elements of cost estimation – Types of estimates – Estimating procedure – Estimation labor cost, material cost - allocation of overhead charges - Calculation of depreciation cost

UNIT IV PRODUCTION COST ESTIMATION 9

Importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations, Machining time calculation for Milling, Shaping, Planning and Grinding, Cost estimation for machining processes.

UNIT V ESTIMATION OF MACHINING TIME AND COST**9**

Importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations, Machining time calculation for Milling, Shaping, Planning and Grinding, Cost estimation for machining processes.

Total : 45 Periods**Text Books**

1. Sinha B.P, "Mechanical estimating and Costing", Tata-McGraw Hill publishing co, 2016.
2. Peterscalon, "Process planning, Design Manufacture Interface", Elsevier science technology Books, Dec-2014.

Reference Books

1. J Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2016.
2. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley, 2015.
3. Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education 2014
4. K.C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Hanna Publishers 2012..

Additional References

1. **EBook: Process planning and cost estimation-**
<https://www.civildserviceindia.com/subject/Management/notes/process-planning.htm>
https://managementstudyguide.com/planning_disadvantages.htm

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|----------|----------|----------|-----------------|----------|----------|----------|--------------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 3 | | | 1 | 2 | | 3 | 2 | 2 | 3 | 2 | | 1 |
| CO 2 | 3 | 3 | | | 1 | 2 | | 3 | 2 | 2 | 3 | 2 | | 1 |
| CO 3 | 3 | 3 | | | 1 | 2 | | 3 | 2 | 2 | 3 | 2 | | 1 |
| CO 4 | 3 | 3 | | | 1 | 2 | | 3 | 2 | 2 | 3 | 2 | | 1 |
| CO 5 | 3 | 3 | | | 1 | 2 | | 3 | 2 | 2 | 3 | 2 | | 1 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|-----------------------------|-----------------------------|--------------|--------------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 40 | 40 | 40 | 80 |
| Apply | | | | |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|------------------------------|----------|----------|----------|----------|
| 20MEE48 | OPERATION RESEARCH | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Manufacturing Technology - I | | | | |

Course Objectives

The course is intended to

1. Understand the Linear models and characteristics
2. Identify the Network and Sequencing models
3. Calculate the inventory ,transportation and assignment models
4. Select the process of Queuing theory
5. Identify the decision models and parameters

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---------------|---|----------------------|
| CO 1 | Understand the Characteristics and Phases of operation research | Remembering |
| CO 2 | Select the network and sequencing models | Understand |
| CO 3 | Evaluate the inventory, transportation and assignment models | Understand |
| CO 4 | Describe the Queuing models and structures | Understand |
| CO 5 | Understand the principles and application | Understand |

Course Contents:

UNIT I LINEAR MODELS

9

Development-Characteristics and Phases of operation research – Types of models –graphical method – simplex algorithm – duality formulation –dual simplex method. Linear Programming Problem – Formulation – Graphical solution – Simplex method – Solution by Excel solver.

UNIT II NETWORK AND SEQUENCING MODELS

9

Network models – shortest route – minimals planning tree – maximum flow models – project network – PERT and CPM networks – critical path scheduling – sequencing models - Flow – Shop sequencing – 'n' jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines

UNIT III INVENTORY, TRANSPORTATION AND ASSIGNMENT MODELS

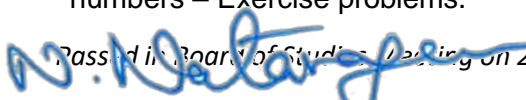
9

Inventory models – economic order quantity models – safety stock – reorder point – lead time –quantity discount models – transportation problems – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy. Assignment problems – Formulation –Optimal solution –Variants of Assignment Problem.

UNIT IV QUEUING THEORY

9

Queuing models – queuing systems and structures – notation parameter – single server and multi server models – Poisson arrival – exponential service – simulation –Monte Carlo technique - use of random numbers – Exercise problems.

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UNIT V DECISION MODELS

Decision models – game theory – two person zero sum games – graphic solution – replacement models – replacement policies – models based on service life–economic life. Dynamic Programming: Introduction – Terminology - Bellman's Principle of Optimality–Applications of dynamic programming - shortest path problem.

Total : 45 Periods

Text Books

1. Taha Hamdy A, "Operations Research", Prentice Hall of India Pvt.Ltd.,2016
2. P.K.Gupta&D.S.Hira,"ProblemsinOperationsResearch(Principles&Solutions)",S.C hand&Co. Ltd., 2013.
3. A.M.Natarajan, P.Balasubramaniam, A. Tamilarasi "Operations Research", Pearson Education,2011.

Reference Books

1. Fourer, D.Gay and B. Kernighan, AMPL, "A Modeling Language for Mathematical Programme", Brooks Cole-Thomson,2016.
2. Dharani Venkata Krishnan . S, "Operations Research" (Principles&Problems), Keerthi Publishing House Pvt. Ltd., 2012.
3. Don. T. Phillips, Ravindren, A and James Solberg, "Operations Research", John Wiley & Sons,2015.
4. J.K. Sharma "Operation Research" MacMilan.,2012

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | | 3 | | | | 3 | | | | | | |
| CO 2 | 3 | 2 | | 3 | | | | 3 | | | | | | |
| CO 3 | 3 | 2 | | 3 | | | | 3 | | | | | | |
| CO 4 | 3 | 2 | | 3 | | | | 3 | | | | | | |
| CO 5 | 3 | 2 | | 3 | | | | 3 | | | | | | |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 40 | 40 | 40 | 80 |
| Apply | | | | |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|--------------------------------------|--------------------------------------|---|---|---|
| 20MEE49 | MANUFACTURING OF COMPOSITE MATERIALS | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | | Professional Elective (PE) | | | |
| Pre requisites | | Engineering Materials and Metallurgy | | | |

Course Objectives

The course is intended to

1. Understand the Basics of composites and fibres
2. Interpret the different types reinforcement of composites
3. Study the Manufacturing methods of Polymer
4. Find the various composite mechanism
5. Examine the Composite structures

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|---|---------------|
| CO 1 | Understand the fundamentals of composite material strength | Remembering |
| CO 2 | Distinguish the construction, constituent's phases & characteristics of the composite materials | Understand |
| CO 3 | Explain the fabrication techniques of different types of composite materials. | Understand |
| CO 4 | Identify the strengthening mechanics adopted in a particular type of composite material. | Understand |
| CO 5 | Analyze the composite material under various load | Applying |

Course Contents

UNIT I INTRODUCTION

9

Definition, Classification of Composite materials based on structure, based on matrix. Advantages of composites, application of composites, functional requirements of reinforcement and matrix. Reinforcement types, Fibres, continuous, particulate and whisker reinforcements, Properties, Applications, Comparison of fibre strengths, Matrix materials, Properties. Wettability fibre with matrix, Effect of surface roughness, Interfacial bonding

UNIT II REINFORCEMENTS AND MATRICES

9

Different types of fibers - Manufacturing, properties and applications of glass fibers, carbon fibers, Kevlar fibers, Thermoset and thermoplastic matrices - properties of polyester, epoxy and nylon matrices, polypropylene and PEEK matrices

UNIT III MANUFACTURING OF ADVANCED COMPOSITES

9

Polymer matrix composites: Preparation of Moulding compounds and pre-pregs, hand layup method Autoclave method, Filament winding method, Compression moulding, Reaction injection moulding.

UNIT IV MECHANICS OF LAMINATED COMPOSITES

9

Stress-strain relationship for anisotropic and orthotropic materials - Rule of Mixtures, invariant properties of orthotropic laminates, strength of an orthotropic lamina - failure criteria of orthotropic lamina - macro mechanical behavior of laminates - classical laminate theory, inter laminar stresses

UNIT V COMPOSITE STRUCTURES**9**

Fatigue, S-N curves, Fatigue behaviors of CMCs, Fatigue of particle and whisker reinforced composites, Hybrid composites, and thermal fatigue. Introduction to structures - selection of material, manufacturing and laminate configuration - design of joints - bonded joints - bolted joints - bonded and bolted – laminate optimization.

Total : 45 Periods**Text Books**

1. Mallick, P.K., "Fiber Reinforced Composites: Materials, Manufacturing and Design", Third Edition, Marcel Dekker Inc, 2010.
2. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, 2015.

Reference Books

1. Autar K. Kaw, "Mechanics of Composite Materials" CRC Press, 2012
2. Robert M. Jones, "Mechanics of Composite Materials" Taylor and Francis, 2012
3. Chawla K.K Composite Materials: Science and Engineering., Springer – Verlag, 2008
4. Ronald Gibson, "Principles of Composite Material Mechanics", Tata McGraw Hill, 2016.

Additional References

1. Automotive Research Association of India - <https://www.araiindia.com/services/technology-and-products>
2. NPTEL –<https://nptel.ac.in/courses/112/104/112104229/>
<https://nptel.ac.in/courses/101/104/101104010/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 2 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 3 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 4 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 5 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|------------------------------------|----------|----------|----------|----------|
| 20MEE50 | CNC MACHINE TOOLS | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Manufacturing Technology II | | | | |

Course Objectives

The course is intended to

1. Understand the evolution and principle of CNC machine tools
2. Describe the constructional features of CNC machine tools
3. Explain the drives and positional transducers used in CNC machine tools
4. Generate the CNC programs for popular CNC controllers
5. Describe the tooling and work holding devices for CNC machine tools.

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO 1 | Know the basic principles and constructional features in CNC machine tools | Remembering |
| CO 2 | Select the CNC machine tool structure | Understand |
| CO 3 | Identify the DC and AC servomotors | Understand |
| CO 4 | Generate the CNC programming and codes | Understand |
| CO 5 | Choose the tooling and work holding devices in CNC machine tools | Applying |

Course Contents

- UNIT I INTRODUCTION TO CNC MACHINE TOOLS 6**
 Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre, grinding machine, EDM, types of control systems, CNC controllers, characteristics, interpolators– Computer Aided Inspection
- UNIT II STRUCTURE OF CNC MACHINE TOOL 10**
 CNC Machine building, structural details, configuration and design, guide ways – Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion – Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, spindle assembly, torque transmission elements – gears, timing belts, flexible couplings, Bearings.
- UNIT III DRIVES AND CONTROLS 9**
 Spindle drives – DC shunt motor, 3 phase AC induction motor, feed drives –stepper motor, servo principle, DC and AC servomotors, Open loop and closed loop control, Axis measuring system– synchro, synchro - resolver, gratings, moiré fringe gratings, encoders, inducto synsn, laser interferometer
- UNIT IV CNC PROGRAMMING 11**
 Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre for well-known controllers such as Fanuc, Heidenhain, Sinumerik etc., generation of CNC codes from CAM packages.

UNIT V TOOLING AND WORK HOLDING DEVICES**9**

Introduction to cutting tool materials – Carbides, Ceramics, CBN, PCD–inserts classification- PMK, NSH, qualified, semi qualified and preset tooling, tooling system for Machining centre and Turning centre, work holding devices for rotating and fixed work parts, economics of CNC, maintenance of CNC machines.

Total : 45 Periods**Text Books**

1. HMT, "Mechatronics", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2016.
2. Warren S. Seamers, "Computer Numeric Control", Fourth Edition – Thomson Delmar, 2015.

Reference Books

1. James Madison, "CNC Machining Hand Book", Industrial Press Inc., 2012.
2. Ken Evans, John Polywka & Stanley Gabrel, "Programming of CNC Machines", Second Edition – Industrial Press Inc, New York, 2015.
3. Peter Smid, "CNC Programming Hand book", Industrial Press Inc., 2012.
4. Berry Leathan – Jones, "Introduction to Computer Numerical Control", Pitman, London, 2010
5. Radhakrishnan P "Computer Numerical Control Machines", New Central Book Agency, 2015.
6. Rao P.N., "CAD/CAM", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2016.

Additional References

1. NPTEL COURSES –
 - a. https://nptel.ac.in/content/storage2/courses/downloads/112105211/noc18_me06_Assignment1.pdf
2. Virtual Lab Courses –
 - a. <http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAM/exp2/index.html>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | | 3 | | 2 | | | 3 | 2 | 3 | 2 | 2 | 3 | 3 |
| CO 2 | 3 | | 3 | | 2 | | | 3 | 2 | 3 | 2 | 2 | 3 | 3 |
| CO 3 | 3 | | 3 | | 2 | | | 3 | 2 | 3 | 2 | 2 | 3 | 3 |
| CO 4 | 3 | | 3 | | 2 | | | 3 | 2 | 3 | 2 | 2 | 3 | 3 |
| CO 5 | 3 | | 3 | | 2 | | | 3 | 2 | 3 | 2 | 2 | 3 | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 40 | 40 | 40 | 80 |
| Apply | | | | |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|----------------------------|---|---|---|---|
| 20MEE51 | SUPPLY CHAIN MANAGEMENT | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Manufacturing Process | | | | |

Course Objectives

The course is intended to

1. Understand the basic concepts of supply chain
2. Identify the supply chain network and Framework
3. Explain the logistics in supply chain roles
4. Discuss the sourcing and coordination in supply chain
5. Identify the roles of IT in supply chain

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO 1 | Outline the roles of Logistics and scope of Chain performance | Remembering |
| CO 2 | Understand the scope of supply chain networks and functions. | Understand |
| CO 3 | Prepare the design option for transportation network, Routing and Scheduling | Understand |
| CO 4 | Select the source of supply chain supplier selection, planning and strategy | Understand |
| CO 5 | Describe the Frame work and customer relationship | Understand |

Course Contents

UNIT I INTRODUCTION

9

Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain - Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles.

UNIT II SUPPLY CHAIN NETWORK DESIGN

9

Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions.

UNIT III LOGISTICS IN SUPPLY CHAIN

9

Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation

UNIT IV SOURCING AND COORDINATION IN SUPPLY CHAIN

9

Role of sourcing supply chain supplier selection assessment and contracts- Design collaboration - sourcing planning and analysis - supply chain co-ordination - Bull whip effect – Effect of lack of co-ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain.

UNIT V SUPPLY CHAIN AND INFORMATION TECHNOLOGY

9

The role IT in supply chain- The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E-Business in supply chain.

Total : 45 Periods

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CHAIRMAN - ACADEMIC COUNCIL

Text Books

1. Sunil Chopra, Peter Meindl and Kalra, "Supply Chain Management, Strategy, Planning, and Operation", Pearson Education, 2016.

Reference Books

1. Jeremy F.Shapiro, "Modelling the Supply Chain", Thomson Duxbury, 2010.
2. Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management, PHI, 2015
3. David Bloomberg, Stephen Lemay and Joe B.Hanna, "Logistics", PHI 2016.
4. James B.Ayers, "Handbook of Supply Chain Management", St.Lucle press, 2015.

Additional References

1. NPTEL Courses - <https://nptel.ac.in/courses/110/106/110106045/>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | | 2 | | 2 | | | 2 | 2 | 3 | | 2 | | 3 |
| CO 2 | 3 | | 2 | | 2 | | | 2 | 2 | 3 | | 2 | | 3 |
| CO 3 | 3 | | 2 | | 2 | | | 2 | 2 | 3 | | 2 | | 3 |
| CO 4 | 3 | | 2 | | 2 | | | 2 | 2 | 3 | | 2 | | 3 |
| CO 5 | 3 | | 2 | | 2 | | | 2 | 2 | 3 | | 2 | | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 40 | 40 | 40 | 80 |
| Apply | | | | |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

Stream - IV

Automobile Engineering

| | | | | | |
|-------------------------|-------------------------------|----------|----------|----------|----------|
| 20MEE61 | AUTOMOBILE ENGINEERING | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Nil | | | | |

Course Objectives

The course is intended to

1. Understand the construction and working principle of various parts of an automobile
2. Interpret the different types of ignition systems of the automotive
3. Examine the list and study the mechanism of transmission systems
4. Practice for assembling and dismantling of engine parts and transmission system like Steering, Brakes and Suspension Systems
5. Find the available alternate source of energy for an automotive engines and suggest the future evolution of energy resources

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---------------|--|----------------------|
| CO 1 | Recall the various parts of the automobile and their functions and materials | Remembering |
| CO 2 | Discuss the engine auxiliary systems and engine emission control | Understand |
| CO 3 | Illustrate the working of different types of transmission systems | Understand |
| CO 4 | Explain the Steering, Brakes and Suspension Systems | Understand |
| CO 5 | Predict possible alternate sources of energy for automotive Engines | Applying |

Course Contents

UNIT I BASICS OF STRUCTURE AND ENGINES 9

Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC, SI, Electric engines – components-functions and materials, variable valve timing (VVT).

UNIT II COMBUSTION SYSTEMS AND NORMS 9

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (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 AND DRIVE SYSTEMS 9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

N. Natarajan
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Passed in Academic Council Meeting on 26.02.2022

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UNIT IV CONTROL SYSTEMS OF AUTOMOBILE**9**

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic, Magnetic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control

UNIT V ALTERNATIVE FUELS**9**

Compressed Natural Gas(CNG), Liquefied Petroleum Gas(LPG), 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.

Total : 45 Periods**Text Books**

1. Kirpal Singh, "Automobile Engineering", Vol 1 &2, Standard Publishers, New Delhi, 14th Edition 2018
2. V. Ganesan, Internal Combustion Engineering, New Delhi :Tata McGraw-Hill Publishing Co, 2012.
3. Devendra Vashist, Manav Rachna, "Automobile Engineering", Dreamtech Press, New Delhi, February 2020

Reference Books

1. Robert Bosch, "Bosch Automotive Handbook", Published by Robert Bosch with a Product Code of BOSCH10, ISBN of 978-0-7680-9567-8, 10th Edition 2018
2. S Srinivasan, "Automotive Mechanics", McGraw Hill Education; 2nd edition July 2017
3. S K Gupta, "Textbook of Automobile Engineering", S Chand & Co Ltd, 2014
4. Heinz Heisler, "Advanced Combustion," SAE International Publications USA, 2005.

Additional References

1. **Automotive Research Association of India** - <https://www.araiindia.com/services/technology-and-products>
2. **NPTTEL** - <https://nptel.ac.in/courses/107/106/107106088/>
3. **MOOC Courses** - <https://www.mooc-list.com/tags/automotive-engineering>
4. **Virtual laboratory – Ministry of Education** - <https://www.vlab.co.in/broad-area-mechanical-engineering>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 2 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 3 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 4 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| CO 5 | 3 | 2 | | | 3 | | | | | | | 2 | | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |


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| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|--|----------|----------|----------|----------|
| 20MEE62 | AUTOMOTIVE TRANSMISSION SYSTEMS | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Automobile Engineering | | | | |

Course Objectives

The course is intended to

1. Understand the construction and working principle of various parts of an automobile transmission
2. Know the various transmission and drive line units of automobiles
3. Utilizing appropriate safety procedures, Perform general transmission and transaxle diagnosis
4. Examine automatic transmission and transaxle maintenance and adjustments;
5. Practice for in-vehicle and off-vehicle automatic transmission and transaxle repair.

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|--------------|--|----------------------|
| CO 1 | Recall the various parts of the clutch and gearbox and their functions | Remembering |
| CO 2 | Discuss the principles of hydrodynamic transmission systems | Understand |
| CO 3 | Illustrate automatic drive train inspection, maintenance, diagnosis and repairs. | Understand |
| CO 4 | Develop and implement strategies and processes to solve automatic drive train repair problems. | Understand |
| CO 5 | Predict automatic drive train repair to professional and ethical standards. | Understand |

Course Contents

UNIT I CLUTCH AND GEAR BOX

9

Requirement of transmission system, Different types of clutches, principle & Construction of Single plate coil spring and Diaphragm spring clutches, Need and Objectives of Gear box. Construction and operation of Sliding mesh, Constant mesh and Synchromesh gearboxes. – Determination of gear ratios for vehicles. Performance characteristics in different speeds. Resistance to motion, Tractive effort, Engine speed & Power and acceleration.

UNIT II HYDRODYNAMIC TRANSMISSION

9

Fluid coupling-Principle-Constructional details. Torque capacity. Performance characteristics. Reduction of drag torque in fluid coupling. Torque converter-Principle-constructional details, performance characteristics. Multistage torque converters and Polyphone torque converters.

UNIT III EPICYCLIC GEARBOXES USED IN AUTOMATIC TRANSMISSION

9

Principle of Planetary gear trains - Wilson Gear box, Cotal electromagnetic transmission- Hydraulic control system for Automatic Transmission.


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UNIT IV AUTOMATIC TRANSMISSION APPLICATIONS**9**

Need for automatic transmission, Four speed longitudinally mounted automatic transmission - Chevrolet "Turbo glide" Transmission, Continuously Variable Transmission (CVT) – Types – Operations of a typical CVT.

UNIT V HYDROSTATIC AND ELECTRIC DRIVE**9**

Hydrostatic drive; Various types of hydrostatic systems – Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, construction and working of typical Janny hydrostatic drive. Electric drive-types- Principle of early and modified Ward Leonard Control system-Advantages & limitations.

Total : 45 Periods**TEXT BOOKS:**

1. Newton and Steeds, "Motor vehicles", Illiffe Publishers, 2000.
2. Devaradjane. G., Kumaresan. M., "Automobile Engineering", AMK Publishers, 2013.
3. P.M. Heldt, Automotive Chassis, New York: Chilton Co, 2014

REFERENCES:

1. Crouse, W.H., Anglin, D.L., "Automotive Transmission and Power Trains construction", McGraw Hill, 2016.
2. Heinz Heisler, "Advance vehicle Technology", Butterworth-Heinemann, 2002.
3. K. Singh, Automobile Engineering-Volume 1, Delhi: Standard Publishes Distributors, 2012.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|----------|----------|----------|-----------------|----------|----------|----------|--------------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | 2 | | 3 | | | | | 3 | | | | 3 |
| CO 2 | 3 | 2 | 2 | | 3 | | | | | 3 | | | | 3 |
| CO 3 | 3 | 2 | 2 | | 3 | | | | | 3 | | | | 3 |
| CO4 | 3 | 2 | 2 | | 3 | | | | | 3 | | | | 3 |
| CO 5 | 3 | 2 | 2 | | 3 | | | | | 3 | | | | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|-----------------------------|-----------------------------|--------------|--------------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| | Attendance | 5 | |


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| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 40 | 40 | 40 | 80 |
| Apply | | | | |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|---------------------------------|----------|----------|----------|----------|
| 20MEE63 | VEHICLE BODY ENGINEERING | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Automobile Engineering | | | | |

Course Objectives

The course is intended to

1. The main objective of this course is to impart knowledge in the construction of vehicle, aerodynamic, concept, panelling of passenger car body trim.
2. At the end of the course the student will be well versed in the design and construction of external body of the vehicles.
3. Calculate various aerodynamic forces and moments acting on vehicle.
4. Calculate load distribution in vehicle body.
5. Explain the ergonomics, stability the vehicle.

Course Outcomes

Upon completion of the course, students will

| CO.No | Course Outcome | Bloom's Level |
|--------------|---|----------------------|
| CO 1 | Recall about different aspects of car body and bus body, types, commercial vehicle. | Remembering |
| CO 2 | Role of various aerodynamic forces and moments, measuring instruments | Understand |
| CO 3 | Illustrate about the material used in body building, tools used, body repairs. | Understand |
| CO 4 | Explain the concept, importance and testing of aerodynamics in car body design. | Understand |
| CO 5 | Predict the different vehicle body materials with their merits and demerits | Understand |

Course Contents

UNIT I CAR BODY DETAILS

9

Types of Car body - Saloon, convertibles, Limousine, Estate Van, Racing and Sports car – Visibility regulations, driver's visibility, improvement in visibility and tests for visibility. Driver seat design -Car body construction-Variou panels in car bodies. Safety aspect of car body.

UNIT II BUS BODY DETAILS

9

Types of bus body: based on capacity, distance travelled and based on construction.– Bus body lay out for various types, Types of metal sections used – Regulations – Constructional details: Conventional and integral. Driver seat design- Safety aspect of bus body.

UNIT III COMMERCIAL VEHICLE DETAILS

9

Types of commercial vehicle bodies - Light commercial vehicle body. Construction details of commercial vehicle body - Flat platform body, Trailer, Tipper body and Tanker body – Dimensions of driver's seat in relation to controls – Drivers cab design - Regulations.


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UNIT IV VEHICLE AERODYNAMICS**9**

Objectives, Vehicle drag and types. Various types of forces and moments. Effects of forces and moments. Side wind effects on forces and moments. Various body optimization techniques for minimum drag. Wind tunnels – Principle of operation, Types. Wind tunnel testing such as: Flow visualization techniques, Airflow management test – measurement of various forces and moments by using wind tunnel.

UNIT V BODY MATERIALS, TRIM, MECHANISMS AND BODY REPAIR**9**

Types of materials used in body construction-Steel sheet, timber, plastics, GRP, properties of materials. Body trim items-body mechanisms. Hand tools-power tools-panel repair-repairing sheet metal-repairing plastics-body fillers-passenger compartment service- corrosion: Anticorrosion methods, Modern painting process procedure-paint problems

Total : 45 Periods**TEXT BOOKS:**

1. A.K Babu, "Vehicle Body Engineering", Khanna Book Publishing, 2021
2. Automobile Chassis and Body Engineering –Prof K V Fadadu, B H Kadiys, Books India Publications 1st edition 2016.
3. Vehicle body layout and analysis - John Fenton, Mechanical Engg. Publication Ltd, London.

REFERENCES:

1. L. Morello, L.R. Rossini, G. Pia and A. Tonoli, the Automotive Body, Volume I: Components Design, London: Springer, 2011.
2. J. Fenton, Handbook of Automotive Body Construction and Design Analysis, New Delhi: Wiley India, 2010.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|----------|----------|----------|-----------------|----------|----------|----------|--------------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | | 3 | | | | | | 3 | | | | 3 |
| CO 2 | 3 | 2 | | 3 | | | | | | 3 | | | | 3 |
| CO 3 | 3 | 2 | | 3 | | | | | | 3 | | | | 3 |
| CO 4 | 3 | 2 | | 3 | | | | | | 3 | | | | 3 |
| CO 5 | 3 | 2 | | 3 | | | | | | 3 | | | | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |


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| Formative Assessment | | | | | |
|----------------------|--|----------------|----------------|-------------------------|-------------|
| Blooms Taxonomy | Assessment Component | | | Marks | Total marks |
| Remember | Quiz | | | 5 | 15 |
| Understand | Tutorial class / Assignment | | | 5 | |
| | Attendance | | | 5 | |
| Summative Assessment | | | | | |
| Bloom’s Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) | |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 | |
| Remember | 10 | 10 | 10 | 20 | |
| Understand | 40 | 40 | 40 | 80 | |
| Apply | | | | | |
| Analyse | | | | | |
| Evaluate | | | | | |
| Create | | | | | |


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| | | | | | |
|-------------------------|--|----------|----------|----------|----------|
| 20MEE64 | ALTERNATE FUELS FOR AUTOMOBILES | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Automobile Engineering | | | | |

Course Objectives

The course is intended to

1. Know about the types of alternative fuels and energy sources for IC engines.
2. Present a problem oriented in depth knowledge of Alternate fuel and energy system.
3. Address the underlying concepts and methods behind alternate fuel and energy system.
4. Develop professional fundamentals and understand energy infrastructure in alternative fuels.
5. Comprehend traditional, alternative, and sustainable energy production technologies.

Course Outcomes

On completion of the course, the student will

| CO.No | Course Outcome | Bloom's Level |
|--------------|--|----------------------|
| CO 1 | Understand the various alternative fuels available and its properties. | Remembering |
| CO 2 | Illustrate the performance characteristics and combustion characteristics. | Understand |
| CO 3 | Explain the various emission characteristics | Understand |
| CO 4 | Identify the engine modifications required and performance. | Understand |
| CO 5 | Can find the applications of all the areas in day to day life. | Understand |

Course Contents

UNIT I ALCOHOLS AS FUELS

9

Introduction to alternative fuels. - Need for alternative fuels - Availability of different alternative fuels for SI and CI engines. Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives. Performance emission and combustion characteristics in CI and SI engines.

UNIT II VEGETABLE OILS AS FUELS

9

Various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating Trans esterification and emulsification of Vegetable oils - Performance in engines – Performance, Emission and Combustion Characteristics in diesel engines.


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UNIT III HYDROGEN AS ENGINE FUEL**9**

Production methods of hydrogen. Combustive properties of hydrogen. Problems associated with hydrogen as fuel and solutions. Different methods of using hydrogen in SI and CI engines. Performance, emission and combustion analysis in engines. Hydrogen storage - safety aspects of hydrogen.

UNIT IV BIOGAS, NATURAL GAS AND LPG AS FUELS**9**

Production methods of Biogas, Natural gas and LPG. Properties studies. CO₂ and H₂S scrubbing in Biogas., Modification required to use in SI and CI Engines- Performance and emission characteristics of Biogas, NG and LPG in SI and CI engines

UNIT V ELECTRIC, HYBRID AND FUEL CELL VEHICLES**9**

Layout of Electric vehicle and Hybrid vehicles – Advantages and drawbacks of electric and hybrid vehicles. System components, Electronic control system – Different configurations of Hybrid vehicles. Power split device. High energy and power density batteries – Basics of Fuel cell vehicles.

Total : 45 Periods**TEXT BOOK:**

1. "Alternate Fuels" by Dr. S. Thipse, Jaico Publications, 2010
2. "Automotive Fuel and Emission Control" by James D. Halderman, James Linder Pearson, 3rd edition 2011.
3. V. Ganesan, "Internal Combustion Engines", New Delhi : Tata Mcgraw Hill Publishing Co. Ltd, 2012

REFERENCES:

1. Devaradjane. Dr. G., Kumaresan. Dr. M., Automobile Engineering, AMK Publishers, 2013.
2. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 2014.
3. Science direct Journals (Biomass & Bio energy, Fuels, Energy, Energy conversion Management, Hydrogen Energy, etc.) on biofuels, 2014.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|----------|----------|----------|-----------------|----------|----------|----------|--------------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | | | | | | 2 | | | | 2 | | 3 |
| CO 2 | 3 | 2 | | | | | | 2 | | | | 2 | | 3 |
| CO 3 | 3 | 2 | | | | | | 2 | | | | 2 | | 3 |
| CO 4 | 3 | 2 | | | | | | 2 | | | | 2 | | 3 |
| CO 5 | 3 | 2 | | | | | | 2 | | | | 2 | | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

N. Natarajan
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| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 40 | 40 | 40 | 80 |
| Apply | | | | |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|--|----------|----------|----------|----------|
| 20MEE65 | AUTOMOTIVE EMISSION AND CONTROL | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | I.C. Engines | | | | |

Course Objectives

Students undergoing this course are expected to

1. Develop the basic knowledge of the students in automobile engines pollution formation
2. Interpret the different types of control techniques, Measurement techniques
3. Know the social, cultural, global and environmental responsibilities of the professional engineer
4. Find the available principles of sustainable design and development.
5. Develop professional fundamentals and understand about measurement techniques.

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|--------------|---|----------------------|
| CO 1 | Describe the emission and its effect on human health and environment. | Remembering |
| CO 2 | Identify the formation of pollutant in SI engine. | Understand |
| CO 3 | Explain the formation of pollutant in CI engine | Understand |
| CO 4 | Describe the Emission control techniques. | Understand |
| CO 5 | Predict the Emission measurement techniques, Emission Standards and various test procedure. | Understand |

Course Contents

UNIT I INTRODUCTION

9

Vehicle Population Assessment in Metropolitan Cities and Contribution to Pollution, Effects on Human Health and Environment, Global Warming, Types of Emission (Controlled and Uncontrolled Emissions), Transient Operational Effects on Pollution.

UNIT II POLLUTANT FORMATION IN SI ENGINES

9

Pollutant Formation in SI Engines, Mechanism of HC and CO Formation in Four Stroke and Two Stroke SI Engines, NO_x Formation in SI Engines, Effects of Design and Operating Variables on Emission Formation, Evaporative Emission. Two Stroke Engine Pollution.

UNIT III POLLUTANT FORMATION IN CI ENGINES

9

Pollutant Formation in CI Engines, Smoke and Particulate Emissions in CI Engines, Effects of Design and Operating Variables on CI Engine Emissions, NO_x Formation

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UNIT IV CONTROL OF EMISSIONS FROM SI AND CI ENGINES**9**

Design of Engine, Optimum Selection of Operating Variables for Control of Emissions, EGR, Catalytic Converters, Catalysts, Fuel Modifications, Two Stroke Engine Pollution Controls. SCR, Lean NOx Trap and DPF, PCV, Fuel Charcoal Canister.

UNIT V MEASUREMENT TECHNIQUES EMISSION STANDARDS AND TEST PROCEDURE**9**

NDIR, FID, Chemiluminescent Analyzers, Gas Chromatograph, Smoke Meters, Emission Standards, Driving Cycles – USA, Japan, Euro and India. Test Procedures – ECE, FTP Tests. SHED Test – Chassis Dynamometers, Dilution Tunnels.

Total : 45 Periods**Text Books.**

1. Engine Emissions, Pollutant formation and Measurement by George Springer, Springer 2012.
2. J.D. Halderman and J. Linder, Automotive Fuel and Emissions Control Systems, NJ: Pearson Education, 4th edition 2016.
3. B.P. Pundir, Engine Emissions: Pollutant Formation and Advances in Control Technology, New Delhi: Narosa Publishing House, 2017.
4. M. Adachi and H. Nakamura, Eds., Engine Emissions Measurement Handbook, PA: SAE International, 2014.

Reference Books

1. B. L. Singhal, Prof. (Dr.) D. R. Shah "Internal Combustion Engines"- Tech Knowledge Publications, 2020
2. Wladyslaw Mitianiec "Fundamentals of Fuel Injection and Emissions from two stroke engines, Nova Science Publishers Inc 2018.
3. M.K.Khair and W.A.Majewski, Diesel Emissions and Their Control, PA: SAE International, 2014.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|----------|----------|----------|-----------------|----------|----------|----------|--------------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | | 3 | | | | | | 3 | | | | | 3 |
| CO 2 | 3 | | 2 | | | | | | 3 | | | | | 3 |
| CO 3 | 3 | | 3 | | | | | | 3 | | | | | 3 |
| CO 4 | 3 | | 3 | | | | | | 3 | | | | | 3 |
| CO 5 | 3 | | 3 | | | | | | 3 | | | | | 3 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |


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| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 20 | 20 | 20 | 20 |
| Understand | 80 | 80 | 80 | 80 |
| Apply | | | | |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|-------------------------------|----------|----------|----------|----------|
| 20MEE66 | TWO AND THREE WHEELERS | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | Automotive chassis | | | | |

Course Objectives

Students undergoing this course are expected to

1. Develop the basic knowledge of the students in constructional details of two and three Wheelers.
2. Know the basic knowledge of the students in constructional details of clutches.
3. Interpret the different types of brakes and tyres
4. Examine the list and study the various two wheeler models.
5. Explain the list and study the various three wheeler models.

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|--------------|---|----------------------|
| CO 1 | Know the working of two and four stroke engines | Remembering |
| CO 2 | Explain the functioning of clutch and gear box | Remembering |
| CO 3 | Discuss the wheels, tyres, suspensions and braking systems | Understand |
| CO 4 | Familiarize the latest models of two wheelers | Understand |
| CO 5 | Find the available operations of three wheelers and latest models of three wheelers | Understand |

Course Contents

UNIT I POWER UNIT

9

Two Stroke SI Engine, Four Stroke SI Engine - Merits and Demerits. Symmetrical and Unsymmetrical Port Timing Diagrams. Types of Scavenging Processes: Merits and Demerits, Scavenging Pumps. Rotary Valve Engine, Fuel System, Lubrication System. Magneto Coil and Battery Coil Spark Ignition System, Electronic Ignition System. Starting System - Kick Starter System.

UNIT II CHASSIS AND SUB-SYSTEMS

9

Mainframe and Its Types - Chassis and Shaft Drive - Single, Multiple Plates and Centrifugal Clutches. Gear Box and Gear Controls - Front and Rear Suspension Systems - Shock Absorbers - Panel Meters and Controls on Handle Bar.


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UNIT III BRAKES, WHEELS AND TYRES**9**

Drum Brakes, Disc Brakes, Front and Rear Brake Links, Layouts - Spoke Wheel, Cast Wheel, Disc Wheel and Disc Types - Tyres and Tubes.

UNIT IV TWO WHEELERS**9**

Study and Comparison of Specification and Features of Major Indian Models of Mopeds, Scooters and High Performance Vehicles. Injection Systems, Silencer Design and After Treatment Devices.

UNIT V THREE WHEELERS**9**

Study and Comparison of Specification and Features of Indian Models. Auto Rickshaws, Pickup Van, Delivery Van and Trailer. Maintenance & Fault Tracing, Injection Systems, Silencer Design and After Treatment Devices

Total : 45 Periods**Text Books**

1. Dhruv U. Panchal, Two and three wheeler Technology, 1st Edition, 2015
2. Irving.P.E. - Motor Cycle Engineering - Veloce Enterprises, Inc., 2017
3. Ramalingam. K. K., "Two Wheelers", Scitech publications, Chennai, 2009.

Reference Books

1. D.U .Panchal, Two and Three Wheeler Technology, New Delhi: PHI Learning Private Ltd, 2015
2. <https://nptel.ac.in/courses/105107123/3>

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|----------|----------|----------|-----------------|----------|----------|----------|--------------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | | | | 3 | | 3 | | | | | | | 2 |
| CO 2 | 3 | | | | 3 | | 3 | | | | | | | 2 |
| CO 3 | 3 | | | | 3 | | 3 | | | | | | | 2 |
| CO 4 | 3 | | | | 3 | | 3 | | | | | | | 2 |
| CO 5 | 3 | | | | 3 | | 3 | | | | | | | 2 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |


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| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 40 | 40 | 40 | 40 |
| Understand | 60 | 60 | 60 | 60 |
| Apply | | | | |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|----------------------------|----------|----------|----------|----------|
| 20MEE67 | OFF ROAD VEHICLES | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | NIL | | | | |

Course Objectives

Students undergoing this course are expected to

1. Understand the basics of off road vehicles.
2. Explain the constructional features and working of earth movers.
3. Illustrate the constructional features and working of Shovels, ditchers, scrappers, graders.
4. Describe the constructional features and working of farm equipments, military and combat vehicles.
5. Know about the vehicle systems and features.

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|--------------|---|----------------------|
| CO 1 | Know the fundamental knowledge about various type of off road vehicles. | Understand |
| CO 2 | Understand the special features about the earth moving machines and other off road vehicles. | Understand |
| CO 3 | Select and apply the appropriate design methodology for the off road vehicles. | Understand |
| CO 4 | Illustrate the knowledge about the working principle for various type of off road vehicles. | Apply |
| CO 5 | Remember the knowledge about application of the off road vehicles and can apply the new methodology to improve the performance of the vehicles. | Apply |

Course Contents

UNIT I CLASSIFICATION OF OFF ROAD VEHICLES 9

Introduction to off road vehicles – Classification: Construction layout, capacity and applications, Power Plants, Chassis and Transmission and Multi-axle vehicles.

UNIT II EARTH MOVING AND MATERIAL HANDLING MACHINES 9

Earthmovers like dumpers, loaders, dozers, excavators, backhoe loaders, bush cutters, stumpers, and rippers – Power, Capacity and Mechanisms of earth moving machines. Material handling vehicles used in the industries – Hydraulic and Electric drives.

UNIT III SCRAPPERS ,GRADERS, SHOVELS AND DITCHERS 9

Scrappers, elevating graders, motor graders, self-powered scrappers and graders, Power shovel, revolving and stripper shovels – drag lines – ditchers – Power, Capacity and Mechanisms of mining machines.

UNIT IV FARM EQUIPMENTS, MILITARY AND COMBAT VEHICLES 9

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Constructional details of Tractors - power take off, special implements. Case study of any one tractor. Special features and constructional details of tanks, gun carriers and military transport vehicles.

UNIT V VEHICLE SYSTEMS, FEATURES

9

Brake system and actuation – OCDB and dry disc calliper brakes. Body hoist and bucket operational hydraulics. Hydro-pneumatic suspension cylinders. Power steering system. Kinematics for loader and bulldozer operational linkages. Safety features, safe warning system for dumper. Design aspects on dumper body, loader bucket and water tank of sprinkler.

Total : 45 Periods

Text Books

1. Robert Peurifoy, Clifford J. Schexnayder, Aviad Shapira, Robert Schmitt, "Construction Planning, Equipment, and Methods", Tata McGraw-Hill Education Pvt. Ltd., 2011.
2. Nakra C.P., "Farm machines and equipments", Dhanparai Publishing company Pvt. Ltd. 2003.
3. Zhaochoao Yong Li Ziguang., "Road Construction machinery", S.K. Kataria, 2018.
4. Wong.J.Y. "Theory of Ground Vehicles", Hardcover 2008.

Reference Books

1. I.S. Ageikin, Off the road wheeled and combined traction devices, CRC Press, 2004.
2. Schulz Erich.J, Diesel equipment I &II, Mcgraw Hill Company, London, 2005.
3. Bart H Vanderveen, Tanks and Transport vehicles, Frederic Warne and Co Ltd London.
4. Satyanarayana. B., Construction planning and equipment, standard publishers and distributors, New Delhi.
5. H.P. Smith, Farm Machinery and Equipment, Belgium: Morse Press, 2011.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|--------|---|---|---|----------|---|---|---|-------|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 2 | 3 | | 3 | | 1 | | | | | | | | 2 |
| CO 2 | 2 | 3 | | 3 | | 1 | | | | | | | | 2 |
| CO 3 | 2 | 3 | | 3 | | 1 | | | | | | | | 2 |
| CO 4 | 2 | 3 | | 3 | | 1 | | | | | | | | 2 |
| CO 5 | 2 | 3 | | 3 | | 1 | | | | | | | | 2 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 40 | 40 | 40 | 20 |
| Understand | 60 | 60 | 60 | 80 |
| Apply | | | | |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|-------------------------------------|----------|----------|----------|----------|
| 20MEE68 | ELECTRIC AND HYBRID VEHICLES | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | NIL | | | | |

Course Objectives

Students undergoing this course are expected to

1. Give the students the idea of global energy scenario, pollution levels and green mobility technology solutions
2. Make the students understand the basics of traction batteries, their operating characteristics, charging and management system.
3. Understand the basics of power electronics used in hybrid and electrical vehicles
4. Explain the characteristics of traction motors, their performance and vehicle performance
5. Familiarize with electromagnetic interference and EV testing standards.

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|--------------|--|----------------------|
| CO 1 | Illustrate the concept of electric vehicles and its propulsion systems | Understand |
| CO 2 | State the concept of hybrid architecture and power plan. | Understand |
| CO 3 | List the energy storage systems. | Understand |
| CO 4 | Explain about the fuel cells | Apply |
| CO 5 | Illustrate the non electric hybrid propulsion systems | Apply |

Course Contents

UNIT I INTRODUCTION

9

Global energy scenario - Electric and hybrid vehicle - need, advantages, challenges - layout, components. Hybrid vehicle – advantages, disadvantages, architecture – series, parallel, plug-in, mild and assist hybrid. Hybrid vehicle operating modes – Fuel cells – basics, types, advantages and disadvantages.

UNIT II TRACTION BATTERIES

9

Targets and properties of batteries, Li-Po battery, Li ion battery, Nickel Metal Hydride Battery, Sodium Sulphur Battery and Aluminium Air Battery, Super capacitors. Battery charging - battery charging profile charging time –charging standards – charging methods – charging modes – vehicle to grid technology – Tesla power wall –Wireless power transfer – Regenerative Braking - Battery management System.


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UNIT III POWER ELECTRONICS FOR EV AND HEV**9**

Semiconductor power diodes, transistors, thermistors, triacs, GTOs. AC-DC converters, DC-DC converters and types – buck, boost, fly back. Isolated converters. Inverters based on MOSFET. Microcontrollers/DSP based controllers, Types of sensors for electric drive, Current sensors and signal conditioners.

UNIT IV MOTORS FOR ELECTRIC VEHICLE**9**

Introduction –Motor and engine ratings- motor torque and power characteristics – EV motor sizing -Construction and working principle of DC machines, BLDC Motor, three phase AC machines, PM and SR machines – Design criteria of DC motor drives, induction motor drives and PM/SRM motor drives for EVs. –Acceleration Performance and Vehicle Power - Final Drive - Speed Calculation with a Torque Profile

UNIT V ELECTROMAGNETIC INTERFERENCE & EV TESTING**9**

EMI – Noise propagation modes – cabling – components – PCB EMC – SAE Automotive EMC standards – SAEJ551- SAE J 1113 – Test methodology - Need for testing EVs – Safety checklist (AIS 038). – significance of isolation resistance - measurement of isolation resistance – water tests(flood test/ wash test/ rain test) motor power test (AIS 041) – chassis dynamometer – motor dynamometer (motor test bed) – Energy consumption test(AIS 039) – battery testing (AIS 048) – steps for reducing the energy consumption – Range test (AIS 040) –FAME scheme of INDIA.

Total : 45 Periods**Text Books**

1. Tom Denton. "Electric and Hybrid Vehicles" Routledge Publications, 2016.
2. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Boca Raton: CRC Press, 2018.
3. Ali Emadi, Handbook of Automotive Power Electronics and Motor Drives, CRC Press, 2017

Reference Books

1. Chau. K. T. "Electric Vehicle Machines and Drives – Design, Analysis and Application", John Wiley & Sons Singapore Pte. Ltd., 2015
2. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 24-Oct-2014
3. Power Electronics and Motor Drives, Bogdan M. Wilamowski, J. David Irwin, CRC Press, 2016

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|------------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | | 3 | | 2 | | | | | | | | | 3 |
| CO 2 | 3 | | 3 | | 2 | | | | | | | | | 2 |
| CO 3 | 3 | | 3 | | 2 | | | | | | | | | 2 |


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| | | | | | | | | | | | | | |
|------|---------------|--|---|--|-----------------|--|--|--|--------------|--|--|--|---|
| CO 4 | 3 | | 3 | | 2 | | | | | | | | 2 |
| CO 5 | 3 | | 3 | | 2 | | | | | | | | 2 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | |

| Formative Assessment | | | |
|-----------------------------|-----------------------------|--------------|--------------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|-----------------------------|---|-----------------------|-----------------------|--------------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 30 | 30 | 30 | 60 |
| Understand | 20 | 20 | 20 | 40 |
| Apply | | | | |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|----------------------------|----------|----------|----------|----------|
| 20MEE69 | VEHICLE MAINTENANCE | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | NIL | | | | |

Course Objectives

Students undergoing this course are expected to

1. Understand the classification of maintenance work, vehicle insurance, workshop practices, safety and tools
2. Illustrate the general engine services, engine subsystem maintenance and engine maintenance.
3. Explain the transmission and driveline maintenance
4. Discuss about the steering, brake, suspension and wheel maintenance
5. Predict the auto electrical and air conditioning maintenance

Course Outcomes

On successful completion of the course the students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---------------|--|----------------------|
| CO 1 | Describe the importance, types and requirements of vehicle maintenance and related records and schedules. | Understand |
| CO 2 | Practice the engine overhauling, reconditioning; methods, procedures, tools of cylinder, valves and other engine components | Apply |
| CO 3 | Demonstrate the maintenance procedures of clutch, gearbox, steering system, braking system, wheel alignment, door actuating systems and body tinkering | Apply |
| CO 4 | Explain the construction, testing, fault diagnosis and maintenance of battery, starter motor, alternator, DC generator, ignition, lighting and dashboard instruments | Understand |
| CO 5 | Illustrate the different service and maintenance aspects of fuel system, lubrication system and calibrate of fuel injection pump | Understand |

Course Contents

UNIT I MAINTENANCE, WORKSHOP PRACTICES, SAFETY AND TOOLS

9

Maintenance – Need, classification of maintenance work – policies- vehicle insurance - basic problem diagnosis. Automotive service procedures – workshop operations – workshop manual and records, Safety – Personnel, machines and equipment, vehicles, fire safety - First aid. Basic tools –special service tools – measuring instruments –Motor vehicle Act, traffic rules, driving rules and regulations


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UNIT II ENGINE AND ENGINE SUB SYSTEM MAINTENANCE**9**

General Engine service- Dismantling of Engine components- Engine repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection engine management- emission controls service and fault diagnosis.

UNIT III TRANSMISSION AND DRIVELINE MAINTENANCE**9**

Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling transmission, transaxle- Removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings servicing differential assemblies- fault diagnosis.

UNIT IV STEERING, BRAKE, SUSPENSION, WHEEL MAINTENANCE**9**

Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, Bleeding of brakes. Inspection, Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation. Inspection, Maintenance and Service of steering linkage, steering system and types.

UNIT V AUTO ELECTRICAL AND AIR CONDITIONING MAINTENANCE**9**

Maintenance of batteries, starting system, charging system and body electrical -Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Replacement of hoses- Leak detection- AC Charging- Fault diagnosis Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

Total : 45 Periods**Text Books**

1. Currie, Robert P, Currie, Michelle B, Keen, George M "Fleet Management", Wandering Brothers Publishing, 2006
2. Ed May, "Automotive Mechanics Volume One" , McGraw Hill Publications, 2003
3. Ed May, "Automotive Mechanics Volume Two" , McGraw Hill Publications, 2003

Reference Books

1. Bosch Automotive Handbook, Sixth Edition, 2004
2. James D Halderman - Advanced Engine Performance Diagnosis – Pearson, 2011.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|----------|----------|----------|-----------------|----------|----------|----------|--------------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | | 2 | | | 2 | | | | | 1 | | | 2 |
| CO 2 | 3 | | 2 | | | 2 | | | | | 1 | | | 2 |
| CO 3 | 3 | | 2 | | | 2 | | | | | 1 | | | 2 |
| CO 4 | 3 | | 2 | | | 2 | | | | | 1 | | | 2 |
| CO 5 | 3 | | 2 | | | 2 | | | | | 1 | | | 2 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |

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| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 30 | 30 | 30 | 80 |
| Understand | 20 | 20 | 20 | 20 |
| Apply | | | | |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|-------------------------|----------------------------|----------|----------|----------|----------|
| 20MEE70 | SMART MOBILITY | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of Course | Professional Elective (PE) | | | | |
| Pre requisites | NIL | | | | |

Course Objectives

Students undergoing this course are expected to

1. Develop an understanding of system engineering processes.
2. Learn about Advanced Transportation Management System
3. Explain the capability of key technologies
4. Knowing the methods of vibration and noise measurement.
5. Understand how to evaluate technologies, applications and services

Course Outcomes

On successful completion of the course the students will be able to

| CO.No | Course Outcome | Bloom's Level |
|--------------|--|----------------------|
| CO 1 | Understand Smart Transportation Systems Advanced Traffic Management Systems | Understand |
| CO 2 | Explain about Advanced Transportation Management System | Apply |
| CO 3 | Know about APTS, CVO, new technology and ETC | Understand |
| CO 4 | Describe about measurement techniques of noise, vibration pertain to an automobile | Understand |
| CO 5 | Summarizes about STS issues in terms of various factors and emerging issues. | Apply |

Course Contents

UNIT I INTRODUCTION

9

Introduction to the Concept of Automotive Electronics- Body, Chassis and Power train Electronics, Advanced Driver Assistance Electronic Systems. Basic Control System Theory applied to Automobiles-Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy.

UNIT II SENSOR TECHNOLOGY FOR AUTOMATED VEHICLES

9

Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems

UNIT III COMPUTER VISION AND DEEP LEARNING

9

Introduction, Computer Vision: Computer Vision Fundamentals, Deep Learning:- Neural Networks, Deep Neural Networks, Convolutional Neural Networks, Keras, Tensor Flow, Sensor Fusion:- Kalman Filters

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UNIT IV LOCALISATION AND PATH PLANNING**9**

Introduction to Localization- Motion Models, Particle Filters, Implementation of a Particle Filter, Path Planning: -search, prediction, behaviour planning, trajectory generation, Control-PID, System Integration-ROS Driverless Car Technology: - Moral, Legal, Roadblock Issues, Technical Issues, Security Issues

UNIT V CONNECTED CAR TECHNOLOGY**9**

Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Wireless Security Overview Connected Car Display Technology- Center Console Technology, Gauge Cluster Technology, Heads-Up Display Technology, Warning Technology-Driver Notification.

Total : 45 Periods**Text Books**

1. Markus Maurer, J. Christian Gerdes, Barbara Lenz, Hermann Winner , Autonomous Driving: Technical, Legal and Social Aspects, Springer,2016
2. Hod Lipson, Melba Kurman, Driverless: Intelligent Cars and the Road Ahead, MIT press, 2016
3. Michael E. McGrath, Autonomous Vehicles: Opportunities, Strategies, and disruptions, 2016.
4. R.P Roess, E.S. Prassas, W.R. McShane. Traffic Engineering, Pearson Educational International, Third Edition, 2004.

Reference Books

1. Vivekwadhwa , Alex salkever, The driver in the driverless car, 2017
2. Sussman, J.M. Perspectives on Intelligent Transportation Systems, Springer, Berlin, 2010
3. Mashrur A. Chowdhury, and Adel Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, Inc., 2003.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|---------------|----------|----------|----------|-----------------|----------|----------|----------|--------------|-----------|-----------|-----------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | | | 2 | | 2 | | | | | | | 2 |
| CO 2 | 3 | 2 | | | 2 | | 2 | | | | | | | 2 |
| CO 3 | 3 | 2 | | | 2 | | 2 | | | | | | | 2 |
| CO 4 | 3 | 2 | | | 2 | | 2 | | | | | | | 2 |
| CO 5 | 3 | 2 | | | 2 | | 2 | | | | | | | 2 |
| | 3-High | | | | 2-Medium | | | | 1-Low | | | | | |


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| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 30 | 30 | 30 | 80 |
| Understand | 20 | 20 | 20 | 20 |
| Apply | | | | |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


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Open Electives

| | | | | | |
|------------------|--------------------------------|---|---|---|---|
| 20MEO01 | INTEGRATED PRODUCT DEVELOPMENT | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of course | OPEN ELECTIVE COURSE | | | | |
| Pre requisites | NIL | | | | |

Course Objectives

The course is intended to

1. Understand the global trends and development methodologies of various types of products and services
2. Conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
3. Understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
4. Understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
5. Develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO 1 | Summarize the various trends affecting product decision | Understand |
| CO 2 | Identify the requirements to create new product | Apply |
| CO 3 | List the different techniques involved in design creation and design testing. | Remembering |
| CO 4 | Illustrate the need of end of life and patenting. | Understand |
| CO 5 | Apply the knowledge on values of product development and engineering service industries in business. | Apply |

Course Contents**Unit – I FUNDAMENTALS OF PRODUCT DEVELOPMENT****9**

Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management

Unit – II REQUIREMENTS AND SYSTEM DESIGN**9**

Requirement Engineering - Types of Requirements - Requirement Engineering -traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization.

Unit – III DESIGN AND TESTING**9**

Conceptualization - Industrial Design, Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines – Concept Screening & Evaluation - Detailed Design - Component Design and Verification, Introduction to Rapid Prototyping, Testing, Certification and Documentation

Unit – IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT**9**

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair.

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Unit – V Introduction to Intellectual Property Rights (Ipr)**9**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, Research Hypothesis, Innovation, patenting development, Citation, International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents.

Total : 45 Periods**Text Books**

1. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
2. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005

Reference Books

1. Hiriappa B, "Corporate Strategy – Managing the Business", Author House, 2013
2. Peter F Drucker, "People and Performance", Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise Resource Planning – Concepts", Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|------------|-------------|----------|----------|----------|----------|---------------|----------|----------|-----------|-----------|------------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 1 | - | - | - | 1 | 1 | 1 | 1 | - | - | 1 | - | 3 |
| CO 2 | 3 | 1 | - | - | - | 1 | 1 | 1 | 1 | - | - | 1 | - | 3 |
| CO 3 | 3 | 1 | - | - | - | 1 | 1 | 1 | 1 | - | - | 1 | - | 3 |
| CO 4 | 3 | 1 | - | - | - | 1 | 1 | 1 | 1 | - | - | 1 | - | 3 |
| CO 5 | 3 | 1 | - | - | - | 1 | 1 | 1 | 1 | - | - | 1 | - | 3 |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|-------------------------|---|---|---|---|
| 20MEO02 | MANUFACTURING PROCESSES | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of course | OPEN ELECTIVE COURSE | | | | |
| Pre requisites | NIL | | | | |

Course Objectives

The course is intended to

1. Understand the basic concepts of sand-casting technique and special casting technique.
2. Understand the principles, equipment's of different welding techniques.
3. Know the various operations and equipment requirements of hot and cold metal forming processes.
4. Familiarize the working principle and applications of different types of sheet metal processes.
5. Demonstrate the working principles of different types of thermo plastic manufacturing methods.

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|---|---------------|
| CO 1 | Summarize the concepts of basic manufacturing processes, metal casting processes and melting furnaces. | Understand |
| CO 2 | Describe the working principles of arc welding, gas welding and special welding processes. | Understand |
| CO 3 | Demonstrate different manufacturing processes, hot and cold working processes with their typical applications | Apply |
| CO 4 | Describe the sheet metal characteristics, operations, and special forming processes. | Remembering |
| CO 5 | Select various types of plastic injection molding processes and typical applications. | Remembering |

Course Contents

Unit – I METAL CASTING

9

Sand Casting: Sand Mould – Type of patterns - Pattern Materials – Pattern allowances –Moulding sand Properties and testing – Cores –Types and applications – Moulding machines– Types and applications; Melting furnaces: Blast and Cupola Furnaces.

Unit – II METAL JOINING PROCESSES

9

Operating principle, basic equipment, merits and applications of: arc welding processes: Gas Tungsten arc welding Gas metal arc welding, Brazing and soldering; Weld defects: types, causes and cure. Adhesive bonding.

Unit – III METAL FORMING PROCESSES

9

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – Rolling of metals– Types of Rolling – Flat strip rolling – shape rolling operations- Principle of rod and wire drawing – Tube drawing.

Unit – IV SHEET METAL PROCESSES

9

Sheet metal processes – blanking, piercing, shearing, bending, slotting, perforating, notching and drawing. Construction simple and compound die.

Unit – V MANUFACTURE OF PLASTIC COMPONENTS

Injection moulding – Plunger and screw machines – Compression moulding, Transfer Moulding – introduction to blow moulding - Rotational moulding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics.

Total : 45 Periods**Text Books**

1. Hajra Choudhary. S.K and Hajra Choudhary. A.K., "Elements of Workshop Technology", volume I and II, Media Promoters and Publishers Private Limited, Mumbai, 2010.
2. Kalpakjian. S, "Manufacturing Engineering and Technology", 7th Edition, Pearson Education India Edition, 2018

Reference Books

1. Roy A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2006
2. Black J.T and Ronald A. Kosher, "Degarmos Materials and Processes, in Manufacturing" 12th Edition, Wiley Publishers, 2017.
3. Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2006
4. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", Vol 1, 4th Edition, McGraw Hill-2017.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|--|------------|-------------|----------|----------|----------|----------|---------------|----------|----------|-----------|-----------|------------|-------------|----------|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 2 | 1 | 1 | - | - | 1 | 2 | - | - | - | 1 | 1 | - | 2 |
| CO 2 | 2 | 1 | | - | - | 1 | 2 | - | - | - | 1 | 1 | - | 2 |
| CO 3 | 2 | 1 | 1 | - | - | 1 | 2 | - | - | - | 1 | 1 | - | 2 |
| CO 4 | 2 | 1 | 1 | - | - | 1 | 2 | - | - | - | 1 | 1 | - | 2 |
| CO 5 | 2 | 1 | 1 | - | - | 1 | 2 | - | - | - | 1 | 1 | - | 2 |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 20 | 20 | 20 | 40 |
| Understand | 20 | 20 | 20 | 40 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|-----------------------|---|---|---|---|
| 20MEO03 | AUTOMOTIVE TECHNOLOGY | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of course | OPEN ELECTIVE COURSE | | | | |
| Pre requisites | NIL | | | | |

Course Objectives

The course is intended to

1. Understand the various types of automobiles, their power packs, and types of vehicle bodies.
2. Differentiate the various types of power train and fuel supply and management systems
3. know the various types of transmission systems for a vehicle
4. Understand the working parameters of various braking and suspension system in a vehicle.
5. Summaries the working parameters of various electrical and electronic devices in a vehicle

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO 1 | Describe the various types of automobiles, their power packs, and types of vehicle bodies. | Remembering |
| CO 2 | Describe various types of power train and fuel supply and management systems | Understand |
| CO 3 | Identify different types of transmission systems for a vehicle | Understand |
| CO 4 | discover the concepts and working principles of various braking and suspension system in a vehicle | Apply |
| CO 5 | Interpret the working parameters of various electrical and electronic devices in a vehicle | Apply |

Course Contents**Unit – I INTRODUCTION TO AUTOMOBILE AND TYPES****9**

An overview of different types of automobiles and their power sources. Specifications, Performance Parameters, Types of power delivery, Safety standards. Regulations, Car body construction. Bus Body Details, General consideration relating to chassis layout.

Unit – II FUEL MANAGEMENT SYSTEMS**9**

Reciprocating Engine systems, Hybrid systems. Working principle of an electric vehicles, fuel cells. Liquid and gaseous alternate fuels - Alcohol, LPG, CNG, and Hydrogen

Unit – III TRANSMISSION SYSTEMS**9**

Clutch system and types, Gear box and types - manual, automatic, and AMT, Wheels, Tyres - types, construction and specification, types of suspension systems.

Unit – IV BRAKING AND STEERING SYSTEMS**9**

Braking system - requirements and types, Antilock breaking systems, Steering system - working, types and power steering. Wheel balancing & Alignment, Maintenance of Vehicles

Unit – V ELECTRICAL AND ELECTRONIC SYSTEMS**9**

Introduction to Battery, Alternator, and Starter Motor systems, working principle, and circuitry, Safety systems - seat belts, air-bag, Modern electronic features in vehicles like tyre pressure monitoring, ESP, EBD, Automatic headlamp ON, Rain sensing wipers, speed sensing auto locking.

Total - 45 Periods

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Text Books

1. Jack Erjavek, "Automotive Technology – A Systems Approach", Thomson Learning, 6th Edition, 2014
2. William H. Crouse and Donald L. Anglin, "Automotive Mechanics", Tata McGraw Hill, 10th Edition, 2017

Reference Books

1. Gill P.S., "A Textbook of Automobile Engineering – Vol. I, II and III", S.K.Kataria and Sons, 2nd Edition, 2012
2. Giri, N.K., "Automotive Technology", Khanna Publishers, 2nd Edition, 2002
3. Kirpal Singh, Automobile Engineering Volume I and II, Standard Publishers & Distributors, 14th Edition, 2017.
4. Kumar D.S., "Automobile Engineering", S.K.Kataria and Sons, 2nd Edition, 2017.
5. Robert Bosch GmbH, "Automotive Handbook", Robert Bosch, 2004.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | 2 | - | - | 3 | - | - | - | - | - | - | 2 | - | 3 |
| CO 2 | 3 | 2 | - | - | 3 | - | - | - | - | - | - | 2 | - | 3 |
| CO 3 | 3 | 2 | - | - | 3 | - | - | - | - | - | - | 2 | - | 3 |
| CO 4 | 3 | 2 | - | - | 3 | - | - | - | - | - | - | 2 | - | 3 |
| CO 5 | 3 | 2 | - | - | 3 | - | - | - | - | - | - | 2 | - | 3 |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | |

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| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 20 | 20 | 20 | 40 |
| Apply | 20 | 20 | 20 | 40 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| 20MEO04 | ALTERNATE ENERGY SOURCES | L | T | P | C |
|------------------|--------------------------|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| Nature of Course | OPEN ELECTIVE COURSE | | | | |
| Pre requisites | NIL | | | | |

Course Objectives

The course is intended to

1. Get exposure on solar radiation and its environmental impact to power
2. Understand role significance of solar energy and various collectors used for storing solar energy.
3. Learn about the wind energy and biomass and its economic aspects
4. Understand the role of geothermal energy and ocean energy in the Energy Generation
5. Understand the concept of energy Conservation

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|---|---------------|
| CO 1 | Recall the basic concepts of solar energy, measurement of solar radiation, solar thermal collector and its performance. | Remember |
| CO 2 | Explain the principle of photovoltaic energy conversion and thermal energy storage system. | Understand |
| CO 3 | Summarize the principle of wind energy conversion and various biomass energy conversion methods. | Understand |
| CO 4 | Demonstrate the principle of geothermal energy conversion and various ocean energy conversion technologies. | Understand |
| CO 5 | Identify the principle of different direct energy conversion technologies. | Apply |

Course Contents**Unit – I PRINCIPLES OF SOLAR RADIATION****9**

The solar energy, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, Instruments for measuring solar radiation and sun shine. Solar energy collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation.

Unit – II SOLAR ENERGY STORAGE AND APPLICATIONS**9**

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.; behavior of solar cells; cell properties;

Unit – III WIND ENERGY & BIO –MASS**9**

Sources and potentials, horizontal and vertical axis windmill, process of electricity generation and wind farms. BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters.

Unit – IV GEOTHERMAL & OCEAN ENERGY**9**

Resources, types of wells, methods of harnessing the energy, potential in India. Ocean energy: OTEC, Principles utilization, setting of OTEC plants. Tidal and wave energy: Potential and conversion techniques.

Unit – V ALTERNATE FUELS**9**

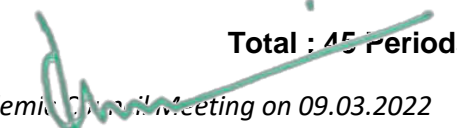
Estimation of petroleum reserve - Need for alternate fuel - Availability and properties of alternate fuels - general use of alcohols - LPG - Hydrogen - Ammonia, CNG, and LNG - Vegetable oils and Biogas - Merits and demerits of various alternate fuels.

Total : 45 Periods

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Text Books

1. S.Rao, Non-conventional, renewable and conventional energy, Khanna Publishers ,New Delhi, 2005
2. Boyle, G. Renewable energy, Power for a sustainable future. Oxford University press, Oxford, UK, 2004.

Reference Books

1. John Twidell & Tony Weir, Renewable Energy resources, Routledge, 2015
2. Kemp, W.H. The Renewable Energy Handbook, Aztext Press Ontario, Canada, 2009
3. Duffie, J. A. & W. A. Beckman, Solar Engineering of Thermal Processes, 3rd ed. John Wiley & Sons, Inc. 2006.
3. Demirbas, A. Biorefineries – for biomass upgrading facilities, Springerpublishers, 2010.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

| COs | POs | | | | | | | | | | | | PSOs | |
|------|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | | - | - | | - | 2 | - | - | - | - | 2 | - | 2 |
| CO 2 | 3 | | - | - | | - | 2 | - | - | - | - | 2 | - | 2 |
| CO 3 | 3 | | - | - | | - | 2 | - | - | - | - | 2 | - | 2 |
| CO 4 | 3 | | - | - | | - | 2 | - | - | - | - | 2 | - | 2 |
| CO 5 | 3 | | - | - | | - | 2 | - | - | - | - | 2 | - | 2 |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | |

Formative Assessment

| Blooms Taxonomy | Assessment Component | Marks | Total marks |
|-----------------|-----------------------------|-------|-------------|
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | 5 | |
| | Attendance | 5 | |

Summative Assessment

| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
|------------------|--|----------------|----------------|-------------------------|
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

| | | | | | |
|------------------|----------------------|---|---|---|---|
| 20MEO05 | ROBOTICS | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of course | OPEN ELECTIVE COURSE | | | | |
| Pre requisites | NIL | | | | |

Course Objectives

The course is intended to

1. understand the functions of the basic components of a robot interpret
2. study the use of various types of End of effectors and sensors
3. impart knowledge on dynamics of robots and sensors used in robot
4. impart knowledge in robot kinematics and programming
5. learn safety issues in robot implementation and economics

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO 1 | Select the robot and its grippers based on application. | Remember |
| CO 2 | Explain the robot position and orientation | Understand |
| CO 3 | Describe the sensing and visioning operations of robot | Understand |
| CO 4 | Summarize optimal trajectory and path planning of robots | Understand |
| CO 5 | Select the robot for an industry and perform economic study. | Apply |

Course Contents

Unit – I FUNDAMENTALS OF ROBOT 9

Robot - Definition - Robot Anatomy - Co-ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.

Unit – II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic-Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers.

Unit – III SENSORS AND MACHINE VISION 9

Requirements of a sensor - Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors, Touch Sensors, binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition.

Unit – IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension). Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

Unit – V IMPLEMENTATION AND ROBOT ECONOMICS**9**

RGV, AGV; Implementation of Robots in Industries-Variou Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

Total : 45 Periods**Text Books**

1. Klafter R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall, 2009.
2. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2001

Reference Books

1. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.
2. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co., 2017.
3. Koren Y., "Robotics for Engineers", McGraw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.
5. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill, 1995.
6. Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company, 2008.
7. Surender Kumar, "Industrial Robots and Computer Integrated Manufacturing", Oxford and IBH Publishing Co. Pvt. Ltd., 1991.

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | 3 | | | | 3 | | | | | | | 2 | | 2 |
| CO 2 | 3 | | | | 3 | | | | | | | 2 | | 2 |
| CO 3 | 3 | | | | 3 | | | | | | | 2 | | 2 |
| CO 4 | 3 | | | | 3 | | | | | | | 2 | | 2 |
| CO 5 | 3 | | | | 3 | | | | | | | 2 | | 2 |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | |

| Formative Assessment | | | |
|-----------------------------|-----------------------------|--------------|--------------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | 5 | |
| | Attendance | 5 | |

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| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |


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| | | | | | |
|------------------|--------------------------|---|---|---|---|
| 20MEO06 | PRINCIPLES OF MANAGEMENT | L | T | P | C |
| | | 3 | 0 | 0 | 3 |
| Nature of course | OPEN ELECTIVE COURSE | | | | |
| Pre requisites | NIL | | | | |

Course Objectives

The course is intended to

1. Enable the students to study the evolution of Management,
2. Study the functions and principles of management.
3. Learn the application of the principles in an organization.
4. Enable the effective and barriers communication in the organization
5. Study the system and process of effective controlling in the organization..

Course Outcomes

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|--------|--|---------------|
| CO 1 | Recall an understanding of basic management concepts, principles, and practices. | Remember |
| CO 2 | Develop strategic planning and decision-making strategies in an organization. | Apply |
| CO 3 | Summarize the concept and complete the process of organizing. | Understand |
| CO 4 | Interpret an understanding of staffing, leadership, and motivation in an organization. | Understand |
| CO 5 | Demonstrate the dynamics of controlling and its emerging issues in management. | Understand |

Course Contents

Unit – I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations, system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment.

Unit – II PLANNING 9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

Unit – III ORGANISING 9

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management.

Unit – IV DIRECTING 9

Foundations of individual and group behavior – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication.

Unit – V CONTROLLING

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

Total : 45 Periods**Text Books**

1. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.
2. Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.

Reference Books

1. Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 1998.
2. Robert Kreitner & Mamata Mohapatra, "Management", Biztantra, 2008.
3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management", 7th Edition, Pearson Education, 2011.
4. Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 19

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | |
|---|-----|------|---|---|---|---|--------|---|---|----|----|-----|------|---|
| COs | POs | | | | | | | | | | | | PSOs | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO 1 | | | | | | 3 | | | 3 | | | | | 2 |
| CO 2 | | | | | | 3 | | | 3 | | | | | 2 |
| CO 3 | | | | | | 3 | | | 3 | | | | | 2 |
| CO 4 | | | | | | 3 | | | 3 | | | | | 2 |
| CO 5 | | | | | | 3 | | | 3 | | | | | 2 |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | |

| Formative Assessment | | | |
|----------------------|-----------------------------|-------|-------------|
| Blooms Taxonomy | Assessment Component | Marks | Total marks |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial class / Assignment | 5 | |
| Apply | | | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|----------------------|--|----------------|----------------|-------------------------|
| Bloom's Category | Internal Assessment Examinations (IAE) | | | Final Examinations (FE) |
| | IAE – I (7.5) | IAE – II (7.5) | IAE – III (10) | 60 |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |


 Passed in Board of Studies Meeting on 25.02.2022
CHAIRMAN - BOARD OF STUDIES


 Passed in Academic Council Meeting on 09.03.2022

CHAIRMAN - ACADEMIC COUNCIL