# DAV UNIVERSITY JALANDHAR

# Course Scheme & Syllabus

# For

# B.Tech. Mechanical Engineering

## 1st TO 8thSEMESTER Examinations
## 2023–2024 Session

## Syllabi Applicable For Admissions in 2023

**Mandatory Induction program (Appendix A)**
**[Induction program for students to be offered right at the start of the first year.]**

## 3 Weeks Induction Program (Mandatory)

- **Physical activity**
- **Creative Arts**
- **Universal Human Values**
- **Literary**
- **Proficiency Modules**
- **Lectures by Eminent People**
- **Visits to local Areas**
- **Familiarization to Dept. /Branch & Innovations**

## PROGRAMME EDUCATIONAL OUTCOMES (PEOs)

After the successful completion of undergraduate course, Mechanical Engineering, Graduates will be able to:

**PEO1**: Plan, design, construct, maintain and improve mechanical engineering systems that are technically sound, economically feasible and socially acceptable.
**PEO2**: Apply analytical, computational and experimental techniques to address the challenges faced in mechanical and allied engineering streams.
**PEO3**: Communicate effectively using conventional platforms as well as innovative / online tools and demonstrate collaboration, networking & entrepreneurial skills.
**PEO4**: Exhibit professionalism, ethical attitude, team spirit and pursue lifelong learning to achieve career, organizational and societal goals.

## PROGRAMME OUTCOMES (POs)

**PO1: Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
**PO2: Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
**PO3: Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
**PO4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
**PO5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
**PO6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
**PO7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
**PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
**PO9: Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
**PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
**PO11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PO12: Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## PROGRAMME SPECFIC OUTCOMES (PSOs)

**PSO1**: Apply mechanical and interdisciplinary knowledge to analyze, design and manufacture products to address the needs of the society.
**PSO2**: Apply state of the art tools and techniques to conceptualize, design and introduce new products, processes, systems and services.

| Code | Definitions |
|---|---|
| L | Lecture |
| T | Tutorial |
| P | Practical |
| HS Courses | Humanities & Social Science |
| BS | Basic Science Courses |
| ES | Engineering Science Courses |
| PC | Program Core Courses |
| PE | Program Elective Courses |
| OE | Open Elective Courses |
| EEC | Employment Enhancement Courses (Project/Summer Internship/Seminar) |
| AEC-C | Ability Enhancement Course-Common |
| VAC-C | Value Added Course-Common |

Mapping of PEO with PO

| POs \ PEOs | PEO1 | PEO2 | PEO3 | PEO4 |
|---|---|---|---|---|
| PO1 | | | Y | Y |
| PO2 | | | Y | Y |
| PO3 | Y | | Y | Y |
| PO4 | | | Y | Y |
| PO5 | Y | Y | Y | Y |
| PO6 | Y | Y | Y | Y |
| PO7 | Y | Y | Y | Y |
| PO8 | | | Y | Y |
| PO9 | | | Y | Y |
| PO10 | | | | Y |
| PO11 | | | | Y |
| PO12 | Y | Y | Y | Y |

Mapping of PEO with PSO

| PEOs \ PSOs | PSO1 | PSO2 |
|---|---|---|
| PEO1 | Y | Y |
| PEO2 | Y | Y |
| PEO3 | Y | Y |
| PEO4 | Y | Y |

## Scheme of Courses
## B. Tech Mechanical Engineering
## Semester-1

| S.NO. | Paper Code | Course Title | L | T | P | Cr | Nature of Course |
|---|---|---|---|---|---|---|---|
| 1. | MAT151 | Engineering Mathematics-I | 3 | 1 | 0 | 4 | BS |
| 2. | CHM151 | Chemistry | 3 | 0 | 2 | 4 | BS |
| 3. | MED102 | Manufacturing Practice | 0 | 0 | 4 | 2 | ES |
| 4. | CST100 | Programming for Problem Solving | 3 | 0 | 0 | 3 | ES |
| 5. | CST102 | Programming for Problem Solving Laboratory | 0 | 0 | 4 | 2 | ES |
| 6. | ENH111 | Cambridge English-I | 1 | 0 | 2 | 2 | AEC-C |
| 7. | EVS104 | Environmental Studies | 2 | 0 | 2 | 3 | VAC-C |
| | | | | | | | Total=20CR |

**L: Lectures T: Tutorial P: Practical Cr: Credits**

## Scheme of Courses
## B. Tech Mechanical Engineering
## Semester-2

| S.NO. | Paper Code | Course Title | L | T | P | Cr | Nature of Course |
|---|---|---|---|---|---|---|---|
| 1. | MATXXX | Engineering Mathematics-II | 3 | 1 | 0 | 4 | BS |
| 2. | PHS151 | Engineering Physics | 3 | 0 | 2 | 4 | BS |
| 3. | MED101 | Engineering Graphics and Design | 0 | 0 | 6 | 3 | ES |
| 4. | EED101 | Basic Electrical Engineering | 3 | 0 | 0 | 3 | ES |
| 5. | EED102 | Electrical Engineering Laboratory | 0 | 0 | 2 | 1 | ES |
| 6. | MED103 | Design Thinking and Idea Lab | 0 | 0 | 2 | 1 | ES |
| 7. | HVE101 | Human Values and Ethics | 2 | 1 | 0 | 3 | VAC-C |
| 8. | ENHXXX | Cambridge English-II | 1 | 0 | 2 | 2 | AEC-C |
| | | | | | | | Total=21CR |

**L: Lectures T: Tutorial P: Practical Cr: Credits**

## Scheme of Courses
## B. Tech Mechanical Engineering
## Semester-3

| S.NO. | Paper Code | Course Title | L | T | P | Cr | Nature of Course |
|---|---|---|---|---|---|---|---|
| 1. | MATXXX | Mathematics 3/Statics and Probability /Numerical Analysis | 3 | 0 | 2 | 4 | BS |
| 2. | PHSXXX | Physics 2/ Optics and Waves | 3 | 0 | 2 | **4** | BS |
| | MEDXXX | Machine Drawing | 0 | 0 | 8 | **4** | ES |
| 3. | MEDXXX | Applied Thermodynamics | 3 | 1 | 0 | 4 | ES |
| 4. | MEDXXX | Kinematics & Dynamics of Machines | 3 | 0 | 2 | 4 | PC |
| 5. | MEDXXX | Engineering Mechanics/Quantum Mechanics | 3 | 1 | 0 | 4 | ES |
| 6. | AECXXX | Community Engagement & Social Responsibility | 1 | 0 | 2 | 2 | AEC-C |
| 7. | XXX | Sports and yoga or NCC/NSS or Swach Bharat | 0 | 0 | 2 | 0 | VAC-C |
| | | | | | | | Total=22CR |

**L: Lectures T: Tutorial P: Practical Cr: Credits**

## Scheme of Courses
## B Tech Mechanical Engineering
## Semester-4

| S.NO. | Paper Code | Course Title | L | T | P | Cr | Nature of Course |
|---|---|---|---|---|---|---|---|
| 1 | MEDXXX | Heat and Mass Transfer | 3 | 0 | 2 | 4 | PC |
| 2 | MEDXXX | Fluid Mechanics & Hydraulic Machines | 3 | 1 | 0 | 4 | PC |
| 3 | MEDXXX | Mechanics of Deformable Solids | 3 | 0 | 2 | 4 | PC |
| 4 | ECEXXX | Basic electronics Engineering | 3 | 0 | 2 | 4 | ES |
| 5 | MEDXXX | Engineering Materials & Applications | 3 | 1 | 0 | 4 | PC |
| 6 | MEDXXX | Mech Engg Lab 1(Fluid Mechanics & Hydraulic Machines) | 0 | 0 | 4 | 2 | PC |
| | | | | | | | Total=22CR |

**L: Lectures T: Tutorial P: Practical Cr: Credits**

***Note:*** *At the end of the examination of 4$^{th}$ Semester the students will undergo compulsory industrial training for a period of 4 weeks duration in reputed industries. Every student will submit the Training Report within two weeks from the start of teaching for 5$^{th}$Semester. The marks for this will be included in the 5$^{th}$ Semester.*

## Scheme of Courses
## B Tech Mechanical Engineering
## Semester-5

| S.NO. | Paper Code | Course Title | L | T | P | Cr | Nature of Course |
|---|---|---|---|---|---|---|---|
| 1. | MEDXXX | Machine Element & System Design | 3 | 1 | 0 | 4 | PC |
| 2. | MEDXXX | Mechatronics, Robotics & Control | 3 | 0 | 2 | 4 | PC |
| 3. | MEDXXX | Manufacturing Processes | 3 | 1 | 0 | 4 | PC |
| 4. | MEDXXX | Measurement & Metrology | 3 | 0 | 2 | 4 | PC |
| 5. | MEDXXX | Program Elective- 1 | 3 | 0 | 0 | 3 | PE |
| 6. | MEDXXX | Mech. Engg Lab 2 (Design) | 0 | 0 | 4 | 2 | PC |
| 7. | MEDXXX | Industrial Training | 0 | 0 | 0 | 2 | AE |
| | | | | | | | Total=23CR |

**L: Lectures T: Tutorial P: Practical Cr: Credits**

***Note:***

- *Program elective-I should be from the basket of "Program Elective-I."*

## Scheme of Courses
## B Tech Mechanical Engineering
## Semester-6

| S.NO. | Paper Code | Course Title | L | T | P | Cr | Nature of Course |
|---|---|---|---|---|---|---|---|
| 1. | MEDXXX | CAD & Analysis | 3 | 0 | 2 | 4 | PC |
| 2. | MEDXXX | Manufacturing Automation | 3 | 0 | 2 | 4 | PC |
| 3. | MEDXXX | Production & Operation Management | 3 | 1 | 0 | 4 | PC |
| 4. | MEDXXX | Product innovation & Entrepreneurship | 3 | 1 | 0 | 4 | PC |
| 5. | MEDXXX | Program Elective-2 | 3 | 0 | 0 | 3 | PE |
| 6. | MEDXXX | Mech. Engg Lab 3 (Manufacturing) | 0 | 0 | 4 | 2 | PC |
| 7. | MEDXXX | Engineering Project-1(Literature Review) | 0 | 0 | 4 | 2 | EEC |
| | | | | | | | Total=23CR |

**L: Lectures T: Tutorial P: Practical Cr: Credits**

***Note:***

- *Program elective-II should be from the basket of "Program Elective-II".*
- *At the end of the examination of 6$^{th}$ Semester the students will undergo compulsory industrial training for a period of 6 weeks duration in reputed industries. Every student will submit the training report within two weeks from the start of teaching of 7$^{th}$ Semester. The marks for this will be included in the 7$^{th}$ semester*

## Scheme of Courses
## B. Tech Mechanical Engineering
## Semester-7

| S.NO. | Paper Code | Course Title | L | T | P | Cr | Nature of Course |
|---|---|---|---|---|---|---|---|
| 1. | MEDXXX | Program Elective 3 | 3 | 0 | 0 | 3 | PE |
| 2. | MEDXXX | Program Elective 4 | 3 | 0 | 0 | 3 | PE |
| 3. | MEDXXX | Open Elective 1 | 3 | 0 | 0 | 3 | OE |
| 4. | MEDXXX | Industrial Training | 0 | 0 | 0 | 3 | AE |
| 5. | MED/XXX | Seminar/Technical Report Writing | 0/2 | 0/0 | 4/0 | 2 | AE |
| 6. | MEDXXX | Engineering Project 2 (Design and Analysis) | 0 | 0 | 10 | 5 | EEC |
| 7. | | | | | | | |
| | | | | | | | Total=19CR |

**L: Lectures T: Tutorial P: Practical Cr: Credits**

***Note:***

- *Program elective-III should be from the basket of "Program Elective-III."*
- *Program elective-IV should be from the basket of "Program Elective-IV, **Open Elective Basket and Interdisciplinary course**."*
- *Open elective-I should be from the "Open Elective Basket or MOOC Course."*

## Scheme of Courses
## B.Tech Mechanical Engineering
## Semester-8

| S.NO. | Paper Code | Course Title | L | T | P | Cr | Nature of Course |
|---|---|---|---|---|---|---|---|
| 1 | MEDXXX | Engineering Project 3 (Prototyping and Testing) | 0 | 0 | 14 | 7 | EEC |
| 2 | MEDXXX | Open Elective 2 | 3 | 0 | 0 | 3 | OE |
| | | | | | | | Total=10CR |

**L: Lectures T: Tutorial P: Practical Cr: Credits**

***Note:***

- *Student can also opt OJT (On job Training) in 8$^{th}$ sem.*
- *Open elective-II should be from the "Open Elective Basket or MOOC Course."*

**Program Elective-I**

| S.NO. | Paper Code | Course Title | L | T | P | Cr | Nature of Course |
|---|---|---|---|---|---|---|---|
| 1 | MEDXXX | Finite Element Method | 3 | 0 | 0 | 3 | Design |
| 2 | MEDXXX | Tool Design | 3 | 0 | 0 | 3 | Manufacturing |
| 3 | MEDXXX | Total Quality Management | 3 | 0 | 0 | 3 | Industrial |
| 4 | MEDXXX | Refrigeration and Air Conditioning | 3 | 0 | 0 | 3 | Thermal |
| 5 | MOOC Courses | | 3 | 0 | 0 | 3 | |

**Program Elective-II**

| S.NO. | Paper Code | Course Title | L | T | P | Cr | Nature of Course |
|---|---|---|---|---|---|---|---|
| 1 | MEDXXX | Mechanical Vibrations | 3 | 0 | 0 | 3 | Design |
| 2 | MEDXXX | Flexible Manufacturing System | 3 | 0 | 0 | 3 | Manufacturing |
| 3 | MEDXXX | Entrepreneurship development and Management | 3 | 0 | 0 | 3 | Industrial |
| 4 | MEDXXX | Gas Dynamics | 3 | 0 | 0 | 3 | Thermal |
| 5 | MOOC Courses | | 3 | 0 | 0 | 3 | |

**Program Elective-III**

| S.NO. | Paper Code | Course Title | L | T | P | Cr | Nature of Course |
|---|---|---|---|---|---|---|---|
| 1 | MEDXXX | Advanced Materials | 3 | 0 | 0 | 3 | Design |
| 2 | MEDXXX | Non-Destructive Testing | 3 | 0 | 0 | 3 | Manufacturing |
| 3 | MEDXXX | Industrial Safety | 3 | 0 | 0 | 3 | Industrial |
| 4 | MEDXXX | Non-conventional Energy Resources | 3 | 0 | 0 | 3 | Thermal |
| 5 | MOOC Courses | | 3 | 0 | 0 | 3 | |

**Program Elective-IV**

| S.NO. | Paper Code | Course Title | L | T | P | Cr | Nature of Course |
|---|---|---|---|---|---|---|---|
| 1 | MEDXXX | Mechanical Behaviour of Materials | 3 | 0 | 0 | 3 | Design |
| 2 | MEDXXX | Product Design and Development | 3 | 0 | 0 | 3 | Manufacturing |
| 3 | MEDXXX | Ergonomics and Workplace Design | 3 | 0 | 0 | 3 | Industrial |
| 4 | MEDXXX | Power Plant Engineering | 3 | 0 | 0 | 3 | Thermal |
| 5 | MOOC Courses | | 3 | 0 | 0 | 3 | |

***Note:***
*In addition to above program electives courses if the topics or subjects- a group of students requires to opt like- Machine drawing, IC engines, Optimization Techniques, Automobile Engineering, Maintenance and Reliability, Machine Learning, Artificial Intelligence, Python Programing, Internet of Things and Metlab programming etc can also be offered by mapping total credit.*

## Open Elective

| S.NO. | Paper Code | Course Title | L | T | P | Cr | Nature of Course |
|---|---|---|---|---|---|---|---|
| 1 | XXX | | 3 | 0 | 0 | 3 | OE |

Note:

- *List of open electives provided by other departments*

## B Tech Course Structure

| CBCS | Nature of Courses | Core | Elective Courses | | | Ability Enhancement Courses | | Total Credits |
|---|---|---|---|---|---|---|---|---|
| Year | Course Structure | Core | Dissertation/ Project(EEC) | Open Elective/ MOOC Courses | Program Elective/ MOOC Courses | Ability Enhancement Compulsory Courses | Value Added Courses | |
| 2023 | B.TECH ME | 109 | 15 | 6 | 12 | 8 | 10 | 160 |

| Core | Basic Sciences (BS) including Mathematics, Physics, Chemistry, Biology | Engineering Sciences (ES) including Materials, WS, ED, Basics of EE/ME/CSE | Discipline Core | Total Credits |
|---|---|---|---|---|
| 58 | 24 | 27 | 27 | 136 |

# Detailed Syllabus

<table>
<tr><td>Course Code</td><td colspan="8">MED</td></tr>
<tr><td>Course Title</td><td colspan="8">Engineering Graphics and Design</td></tr>
<tr><td>Course Outcomes</td><td colspan="8">On the completion of the course the student will be able to:<br>CO1: To provide the basic knowledge about Engineering Drawing, technical lettering, and dimensioning. Theory of projections for point, line and plane.<br>CO2: Detailed concepts of orthographic and isometric projections for point, line and plane.<br>CO3: Detailed concepts of orthographic and isometric projections for regular solids. To evaluate the sectional view of solids and developing their lateral surface<br>CO4: To impart knowledge of layers command and building 3D objects. To impart knowledge of the CAD software and to use edit, modify and draw commands.</td></tr>
<tr><td>Examination Mode</td><td colspan="8">Theory</td></tr>
<tr><td rowspan="2">Assessment Tools</td><td colspan="4">Continuous Assessment(CA)</td><td rowspan="2">MSE</td><td rowspan="2">MSP</td><td rowspan="2">ESE</td><td rowspan="2">ESP</td><td rowspan="2">Total</td></tr>
<tr><td>Quiz</td><td>Assignment/ Project Work</td><td>Attendance</td><td>Lab Performance</td></tr>
<tr><td>Weightage</td><td>-</td><td>-</td><td>-</td><td>20%</td><td>-</td><td>30%</td><td>-</td><td>50%</td><td>100</td></tr>
<tr><td>Syllabus</td><td colspan="8"></td><td>CO Mapping</td></tr>
<tr><td>Unit 1</td><td colspan="8">Introduction and Theory of Projection No. of Sheets: 3</td><td></td></tr>
<tr><td></td><td colspan="8">Engineering Graphics/Technical Drawing, Introduction to drawing equipments and use of instruments, Conventions in drawing practice. Types of lines and their uses, BIS codes for lines, Technical lettering as per BIS codes, Introduction to dimensioning, Types, Concepts of scale drawing, Types of scales.<br>Theory of projections, Perspective, Orthographic, System of orthographic projection: in reference to quadrants, Projection of Points, Projection in different quadrants, Projection of point on auxiliary planes. Distance between two points, Illustration through simple problems.</td><td>CO1</td></tr>
<tr><td>Unit 2</td><td colspan="8">Projections of Lines and Planes No. of Sheets: 4</td><td></td></tr>
<tr><td></td><td colspan="8">Line Parallel to both H.P. and V.P., Parallel to one and inclined to other, Other typical cases: three view projection of straight lines, true length and angle orientation of straight line: rotation method, Trapezoidal method and auxiliary plane method, traces of line.<br>Projection of Planes Parallel to one and perpendicular to other, Perpendicular to one and inclined to other, Inclined to both reference planes, Plane oblique to reference planes, traces of planes.</td><td>CO2</td></tr>
<tr><td>Unit 3</td><td colspan="8">Projection of Solids, Section of Solids No. of Sheets: 4</td><td></td></tr>
<tr><td></td><td colspan="8">Projection of solids in first or third quadrant, Axis parallel to one and perpendicular to other, Axis parallel to one inclined to other, Axis inclined to both the principle plane, Axis perpendicular to profile plane and parallel to both H.P. and V.P., Visible and invisible details in the projection, Use of rotation and auxiliary plane method.<br>Definition of Sectioning and its purpose, Procedure of Sectioning, Illustration through examples, Types of sectional planes-application to few examples.</td><td>CO3</td></tr>
<tr><td>Unit 4</td><td colspan="8">Development of Surface, Isometric and Orthographic Projection No. of Sheets: 3</td><td></td></tr>
</table>

| | | |
|---|---|---|
| | Purpose of development, Parallel line, radial line and triangulation method, Development of prism, cylinder, cone and pyramid surface for both right angled and oblique solids, Development of surface.<br>Classification of pictorial views, Basic Principle of Isometric projection, Difference between isometric projection and drawing, Isometric projection of solids such as cube, prism, pyramid and cylinder.<br>Review of principle of Orthographic Projection, Examples of simple machine parts, Drawing of Block and machine parts.<br>Introduction to CAD: Interfacing and Introduction to CAD Software, Coordinate System, 2D drafting: lines, circles, arc, polygon, etc., Dimensioning, 2-D Modelling, Use of CAD Software for engineering drawing practices. | CO4 |
| | ***Total No. of Sheets: 14*** | |
| Text Books | 1. P.S. Gill, "Engineering Graphics & Drafting", S.K. Kataria & Sons<br>2. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing.<br>3. Jain, Maheshwari, Gautam (2021), Engineering Graphics & Design, Khanna Book Publishing.<br>4. S. Vishal "AutoCAD" Dhanpat rai publishing company. | |
| Reference Books | 1. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson.<br>2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.<br>3. M.B. Shah, B.C. Rana, "Engineering Drawing", 3rd Ed., Pearson Education, New Delhi, 2009<br>4. Frederick E. Giesecke, Shawna Lockhart, Marla Goodman, Cindy M. Johnson, "Technical Drawing with Engineering Graphics", 15th Ed., Prentice Hall, USA, 2016<br>5. (Corresponding set of) CAD Software Theory and User Manuals. | |

<table>
<tr><td>Course Code</td><td colspan="8">MED102</td></tr>
<tr><td>Course Title</td><td colspan="8">Manufacturing Practice</td></tr>
<tr><td>Course Outcomes</td><td colspan="8">On the completion of the course the student will be able to:<br>CO1: To Know basic workshop processes, Read, and interpret job drawing.<br>CO2: Identify, select, and use various marking, measuring, holding, striking, and cutting tools & equipment’s<br>CO3: Operate and control different machines and equipment’s.<br>CO4: To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.</td></tr>
<tr><td>Examination Mode</td><td colspan="8">Practical</td></tr>
<tr><td rowspan="2">Assessment Tools</td><td colspan="4">Continuous Assessment (CA)</td><td rowspan="2">MSE</td><td rowspan="2">MSP</td><td rowspan="2">ESE</td><td rowspan="2">ESP</td><td rowspan="2">Total</td></tr>
<tr><td>Quiz</td><td>Assignment/ Project Work</td><td>Attendance</td><td>Lab Performance</td></tr>
<tr><td>Weightage</td><td>-</td><td>-</td><td>-</td><td>20%</td><td>-</td><td>30%</td><td>-</td><td>50%</td><td>100</td></tr>
<tr><td>Syllabus</td><td colspan="7"></td><td>CO Mapping</td></tr>
<tr><td>Unit 1</td><td colspan="7">Carpentry Shop and Welding shop</td><td></td></tr>
<tr><td></td><td colspan="7">Introduction, Classification of wood, Seasoning of wood, Classification of carpentry tools, Joints and joining processes, Wood working machines and processes, safety precaution, Preparation of half lap joint, Preparation of Mortise and Tenon Joint, Preparation of a Dove & Tail joint, To prepare a White board duster.<br>Introduction, Various welding processes with brief introduction, Electric Arc welding, Arc welding procedure, List of equipment for electric arc welding, Gas welding process and equipment, Preparation of Joint by Arc Welding, Preparation of Joint by using Gas Welding, Preparation of Joint by MIG/ TIG Welding, Preparation of Joint by Spot/ Seam Welding.</td><td>CO1</td></tr>
<tr><td>Unit 2</td><td colspan="7">Fitting shop and Foundry shop</td><td></td></tr>
<tr><td></td><td colspan="7">Introduction, Tools used in fitting, measuring and marking tools, the process of making sawing, Filling, Tapping and die, Introduction to drills, Filing a dimensioned rectangular or square piece and prepare a sq. fitting, Preparation of T fitting male part, Preparation of U fitting Female part, Internal thread Cutting in Square piece and external thread cutting on a rod and assembling as a paper weight.<br>Introduction, Basic terminology, Pattern, Types of patterns, Patterns allowances, Tools for hand Moulding, Moulding sand and Moulding process, Crucible furnace, Operation of cupola, Foundry containers, Casting defects, Safety precautions, To make a Mould of solid pattern, To prepare a mould of sleeve fitting using gating system, To make a Mould of Split Pattern using Cope & Drag, To check the Hardness of the Mould.</td><td>CO2</td></tr>
<tr><td>Unit 3</td><td colspan="7">Sheet- Metal Shop and Machine Shop</td><td></td></tr>
<tr><td></td><td colspan="7">Introduction, Types of sheets (ferrous/non-ferrous), Standard sheet sizes and their measurement, Tools used in sheet metal. Preparation of a funnel from G.I. sheet, Preparation of a book rack stand from G.I. Sheet, Preparation of a leak proof tray with inclined edges from G.I. Sheet, Preparation of a square pen stand from G.I. Sheet with riveting at corners.</td><td>CO3</td></tr>
</table>

| | | |
|---|---|---|
| | Introduction, Classification of machine tools and cutting tolls, Basic operations on lathe, Drilling, Shaper, Milling, Cutting tool material, Work-holding devices, To make a job using step turning and grooving, To make a job using knurling and threading, To make a multi operation job on a Lathe machine, To make V – slot by using shaper machine | |
| **Unit 4** | ***Smithy Shop and Electrical Shop*** | |
| | Introduction, Types of forging, Equipment used in the smithy shop, Smithy tools, Black smith's hearth, Hand forging operations. To Forge the L – Hook, To Forge a Chisel, To Forge a Cube from a M.S Round, To forge a screw driver.<br>Layout of electrical tube light wiring, Layout of stair case wiring using two-way switch, Testing and rectification of simulated faults in electrical appliances such as 'Electric Iron' Ceiling Fan. Electric kettle, To fabricate a circuit for the electrical wiring of Fan with regulator and Bulb through a main switch and its testing using a series lamp | CO4 |
| Text Books | 1. Johl, K. C. Mechanical Workshop Practice. Prentice Hall India, 1st Edition, 2010. Print.<br>2. Bawa, H.S. Workshop Technology. New Delhi: Tata McGraw Hill, 7th Edition, 2004. Print.<br>3 Amrinder Singh, Manufacturing Practice. Mahalakshmi Publication, New Delhi. | |
| Reference Books | 1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.<br>2. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.<br>3. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998. | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | MED103 | | | | | | | |
| Course Title | **Design Thinking and Idea Lab** | | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>**CO1**: To learn all the skills associated with the tools and inventory associated with the IDEA Lab.<br>**CO2:** Learn useful mechanical and electronic fabrication processes.<br>**CO3**: Learn necessary skills to build useful and standalone system/ project with enclosures.<br>**CO4**: Perceive individual differences and its impact on everyday decisions and further Create a better customer experience. | | | | | | | |
| Examination Mode | Practical | | | | | | | |
| Assessment Tools | Continuous Assessment (CA) | | | | MSE | MSP | ESE | ESP | Total |
| | Quiz | Assignment/ Project Work | Attendance | Lab Performance | | | | | |
| Weightage | - | - | - | 20% | - | 30% | - | 50% | 100 |

| S. No. | LIST OF EXPERIEMENTS | CO Mapping |
|---|---|---|
| **1.** | To study the working principles and operation of normal lathe machine. | CO1 |
| **2.** | To study the, working and operation of different welding equipment's. | CO1 |
| **3.** | To study the working principles and operation of wood lathe machine. | CO1 |
| **4.** | To Study the machining of 3D geometry on soft material such as soft wood or modelling wax. | CO2 |
| **5.** | To Study the 2D profile cutting on plywood /MDF (6-12 mm) for press fit designs. | CO2 |
| **6.** | To Study the 3D 2D profile cutting of press fit box/casing in acrylic (3 or 6 mm thickness)/cardboard, MDF (2 mm) board using laser cutter & engraver. | CO2 |
| **7.** | Scanning of computer mouse geometry surface. 3D printing of scanned geometry using FDM or SLA printer. | CO2 |
| **8.** | Schematic and PCB layout design of a suitable circuit, fabrication and testing of the circuit. | CO3 |
| **9.** | Embedded programming using Arduino and/or Raspberry Pi. | CO3 |
| **10.** | Design and implementation of a capstone project involving embedded hardware, software and machined or 3D printed enclosure. | CO4 |

| | **Reference content for theory Syllabus** | **CO Mapping** |
|---|---|---|
| **Unit 1** | ***An Insight to Learning, Remembering Memory and Emotions: Experience & Expression*** | |
| | Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting. Understanding the Memory process, Problems in retention, Memory enhancement techniques. Understanding Emotions: Experience & Expression, Assessing Empathy, Application with Peers | CO1 |
| **Unit 2** | ***Basics of Design Thinking*** | |
| | Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test. Understanding Creative thinking process, Understanding Problem Solving, Testing Creative | CO2 |

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|---|---|---|
| | Problem Solving. Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design,<br>Examples of best product designs and functions, Assignment – Engineering Product Design | |
| **Unit 3** | ***Prototyping & Testing*** | |
| | What is Prototype? Why Prototype? Rapid Prototype Development process, Testing, Sample Example, Test Group Marketing. Understanding Individual differences & Uniqueness, Group Discussion and Activities to encourage the understanding, acceptance and appreciation of Individual differences | CO3 |
| **Unit 4** | ***Design Thinking & Customer Centricity*** | |
| | Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product<br>Design. Feedback loop, Focus on User Experience, Address "ergonomic challenges, User focused design,<br>rapid prototyping & testing, final product, Final Presentation – "Solving Practical Engineering<br>Problem through Innovative Product Design & Creative Solution". | CO4 |
| Text Books | 1. E Balaguruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company.<br>2. AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with Lab Manual), ISBN: 978-9391505332<br>3 Amrinder Singh, Manufacturing Practice. Mahalakshmi Publication, New Delhi. | |
| Reference Books | 1. All-in-One Electronics Simplified, A.K. Maini; 2021. ISBN-13: 978-9386173393, Khanna Book Publishing Company, New Delhi.<br>2. 3D Printing & Design, Dr. Sabrie Soloman, ISBN: 978-9386173768, Khanna Book Publishing Company, New Delhi<br>3. The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018. ISBN-13: 978-1681884325. | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED | | | | | | |
| Course Title | **Applied Thermodynamics** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To identify and formulate power production based on the fundamentals laws of Thermal engineering.<br>CO2: Analyze the performance of vapour power cycles cycle and steam nozzles<br>CO3: Describe the various cooling, lubrication, ignition & fuel supply systems and evaluate the performance parameters of internal combustion engines<br>CO4: Analyze the performance of air compressors and steam turbine solve numerical related to the performance of single stage and multi stage. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Introduction to basic of thermodynamics*** | | | | | | |
| | Introduction to solid, liquid and gaseous fuels–Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature Chemical equilibrium and equilibrium composition calculations using free energy. Compressible flow in diffusers, efficiency of nozzle and diffuser. | | | | | | CO1 |
| **Unit 2** | ***Vapor power cycles*** | | | | | | |
| | Vapor power cycles Rankine cycle with superheat, reheat and regeneration, energy analysis. Supercritical and ultra-super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual Cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties. Properties of dry and wet air, use of psychometric chart, processes involving heating/cooling and humidification/dehumidification, dew point. | | | | | | CO2 |
| **Unit 3** | ***Compressible flow*** | | | | | | |
| | Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, super saturation. | | | | | | CO3 |
| **Unit 4** | **Compressor and Steam turbine** | | | | | | |
| | Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. Analysis of steam turbines, velocity and pressure compounding of steam turbines. | | | | | | CO4 |
| Text Books | 1. Y. A. Cengel, M. A. Boles; Thermodynamics – An Engineering Approach; Tata McGraw Hill Education Pvt. Ltd. New Delhi.4th Ed; 2012.<br>2. P. K Nag; Engineering Thermodynamics; Tata McGraw Hill Education Pvt. Ltd.; New Delhi.4th Ed.; 2008.<br>3. P. W Gill, J. H. Smith., E. J. Ziurys; Fundamentals of Combustion Engines; Oxford & IBH Publishing Co. Pvt. Ltd.; 4th revised Ed.;1967. | | | | | | |

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| | 4. G. V. Wylen; R. Sonntag, C. Borgnakke; Fundamentals of Classical Thermodynamics; John Wiley & Sons, 4th Ed.; 1996.<br>5. G. Rogers, Y. Mayhew; Engineering Thermodynamics-Work and Heat Transfer; Pearson Education Ltd., 7th Ed.; 2012.<br>6. J. B. Jones, R. E. Dungan; Engineering Thermodynamics; Prentice Hall of India Pvt. Ltd., New Delhi, Eastern Economy Ed.; 1996. | |
| Reference Books | 1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.<br>2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India<br>3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.<br>https://archive.nptel.ac.in/courses/112/106/112106314/ | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED | | | | | | |
| Course Title | **Kinematics & Dynamics of Machines** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To provide the basic concepts of forces in mechanisms.<br>CO2: To learn about the various types of cam & follower.<br>CO3: To provide the information of balancing of machines.<br>CO4: To learn the concept of flywheels. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | - | 25% | - | 35% | 25% | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | **Mechanisms** | | | | | | |
| | Definition and types of joints; Lower and higher pairs; Classification of mechanisms based on function and constraints; Common mechanisms such as slider crank and 4-bar mechanisms and their inversions; Quick return mechanism, Straight line generators, rocker mechanisms, universal joints, steering mechanisms, etc. Degree of freedom and Grübler's formula; Grashof's rule and rotatability limits; Mechanical advantage; Transmission angle; Limit positions. | | | | | | CO1 |
| **Unit 2** | **Cams and Followers** | | | | | | |
| | Classification of cams and followers, disc cam nomenclature, construction of displacement, velocity and acceleration diagrams for different types of follower motions, determination of basic dimension, synthesis of cam profile by graphical methods with various motions, cams with specified contours, problems. | | | | | | CO2 |
| **Unit 3** | **Balancing of Rotating Components and Reciprocating Parts** | | | | | | |
| | Static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of rotors, balancing machines, field balancing.<br>Balancing of single cylinder engine, balancing of multi cylinder; inline, radial and V type engines, firing order. | | | | | | CO3 |
| **Unit 4** | **Flywheels** | | | | | | |
| | Turning moment and crank effort diagrams for reciprocating machines' Fluctuations of speed, coefficient of fluctuation of speed and energy, Determination of mass and dimensions of flywheel used for engines and punching machines. | | | | | | CO4 |
| Text Books | Rattan, S.S. Theory of Machines. New Delhi: Tata McGraw-Hill Publishing Company Ltd. Print.<br>Singh, V.P. Theory of Machines. New Delhi: Dhanpat Rai & Co. Print.<br>Ballaney, P.L.Theory of Machines and Mechanism, New Delhi:Khanna Publishers, 2015.Print. | | | | | | |
| Reference Books | Shigley, J.E. and Uicker,J.J.Theory of Machines and echanisms. New Delhi:Oxford University Press, 2015. Print.<br>Ghosh, A. and Mallick, A.K.Theory of Mechanisms and Machines. New Delhi: Affiliated East-West Pvt. Ltd., 2009. Print. | | | | | | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED201 | | | | | | |
| Course Title | **Engineering Mechanics** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To understand the concepts of force and free body diagram.<br>CO2: To gain knowledge of force system in trusses, cables and beams.<br>CO3: To apply Methods of virtual work and stationary Potential Energy in engineering applications.<br>CO4: To understand the Kinematics of a Particle-simple Relative Motion | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Introduction to Mechanics*** | | | | | | |
| | Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates.<br>Position Vector, Moment of a Force about a Point, Moment of a Force about an Axis, The Couple and Couple Moment, Addition and Subtraction of Couple Moment of a Couple About a Line, The Free-body Diagram, Free Bodies Involving Interior Sections, Looking Ahead-Control Volumes<br>General Equations of Equilibrium. | | | | | | CO1 |
| **Unit 2** | **Introduction to structural Mechanics and Friction Forces** | | | | | | |
| | Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field;<br>Part A: Trusses: The Structural Model, The Simple Truss Solution of Simple Trusses, Method of Joints, Method of Sections, Looking Ahead-Deflection of a Simple, Linearly Elastic Truss,<br>Part B: Section Forces in Beams: Introduction, Shear Force, Axial Force, and Bending Moment, Differential Relations for Equilibrium<br>Part C: Chains and Cables: Introduction, Coplanar Cables; Loading is a Function, Coplanar Cables: Loading is the Weight of the Cable Itself, Friction Forces: Introduction, Laws of Coulomb Friction, A Comment Concerning the Use of Coulomb'.: Law, Simple Contact Friction Problems, Belt Friction, The Square Screw Thread, Rolling Resistance. | | | | | | CO2 |
| **Unit 3** | ***Methods of virtual work and stationary Potential Energy*** | | | | | | |
| | **Part A: Method of Virtual Work:** Principle of Virtual Work for a Particle, Principle of Virtual Work for Rigid Bodies, Degrees of Freedom and the Solution of Problems, Looking Ahead-Deformable<br>Solids.<br>**Part B: Method of Total Potential Energy**: Conservative Systems, Condition of Equilibrium for a Conservative System, Stability, Looking Ahead-More on Total Potential Energy. | | | | | | CO3 |
| **Unit 4** | ***Kinematics of a Particle-simple Relative Motion*** | | | | | | |

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| | **Part A: General Notions:** Introduction, Differentiation of a Vector with Respect to Time, **Part B: Velocity and Acceleration Calculations:** Introductory Remark, Rectangular Components, Velocity and Acceleration in Terms of Path Variables, Cylindrical Coordinates. **Part C: Simple Kinematical Relations and Applications**: Simple Relative Motion, Motion of a Particle Relative to a Pair of Translating Axes. | CO4 |
| Text Books | 1. Irving H. Shames, "Engineering Mechanics Statics and Dynamics", Prentice Hall Publications<br>2. An Introduction to Mechanics — D Kleppner & R Kolenkow<br>3. Engineering Mechanics - Dynamics, 7th ed. - JL Meriam | |
| Reference Books | 1. Boresi. P, "Engineering Mechanics Statics and Dynamics", Cengage Publishers.<br>2.Hibbler. H. C., "Engineering Mechanics", Pearson publishers. | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED | | | | | | |
| Course Title | **Heat and Mass Transfer** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To understand the fundamental principles and mathematical basis underlying the balance equations for heat transfer.<br>CO2: To analyses problems involving steady and unsteady heat conduction, convection and radiation heat transfer in different geometries.<br>CO3: To solve real life engineering problems such as heat transfer enhancement through extended surfaces, lumped heat capacity systems, heat exchangers, boiling and condensation, and calculating radiation view factor in different geometries.<br>CO4: Design heat and mass transfer equipment like Heat Exchanger, condenser, steam turbine etc. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 35% | 25 | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Introduction and Conduction Heat Transfer*** | | | | | | |
| | Introduction Three modes of heat transfer; Examples of equipment (like air conditioner and air cooler) involving heat transfer; Derivation of heat balance equation. Conduction Heat Transfer Steady 1D solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry; Concept of conduction and film resistances; Critical insulation thickness; Lumped system approximation and Biot number; Heat transfer through pin fins; 2D conduction solutions for steady and unsteady heat transfer. | | | | | | CO1 |
| **Unit 2** | **Convection Heat Transfer** | | | | | | |
| | Convection Heat Transfer Basic equations; Boundary layers; Forced convection; External and internal flows; Natural convective heat transfer; Dimensionless parameters for forced and free convection heat transfer; Correlations for forced and free convection; Approximate solutions to laminar boundary layer equations for internal and external flow; Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection. | | | | | | CO2 |
| **Unit 3** | ***Radiation Heat Transfer and Heat Exchanger Design*** | | | | | | |
| | Radiation Heat Transfer Interaction of radiation with materials; Definitions of radiative properties; Stefan Boltzmann's law; Black and grey body radiation; Calculation of radiation heat transfer between surfaces using radiative properties; View factors and the radiosity method; Examples for two-body enclosures; Radiation shield. Heat Exchanger Design Function, classification and configuration of heat exchangers; Evaluation of mean temperature difference; Heat exchanger effectiveness; Analysis, design and selection of heat exchangers. | | | | | | CO3 |
| **Unit 4** | ***Boiling and Condensation heat transfer*** | | | | | | |

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|---|---|---|
| | Boiling and Condensation heat transfer Pool boiling; Flow boiling; Film and drop wise condensation, Introduction to mass transfer, Analogy between heat and mass transfer; Mass diffusion; Fick's Law; Steady and transient mass diffusion; Simultaneous heat and mass transfer. | CO4 |
| Text Books | 1. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2000<br>2. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5th Edition 2015. | |
| Reference Books | 1. A. Bejan, "Heat Transfer," John Wiley, 1993.<br>2 J.P. Holman and S. Bhattacharyya, "Heat Transfer," McGraw Hill, 2017.<br>3 F.P. Incropera, and D.P. Dewitt, "Fundamentals of Heat and Mass Transfer," John Wiley, 2019.<br>4 Massoud Kaviany, "Principles of Heat Transfer," John Wiley, 2002.<br>5 Yunus A Cengel, "Heat Transfer: A Practical Approach," McGraw Hill, 2002 | |
| Online Resources: | 1 https://onlinecourses.nptel.ac.in/noc22_ch65/preview | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED | | | | | | |
| Course Title | **FLUID MECHANICS AND HYDRAULIC MACHINES** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To understand the fundamental principles of fluid mechanics.<br>CO2: To give basic understanding of boundary layer concept and analyze different types of losses and measurement of flow.<br>CO3: To analyze a variety of practical fluid flow and measuring devices and utilize Fluid Mechanics principles in design.<br>CO4: To become familiar about different types of turbines & able to analyze their performance characteristics of various turbines. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Introduction to Fluid*** | | | | | | |
| | Properties of Fluid: Definition of fluid; Newton's law of viscosity; Units and dimensions; Physical properties of fluids; Control volume; Fluid Statics: Pressure-density-height relationships, Manometers and Mechanical gauges, Force on plane and curved surfaces, Centre of pressure, Buoyancy, Stability of immersed and floating bodies. | | | | | | CO1 |
| **Unit 2** | **Fluid Kinematics** | | | | | | |
| | Different approaches; Reynolds transport theorem; Flow visualization; Types of flow; Strain rate, stream line, streak line, path lines and stream tubes; Continuity equation in Cartesian coordinates in 3D forms; Velocity and acceleration of fluid particles; Velocity potential function and stream function. Dimensional Analysis: Dimensionally homogeneous equations; Buckingham Pi Theorem; Calculation of dimensionless parameters. Similitude and complete similarity; Model scales; Basic boundary layer theory and analysis. | | | | | | CO2 |
| **Unit 3** | ***Fluid Dynamics and Flow Measuring Device*** | | | | | | |
| | Momentum Equation: Momentum equation; Nervier Stoke equation; Development of Euler's equation; Bernoulli's equation and application; Steady and unsteady flow through orifice; Orifice placed in pipe; Venturimeter; Flow over triangular and rectangular notches; Pitot tube. Laminar and Turbulent Flow: Viscous/Laminar flow – Plane Poiseuille flow and Coutte flow; Laminar flow through circular pipes; Loss of head and power absorbed in viscous flow; Turbulent flow – Reynolds experiment; Frictional losses in pipe flow; Shear stress in turbulent flow; Major and minor losses (Darcy's and Chezy's equation); Flow through siphon pipes; Branching pipes and equivalent pipe. | | | | | | CO3 |
| **Unit 4** | ***Hydraulic Machines*** | | | | | | |
| | Rotodynamic Machines: Euler's equation; Theory of Rotodynamic machines; Various efficiencies; Velocity components at entry and exit of the rotor; Velocity triangles; Centrifugal pumps – working principle, work done by the impeller and performance curves; Cavitation in pumps; Reciprocating pump – working principle. Hydraulic Turbines: | | | | | | CO4 |

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| | Classification of water turbines; Heads and efficiencies; Velocity triangles; Axial, radial and mixed flow turbines; Pelton wheel, Francis turbine and Kaplan turbines – working and design principles. | |
| Text Books | 1. S.S. Rattan, Fluid Mechanics & Hydraulic Machines, Khanna Book Publishing, 2019.<br>2. R. K. Rajput, "A Textbook of Fluid Mechanics and Hydraulic Machines," S Chand Publication, 2014.<br>3. P.J. Pritchard, A.T. McDonald and R.W. Fox, "Introduction to Fluid Mechanics," Wiley India, 2012. | |
| Reference Books | 1. S. K. Som, G. Biswas and S. Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill, 2017.<br>2. F.M. White, "Fluid Mechanics," Tata McGraw Hill, 2011<br>3. Mechanics of Fluids, Shames, McGraw Hill Book Co., New Delhi, 1988 | |
| Online Resources: | https://onlinecourses.nptel.ac.in/noc22_ce85/preview | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED301 | | | | | | |
| Course Title | **Mechanics of Deformable Solids** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To understand the concepts of Stresses produced in rigid body because of different loading conditions.<br>CO2: To calculate slope and deflection in beams.<br>CO3: To calculate load for failure of columns and shafts.<br>CO4: To calculate hoop and radial stresses in pressure vessels. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Concept of Stress and Strain*** | | | | | | |
| | Deformation of bars: Hooke's law, stress, strain, and elongation; Tensile, compressive and shear stresses in 2D solids; Elastic constants and their relations; Volumetric, linear and shear strains; Temperature Stresses<br>Principal stresses and strain; Principal planes; Mohr's circle | | | | | | CO1 |
| **Unit 2** | **Mechanics of Beams and their deflection** | | | | | | |
| | Transverse loading on beams, point and distributed loads; Shear force and bend moment diagrams; Types of beam supports – simply supported, over-hanging, cantilevers, fixed and guided beams; Static determinacy and indeterminacy; Theory of bending of beams, pure bending stress distribution and neutral plane, second moment of area; Different cross-sections of beams; Shear stress distribution.<br>Deflection of a beam using the double integration method; Computation of slopes and deflection in beams; Myosotis method for computing deflections and slopes. | | | | | | CO2 |
| **Unit 3** | ***Column Buckling and torsion of Shafts*** | | | | | | |
| | Critical loads using Euler's theory; Different boundary conditions; Eccentric columns<br>Torsion stresses and deformation of circular and hollow shafts; Polar moment of area, stepped shafts; Deflection of shafts fixed at both ends; Stresses and deflection of helical springs. | | | | | | CO3 |
| **Unit 4** | ***Resilience and pressure vessels*** | | | | | | |
| | Principle of virtual work; Minimum potential energy theorem; Castigliano's theorems; Maxwell reciprocity theorem.<br>Axial and hoop stresses in cylinders subjected to internal pressure; Deformation of thin and thick cylinders; Deformation in spherical shells subjected to internal pressure; Combined thermo mechanical stress; Examples and case studies (boilers). | | | | | | CO4 |
| Text Books | 1. Lehri. R. S, "Strength of Materials", Kataria and son's publications<br>2. Bansal. R.K "Strength of Materials" Laxmi Publications<br>3. Hibbler. H. C "Mechanics of Materials" - Pearson publishers | | | | | | |
| Reference Books | 1. Boresi. P, "Engineering Mechanics Statics and Dynamics", Cengage Publishers.<br>2.Gere, "Mechanics of Materials", Cengage publishers. | | | | | | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED | | | | | | |
| Course Title | **Engineering Materials and Applications** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: Know the range of engineering materials, their mechanical properties and applications<br>CO2: Know various methods to measure the mechanical properties of materials.<br>CO3: Learn how to improve the properties of ferrous alloys through various heat treatments<br>CO4: To learn about the polymer Electrical and Magnetic Materials | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Engineering Materials and Classification*** | | | | | | |
| | Metals, plastics, ceramics and composites; Relevant properties (physical, mechanical, thermal, electrical, chemical), cost; Range of applications; Material designation and standards; Ashby diagrams; Selection criteria and process.<br>**Mechanical Properties and Testing**: Tensile, compression, torsion, fatigue, fracture and wear tests; Young's modulus; Relations between true and engineering stress-strain curves; Generalized Hooke's law; Yielding and yield strength; ductility, resilience, toughness and elastic recovery; Hardness measurement their relation to strength; SN curve, endurance and fatigue limits; Introduction to non-destructive testing (NDT). | | | | | | CO1 |
| **Unit 2** | ***Metal and Alloys*** | | | | | | |
| | Iron and steel; Stainless steel and tool steels; Copper & its alloys – brass, bronze & cupro-nickel; Aluminium & Al-Cu-Mg alloys; Nickel based superalloys & Titanium alloys; Phase diagrams and interpretation of microstructure; Iron Iron-carbide phase diagram and cooling (TTT) diagrams.<br>Heat Treatment: Heat treatment of Steel; Annealing, tempering, normalizing, spheroidising, austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding,<br>flame and induction hardening, vacuum and plasma hardening | | | | | | CO2 |
| **Unit 3** | ***Polymers, Ceramics and Composites*** | | | | | | |
| | *Polymers* – Classification and applications; Polymerization techniques; *Ceramics* – Oxide ceramics, ceramic insulators, bio-ceramics and Glasses; *Composites* –Reinforcement, matrix, metal matrix composites, ceramic composites, polymer composites; Other<br>Advanced materials – biomaterials, optical materials, high temperature materials, energy materials, and nanomaterials. | | | | | | CO3 |
| **Unit 4** | ***Electrical and Magnetic Materials*** | | | | | | |
| | Conducting and resisting materials – types, properties and applications; Semiconducting materials – properties and applications; Magnetic materials – Soft and hard magnetic materials and applications; Superconductors and dielectric materials – properties and applications; Smart materials; Sensors and actuators; Piezoelectric, magneto strictive and electro strictive materials. | | | | | | CO4 |
| Text Books | 1. V. Raghavan, "Material Science and Engineering', PHI India, 2015. | | | | | | |

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| | 2. K. G. Budinski and M.K. Budinski, "Engineering Materials", PHI India, 2002. | |
| Reference Books | 1. W. D. Callister, "Materials Science & Engineering," Wiley India, 2014.<br>2. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.<br>3. M.F. Ashby and D.R.H. Jones, Engineering Materials 1 - An Introduction to Properties,<br>Applications and Design, Butterworth-Heinemann, USA, 2011 | |
| Online Resources | https://onlinecourses.nptel.ac.in/noc22_me90/preview | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED | | | | | | |
| Course Title | **Mechanical Engineering Lab-1 (Fluid Mechanics & Hydraulic Machines)** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>**CO1: To understand the measurement of mechanical properties of materials.**<br>**CO2: To understand the deformation behavior of materials.**<br>**CO3: To understand the kinematic characteristics of mechanical devices.**<br>**CO4: To understand the dynamic characteristics of mechanical devices.** | | | | | | |
| Examination Mode | Practical | | | | | | |
| Assessment Tools | Written Quiz | Project Work/Lab Performance | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | - | 20% | - | 30% | | 50% | - |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Content** | ***List of experiments*** | | | | | | |
| | 1. **Uniaxial tension test on mild steel rod**<br>**2. Torsion test on mild steel rod**<br>**3. Impact test on a metallic specimen**<br>**4. Brinnell and Rockwell hardness tests on metallic specimen**<br>**5. Bending deflection test on beams**<br>**6. Strain measurement using Rosette strain gauge**<br>**7. Microscopic examination of heat-treated and untreated metallic samples**<br>**8. Velocity ratios of simple, compound, epicyclic and differential gear trains**<br>**9. Kinematics of four bar, slider crank, crank rocker, double crank, double rocker, and oscillating cylinder mechanisms**<br>**10. Cam & follower and motion studies**<br>**11. Single degree of freedom Spring-mass-damper system, determination of natural frequency and damping coefficient**<br>**12. Determination of torsional natural frequency of single and double rotor systems- undamped and damped natural frequencies** | | | | | | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED | | | | | | |
| Course Title | **Machine Element and system design** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: Principles of machine elements and how they can be combined to function as a system<br>CO2: Failure analysis of machine elements<br>CO3: An overview of codes, standards and design guidelines for different elements<br>CO4: Ability to analyse mechanical systems | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Introduction*** | | | | | | |
| | Anatomy of machines; Functional dissection of motorcycle, washing machine, sewing machine, etc. into machine elements including gears, rack and pinions, cams, chains, belts, pulleys, flywheels, bearings, shafts, keys, brakes, etc.; Design considerations – Limits, fits and standardization; Friction and lubrication.<br>**Free-body Diagrams**<br>Force analysis of machine elements and machine systems; Application to power screws and couplings, clutches, and brakes. | | | | | | CO1 |
| **Unit 2** | ***Failure Theories*** | | | | | | |
| | Static failure theories including normal stress theory, shear stress theory, distortion energy theory; von Mises stress; Factor of safety; Stress concentration factors; Fatigue failure theories: mean and<br>alternating stresses, yield, ultimate, and endurance strength; Goodman, Gerber, and Soderberg lines. | | | | | | CO2 |
| **Unit 3** | ***Design of Machine Elements*** | | | | | | |
| | Springs – Helical compression, tension, torsional and leaf springs; Fasteners – threaded fasteners, bolted joints, preloaded bolts, rivets and welded joints; Shafts – shafts under static and fatigue<br>loadings; Keys; Sliding and rolling contact bearings; Transmission elements – transmission ratio and efficiency of spur, helical, bevel and worm gears; belt and chain drives; Flywheels. | | | | | | CO3 |
| **Unit 4** | ***Vibrations of Machine Elements*** | | | | | | |
| | Single degree-of-freedom systems; Natural frequency and critical damping; Forced vibration; Resonance; Balancing of reciprocating and rotating masses; Torsional vibration and critical speeds of shafts.<br>**Mechanical Systems**<br>Case studies on automobile suspensions, automatic transmissions, material conveyor systems,<br>construction machinery, etc. | | | | | | CO4 |
| Text Books | 1. Shigley, J.E. and Mischke, C.R., "Mechanical Engineering Design," McGraw-Hill, 1989.<br>2. Deutschman, D., & Wilson, C.E., "Machine Design Theory & Practice," Macmillan, 1992<br>3. Juvinal, R.C., "Fundamentals of Machine Component Design," John Wiley, 1994. | | | | | | |

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| Reference Books | 1. Spottes, M.F., “Design of Machine elements,” Prentice-Hall India, 1994.<br>2. R. L. Norton, “Mechanical Design – An Integrated Approach,” Prentice Hall, 2009.<br>3.Sadhu Singh, “Machine Design”, Khanna Book Publishing, 2021.<br>4. Sadhu Singh, “Machine Design Data Book”, Khanna Book Publishing, 2022. | |
| Online Resources | https://archive.nptel.ac.in/courses/112/105/112105124/ | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED | | | | | | |
| Course Title | **Mechatronics, Robotics & Control** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To understand the concept of Robot, Sensors and End effectors.<br>CO2: To know the concepts of the fluid power and various control valves.<br>CO3: To give understanding about the robotics and its programming.<br>CO4: To apply the concept of robotics in industrial applications. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | - | 25% | - | 35% | 25% | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | **Introduction to Robot, Sensors and End Effectors** | | | | | | |
| | Introduction, terminology, laws of robotics, classification based on geometry, machine vision, robot components, degree of freedom, coordinators, reference frames.<br>Types of Sensors in robots, exteroceptors, proprioceptors, tactile, proximity, range, velocity and machine vision sensors, robot end-effectors, classification, gripper, gripper mechanism, type of gripper. | | | | | | CO1 |
| **Unit 2** | **Fluid Power and Fluidics** | | | | | | |
| | Fluid power control elements, Construction and performance of fluid power generators; Hydraulic and pneumatic cylinders - construction, design and mounting; Hydraulic and pneumatic valves for pressure, flow and direction control.<br>Boolean algebra; Truth tables; Conda effect. | | | | | | CO2 |
| **Unit 3** | **Robot Programming and Control** | | | | | | |
| | Robot programming, techniques of programming, robot languages, requirement for a standard robot language, types of languages. | | | | | | CO3 |
| **Unit 4** | **Industrial and Mechatronic applications** | | | | | | |
| | Applications of robots in welding, machine loading, fabrication, spray painting, assembly and unusual applications. | | | | | | CO4 |
| Text Books | 1. Deb, S.R. *Robotics and Flexible Automation*. New Delhi: Tata McGraw-Hill Publishing Company Ltd. 2010. Print.<br>2. Majumdar, S.R. *Pneumatic Systems.* New Delhi: Tata McGraw-Hill Publishing Company Ltd. Sixteenth reprint 2006. Print. | | | | | | |
| Reference Books | 1. Asfahl, C.R. *Robotics and Manufacturing Automation.* Wiley India. 1992. Print.<br>2. Niku, S.B. *Introduction to Robotic Analysis systems and applications.* Wiley India. 2001. Print. | | | | | | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED401 | | | | | | |
| Course Title | **Manufacturing Processes** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To understand the fundamental principles of materials, processes and manufacturing.<br>CO2: To gain knowledge of various material shaping and removal manufacturing processes<br>CO3: Application of various advanced manufacturing processes in engineering applications.<br>CO4: selection of material joining or fabrication processes. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | - | 25% | - | 35% | 25% | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Manufacturing Processes and Classification*** | | | | | | |
| | Additive, subtractive and shaping processes; Relative advantages and limitations; Inter-dependency of geometry, material and process; Effect on product quality and cost; Part design for manufacturability; Process selection criteria. | | | | | | CO1 |
| **Unit 2** | ***Material Shaping & Removal Processes*** | | | | | | |
| | Metal casting (sand, die and investment casting), Bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending); Thermoplastic and thermoset plastic processes (ex. injection and blow molding); Powder metallurgy;<br>Metal injection molding; Glass and composite processes (layup).<br>Turning, Drilling, Milling, Grinding and other finishing processes; Single and multi-point cutting tools; Cutting tool materials; Cutting fluids; Material removal rates, surface finish, accuracy, integrity and machinability | | | | | | CO2 |
| **Unit 3** | ***Unconventional & Additive Manufacturing Processes*** | | | | | | |
| | Abrasive Jet Machining, Water Jet Machining; Ultrasonic Machining; Electrical Discharge Machining, Wire EDM; Electro Chemical Machining; Laser Beam Machining, Plasma Arc Machining and Electron Beam Machining; Micro and nano manufacturing.<br>Extrusion; vat polymerization, powder bed fusion; material jetting, binder jetting; direct energy deposition and lamination processes | | | | | | CO3 |
| **Unit 4** | ***Joining and Fastening Processes and Process Modeling*** | | | | | | |
| | Arc welding, gas welding, shielded metal arc welding; GMAW (MIG) and GTAW (TIG); Brazing and soldering; Solid state joining; Adhesive bonding.<br>Casting – metal flow, solidification and cooling; application to design of gating and feeding systems for quality and yield optimization; **OR** Forming – Plastic deformation and yield criteria; load estimation; OR Machining – Orthogonal cutting, various force components; Chip formation, Tool wear and tool life. | | | | | | CO4 |
| Text Books | 1. Amitabha Ghosh and A.K. Mallick, Manufacturing Science. Affiliated East-West Press Pvt. Ltd. 2010.<br>2. Kalpakjian and Schmid, Manufacturing Processes for Engineering Materials, Pearson India, 2014<br>3. M. P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems. | | | | | | |

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| Reference Books | 1. Lindberg R.A, “Processes and Materials of Manufacture”, Prentice Hall of India (P) Ltd.,1996<br>2. Degarmo, Black & Kohser, Materials and Processes in Manufacturing 3.William F. Hosford and Robert M. Caddel, “Metal forming”, PrenticeHall Publishing Co., 1990.Shaw, “Principles of Metal cutting”, Oxford I.B.H. | |

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|---|---|---|---|---|---|---|---|
| **Course Code** | MED | | | | | | |
| **Course Title** | Measurement & Metrology | | | | | | |
| **Course Outcomes** | 1. To provide basic knowledge about errors in measurement systems.<br>To learn about measuring mechanical quantities like surface roughness, and speed.<br>To learn about various sensors and transducers used for the measurement of mechanical quantities.<br>To learn about the measurement of pressure and temperature measuring devices. | | | | | | |
| **Examination Mode** | **Theory** | | | | | | |
| **Assessment Tools** | **Written Quiz** | **Assignment/ Project Work** | **MSE** | **MTP** | **ESE** | **EPR** | **ABL/PBL** |
| **Weightage** | 10% | | 25% | | 35% | 25% | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | | | | | | | |
| | **Introduction:** Measurement, Significance, method of measurement definitions and concept of accuracy, precision, range, resolution, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response times delay, Factor in the selection of measuring instruments.<br>**Errors in measuring instruments:** Classifications of error, sources of error, temperature problem, static & dynamic characteristics of measuring instruments, calibration, error. | | | | | | CO1 |
| **Unit 2** | | | | | | | |
| | **Metrology:** Standards of measurements- Line, end and wavelength; linear measurements - Vernier calipers, Vernier height gauge, and depth gauge and micrometer; Angular measurements - sine bar, clinometer, angle gauge; Measurement of major diameter, minor diameter, effective diameter, pitch, angle and form of threads for internal and external threads; comparators - their types, relative merits, and limitations; surface roughness - specifications and measurement, concept, and measurement of straightness and flatness by interferometry.<br><br>**Speed**:, Force, Torque and Shaft Power Measurement Mechanical tachometers, vibration reed tachometer and stroboscope; proving ring, hydraulic and pneumatic load cells, torque on rotating shafts; Absorption, transmission and driving dynamo meters. | | | | | | CO2 |
| **Unit 3** | | | | | | | |
| | **Sensors and transducers**: Introduction to sensors and transducers, types of sensors, review of electro-mechanical sensors and transducers - variable resistance, inductance and capacitive pickups, photo cells and piezoelectric transducers and application of these elements for measurement of position/displacement, speed/velocity / acceleration, force and liquid level. Resistance strain gauges, gauge factor, bonded and unbounded gauges, surface preparation and bonding technique signal conditioning and bridge circuits, temperature compensation, application of strain gauges for direct, bending and torsional loads. Introduction to amplifying, transmitting and recording devices. | | | | | | CO3 |

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| **Unit 4** | | |
| | **Pressure and Flow Measurement:** Bourdon tube, diaphragm and bellows, vacuum measurement - Mcleod gauge, thermal conductivity gauge and ionization gauge; Dead weight gauge tester. Electromagnetic flux meters, ultra-sonic flow meters and hot wire anemometer: flow visualization techniques.<br>**Temperature Measurement**: Thermal expansion methods - bimetallic thermometers, liquid-in-glass thermeter and filled-insystem thermometers; thermo-electric sensors - common thermo couples, reference junction considerations, special materials and configurations; metal resistance thermometers and thermistors; optical and total radiation pyrometers; calibration standards. | CO4 |
| Text Books | 1. Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard V, Mechanical Measurements (6th Edition) 6th Edition, Pearson Education India, 2007. | |
| Reference Books | 1. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 200<br>2. Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, McGraw-Hill: New York,1999.<br>3. A Textbook of Measurements & Metrology by Er. R.K. Rajput, 1st Edition 2012, S.K. Kataria & Sons | |

## Elective 1- As per basket.

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|---|---|---|---|---|---|---|---|
| Course Code | MED | | | | | | |
| Course Title | **Mechanical Engineering Lab-2 (Design)** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To understand the measurement of mechanical properties of materials.<br>CO2: To understand the deformation behavior of materials.<br>CO3: To understand the kinematic characteristics of mechanical devices.<br>CO4: To understand the dynamic characteristics of mechanical devices. | | | | | | |
| Examination Mode | Practical | | | | | | |
| Assessment Tools | Written Quiz | Project Work/Lab Performance | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | - | 20% | - | 30% | | 50% | - |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Content** | ***List of experiments*** | | | | | | |
| | 1. Uniaxial tension test on mild steel rod<br>2. Torsion test on mild steel rod<br>3. Impact test on a metallic specimen<br>4. Brinnell and Rockwell hardness tests on metallic specimen<br>5. Bending deflection test on beams<br>6. Strain measurement using Rosette strain gauge<br>7. Microscopic examination of heat-treated and untreated metallic samples<br>8. Velocity ratios of simple, compound, epicyclic and differential gear trains<br>9. Kinematics of four bar, slider crank, crank rocker, double crank, double rocker, and oscillating cylinder mechanisms<br>10. Cam & follower and motion studies<br>11. Single degree of freedom Spring-mass-damper system, determination of natural frequency and damping coefficient<br>12. Determination of torsional natural frequency of single and double rotor systems- undamped and damped natural frequencies | | | | | | |

## Industrial Training- As per guidelines

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|---|---|---|---|---|---|---|---|
| Course Code | MED | | | | | | |
| Course Title | **CAD & Analysis** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To understand the fundamental of CAD.<br>CO2: To gain knowledge of various concepts of geometric modelling.<br>CO3: To provide basic knowledge of NC/CNC/DNC systems.<br>CO4: To apply the concept in CAPP. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | - | 25% | - | 35% | 25 | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | **Fundamentals of CAD and Geometric Transformations** | | | | | | |
| | Introduction, Design Process, Application of computers in design, Creating manufacturing database, benefits of CAD, Software configuration of a graphics system, functions of a graphics package, geometric modeling, Fundamentals of Computer Graphics, Visual realism- hidden line surface- solid removal algorithms, Product cycle, sequential and concurrent engineering.<br>Mathematics preliminaries, matrix representation of 2 and 3 dimensional transformation, Concatenation of transformation matrices, Application of geometric transformations. | | | | | | CO1 |
| **Unit 2** | **Geometric modeling** | | | | | | |
| | Need of Geometric Modeling, types of geometric modeling, geometric modeling representation, and geometric modeling techniques and uses, parametric representation of analytical and synthetic curves, parametric representation of surfaces, Coons and bicubic. Patches, Solid modeling, CSG and Boundary Representation, CAD standards- Graphical Kernel System (GKS), Data exchange standards- IGES, STEP | | | | | | CO2 |
| **Unit 3** | **Numerical Control** | | | | | | |
| | Types of NC systems, MCU and other components, NC manual part programming, coordinate systems, G & M codes, Part program for simple parts, computer assisted part programming. Direct numerical control, Adaptive control in machining system, DNC/CNC systems | | | | | | CO3 |
| **Unit 4** | **Computer Aided Process Planning** | | | | | | |
| | Introduction and benefits of CAPP, types of CAPP, Steps in variant process planning, planning for CAPP, machinability data selection systems in CAPP. | | | | | | CO4 |
| Text Books | 1. Groover and Zimmer. CAD/ CAM. Prentice Hall. Print. 2010.<br>2. Zeid, I. CAD/ CAM Theory and Practice. McGraw Hill. 2009. | | | | | | |
| Reference Books | 1. Bedworth, D.D., Henderson, M.R. & Wolfe, P.M. Computer Integrated Design and Manufacturing. New Delhi: Tata McGraw Hill. 1991<br>2. W. M. Neumann and R.F. Sproul, Principles of Computer Graphics, McGraw Hill, 1989.<br>3. Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing, prentice Hall, 2007 | | | | | | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED | | | | | | |
| Course Title | **Manufacturing Automation** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To understand the fundamental principles of automation.<br>CO2: To gain knowledge of design of automated assembly systems.<br>CO3: To understand the concept of group technology.<br>CO4: To understand the application of automation in flexible manufacturing systems. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | - | 25% | - | 35% | 25% | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | **Automation** | | | | | | |
| | Types of automation, reasons for automating, automation strategies, Detroit-type automation: Automated flow lines, methods of work part transport, Transfer mechanisms, buffer storage, automation for machining operations. Mechanization.<br>Factory Automation: Lean manufacturing, Automation scalability, Design and analysis of automated flow lines; Average production time, production rate, line efficiency; Analysis of transfer lines without storage; Partial and full automation. | | | | | | CO1 |
| **Unit 2** | **Automated assembly systems** | | | | | | |
| | Design for automated assembly, types of automated assembly systems, part feeding devices, quantitative analysis of the delivery system operation, and analysis of a single-station<br>assembly machine, numerical. | | | | | | CO2 |
| **Unit 3** | **Group Technology** | | | | | | |
| | Part families, parts classification and coding, types of classification and coding systems, Machine cell design: The composite part concept, types of cell designs, determining the best machine arrangement, benefits of group technology. | | | | | | CO3 |
| **Unit 4** | **Flexible Manufacturing Systems** | | | | | | |
| | Components of an FMS, types of systems, where to apply FMS technology, FMS work stations, Material handling and storage system: Functions of the handling system, FMS layout<br>configurations. Material handling equipment, Computer control system: Computer function, FMS data file, system reports. Planning the FMS, analysis methods for FMS, applications and benefits | | | | | | CO4 |
| Text Books | 1. Groover, M.P. Automation, Production Systems and computer Integrated Manufacturing. Prentice Hall of India, 2007. Print.<br>2. S. Kalpakjian and S. R. Schmid, Manufacturing – Engineering and Technology, Pearson. | | | | | | |
| Reference Books | 1. Yoram Koren, Computer Control of Manufacturing Systems, McGraw Hill, 2005<br>2. CAD/CAM Principles and Applications, P.N. Rao, Tata McGraw Hill, 2010. | | | | | | |

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|---|---|---|---|---|---|---|---|
| **Course Code** | MED | | | | | | |
| **Course Title** | Production & Operation Management | | | | | | |
| **Course Outcomes** | • To understand the role of Production and operations management and productivity in the overall business strategy of the organization.<br>• To understand the functions of PPC.<br>• To identify the key factors affecting the location and layout.<br>• To understand the selection and function of Material Handling Equipment and the concept of repair and maintenance. | | | | | | |
| **Examination Mode** | **Theory** | | | | | | |
| **Assessment Tools** | **Written Quiz** | **Assignment/ Project Work** | **MSE** | **MTP** | **ESE** | **EPR** | **ABL/PBL** |
| **Weightage** | 10% | 10% | 25% | | 50% | | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | **Introduction** | | | | | | |
| | Production Management, Service verses Goods, Objectives, Scope & Functions/Activities of Production and Operation Management, Decisions in Production and Operation Management, Production Management verses Industrial Engineering.<br>**Production and Productivity**<br>Introduction, Fabrication, Manufacturing and Production, **Production Systems**: Intermittent System, Project System, Job Order Production, Batch Production, Continuous Production and their characteristics, Process Life Cycle or Production Life Cycle, Productivity, Measurement of Productivity, Ways to improve Productivity, Productivity and Fatigue, Relationship between Productivity and Standard of living. | | | | | | CO1 |
| **Unit 2** | **Production Planning and Control** | | | | | | |
| | Production, Planning, Control, Definition and Objectives of PPC, Functions of PPC, (Pre-Planning, Active Planning and Post Planning), Definition and Concept of forecasting, Importance and application for purpose of sales forecasts, Methods of Sales forecast, Routing (Routing Procedures, Route Sheet and Route Cards, Advantages of good Routing), Scheduling Loading (Objectives of Loading, Adjustment to Machine Overloading and under loading), Dispatching (Duties/Activities of a dispatcher, Centralized and Decentralized dispatching), Control(Need and Significance, Objectives), Follow up Phase(Progress Reporting, Corrective Action, Common reasons for Production delay, Method of taking corrective action), Advantage of better PPC, Principles of Sound PPC, Assembly line balancing; Aggregate production planning; Master production scheduling; MRP and MRP-II | | | | | | CO2 |
| **Unit 3** | **Factory Organization** | | | | | | |

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|---|---|---|
| | Concept and structure of an organization, Significance and Requirement of an organization structure, Types of Organization- Military or Line Organization, Functional Organization, Line and Staff Organization, Committees Organization.<br>**Facility Location and Layout**<br>Need for a suitable location, Factor Affecting Plant Location, Selection of actual site, Selection of Urban, Suburban or Rural area, Comparison between Urban and Rural area in connection with selection of site, Recent Trends in Location of Industries.<br>Ideal Plant Layout, Objectives of plant layout, Factors affecting the plant layout decision, Principles of plant layout, Material Flow System, Different types of layouts viz. Product, Process, Combination, Static or Project and Group layouts and their suitability. Computer aided layout design techniques. | CO3 |
| **Unit 4** | **Material Handling** | |
| | Introduction, Definition and Concept, Material Handling and Plant Layout, Benefits, Negative aspects of Material Handling, Objectives of Material Handling, Functions of Material Handling, Principles of economic Material Handling, Selection of Material Handling Equipment, Types of Material Handling Equipment's.<br>**Repair and Maintenance**<br>Objective and importance of Maintenance, Different type of maintenance, Predictive and Preventive Maintenance, Procedure of Preventive Maintenance, Schedules of Preventive Maintenance, Nature of maintenance problem | CO4 |
| Text Books | 1. Bansal, V.B. *Industrial Engineering and Production Management.* New Delhi: Kapson Publishers. 2015. Print<br>2. Raju, N.V.S. *Industrial Engineering and Management*. New Delhi: Cengage Learning. 2013. Print. | |
| Reference Books | 1. Chunawala. *Production and Operation Management.* New Delhi: Himalaya Publication. 2013. Print.<br>2. Dalela, and Ali, Mansoor. *Industrial Engineering and Management Systems*. New Delhi: Standard Publishing Distributors. 2010. Print.<br>3. Hicks. *Industrial Engineering & Management-A new perspective*. New Delhi: Tata McGraw Hill. 2014. Print.<br>4. Shankar, Ravi. *Industrial Engineering and Management*. New Delhi: Galgotia Publishers. 2010. Print.<br>5. Jain and Agarwal. *Production Planning & Control.* New Delhi: Khanna Publishers. 2013. Print.<br>6. Verma, A.P. *Industrial Engineering and Management*. New Delhi: Katson Books. 2010. Print. | |

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|---|---|---|---|---|---|---|---|
| **Course Code** | MED | | | | | | |
| **Course Title** | **Product Innovation & Entrepreneurship** | | | | | | |
| **Course Outcomes** | • To know about entrepreneurship and entrepreneurship Support System.<br>• To know the different types of business, market opportunities and product innovation.<br>• To identify the various components of management and the importance of the management process in business.<br>• To impart knowledge of venture creation. | | | | | | |
| **Examination Mode** | **Theory** | | | | | | |
| **Assessment Tools** | **Written Quiz** | **Assignment/ Project Work** | **MSE** | **MTP** | **ESE** | **EPR** | **ABL/PBL** |
| **Weightage** | 10% | 10% | 25% | | 50% | | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | | | | | | | |
| | **Entrepreneur and Entrepreneurship**<br>Introduction, Definition, Concept, Characteristics, Classification, Types, Functions and Competencies<br>**Entrepreneurship**<br>Definition, Concept, Need, Entrepreneurship as a career option<br>**Entrepreneurship Support System**<br>Concept and Need of entrepreneurship support system | | | | | | CO1 |
| **Unit 2** | **Business Ownership and its Features**<br>Sole proprietorship, Partnership, Joint Stock Companies, Cooperative, Private Limited, Public Limited and PPP mode<br>**Market Survey, Opportunity and Product Innovation**<br>Introduction, Industry and its Classification, Small Scale Industries (SSI): Definition, Objectives, Features and importance, Steps for starting SSIs, Procedure for registration of SSIs, Understanding business opportunity, Consideration in product selection, Data collection for setting up small venture Creative design thinking for concept generation; Detailed design & prototyping; Functionality & manufacturability; Bill of materials & components supply chain; Manufacturing & assembly plan; Product testing & quality assurance | | | | | | CO2 |
| **Unit 3** | **Managerial Aspects of Small Business Management**<br>Fayol's principles, Functions of management, Levels of Management, Organization Structure, Principles of marketing management, Marketing Strategies, Personnel Management, Training and Development,<br>**Labour Welfare**<br>Definition and Concept, Significance, Features, Labour welfare schemes | | | | | | CO3 |
| **Unit 4** | **Venture Creation**<br>Sustainable business options & pathways; Business model & business canvas; Startup team & business partners; Startup ecosystem and stakeholders; Technology business incubators & parks; Proposal pitching & agreements; Startup company incorporation; Social impact & responsibility | | | | | | CO4 |

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|---|---|---|
| Text Books | 1. Singh, A.K. ***Entrepreneurship Development and Management,*** New Delhi: Laxmi Publication. . Second Edition. 2009. Print.<br>2. Bansal. *Entrepreneurship Development and Management*, New Delhi: Kapson. Print. | |
| Reference Books | 1. Negendra. ***Entrepreneurship and Management,*** New Delhi: Pearson.1995. Print.<br>2. Saravate, Dilip. ***Entrepreneurship Development and Project Managemen, Pune:*** **Everest** Publication. Print.<br>3. Sharma Pritosh. ***Entrepreneurship Development and Management, New Delhi:*** **Dhanpat Rai & Co** Print.<br>4. Lal, A. K. *Entrepreneurship Development and Management,* Vayu Education. Print.<br>5. Bill Aulet, "Technology Entrepreneurship", 4th ed., Tata McGraw Hill, 2014.<br>6. Peter F. Drucker, "Innovation and Entrepreneurship", 1st ed., Harper Business, 2006.<br>7. Chelat Bhuvanachandran, Innovision, Khanna Book Publishing, 2022.<br>8. Byers, Dorf, and Nelson, Technology Ventures: From Ideas to Enterprise, McGraw Hill, 2010<br>9. Steve Blank, "The Startup Owner's Manual"<br>10. T.V. Rao, "Entrepreneurship - A South Asian Perspective" | |

## Elective 2: As per elective basket

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|---|---|---|---|---|---|---|---|
| Course Code | MED | | | | | | |
| Course Title | **Mechanical Engineering Lab-3 (Manufacturing)** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To provide an understanding of advanced manufacturing methods.<br>CO2: To get an idea of the dimensional & form accuracy of products.<br>CO3: To perform some advanced manufacturing operations<br>CO4: To evaluate the accuracy & tolerance of components produced. | | | | | | |
| Examination Mode | Practical | | | | | | |
| Assessment Tools | Written Quiz | Project Work/Lab Performance | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | - | 20% | - | 30% | | 50% | - |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Content** | ***List of experiments*** | | | | | | |
| | 1. Taper turning and external thread cutting using lathe<br>2. Contour milling using vertical milling machine<br>3. Spur gear cutting in milling machine<br>4. Measurement of cutting forces in Milling/ Turning process<br>5. CNC part programming<br>6. Drilling of a small hole using wire EDM<br>7. Microprocessor controlled pick & place robot<br>8. Use of Tool Maker's Microscope<br>9. Comparator and sine bar<br>10. Surface finish measurement equipment<br>11. Bore diameter measurement using micrometer and telescopic gauge<br>12. Use of Autocollimator. | | | | | | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED | | | | | | |
| Course Title | **Engineering Project-1 (Literature Review)** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To understand and gain knowledge in different areas.<br>CO2: To understand the design process.<br>CO3: To understand the selection of materials.<br>CO4: To understand the fabrication or prototyping. | | | | | | |
| Examination Mode | Practical | | | | | | |
| Assessment Tools | Written Quiz | Project Work/Lab Performance | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | - | 20% | - | 30% | | 50% | - |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Content** | | | | | | | |
| | This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course. | | | | | | |

## Elective 3, 4 and open electives as per baskets

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|---|---|---|---|---|---|---|---|
| Course Code | MED | | | | | | |
| Course Title | **Engineering Project-1 (Literature Review)** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To understand and gain knowledge in different areas.<br>CO2: To understand the design process.<br>CO3: To understand the selection of materials.<br>CO4: To understand the fabrication or prototyping. | | | | | | |
| Examination Mode | Practical | | | | | | |
| Assessment Tools | Written Quiz | Project Work/Lab Performance | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | - | 20% | - | 30% | | 50% | - |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Content** | | | | | | | |
| | This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course. | | | | | | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED | | | | | | |
| Course Title | **Engineering Project-3 (Prototyping and Testing)** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To understand and gain knowledge in different areas.<br>CO2: To understand the design process.<br>CO3: To understand the selection of materials.<br>CO4: To understand the fabrication or prototyping. | | | | | | |
| Examination Mode | Practical | | | | | | |
| Assessment Tools | Written Quiz | Project Work/Lab Performance | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | - | 20% | - | 30% | | 50% | - |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Content** | | | | | | | |
| | This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course. | | | | | | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED ( PROGRAM ELECTIVE I) | | | | | | |
| Course Title | **Finite Element Method** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: Students will learn about the basic concepts of FEM.<br>CO2: To provide the knowledge of one, two dimensional and axisymmetric Problems in FEM.<br>CO3: To provide the information of static, scalar field and dynamic problems.<br>CO4: To know about the dynamic considerations and computer implementations. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Introduction*** | | | | | | |
| | Introduction: Historical Background, Mathematical modeling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method. | | | | | | CO1 |
| **Unit 2** | ***Dimensional Problems*** | | | | | | |
| | One Dimensional Problems: One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics.<br>Two Dimensional Problem: Finite Element Modeling, Constant Strain Triangle (CST), problem modelling and boundary conditions. The Four Node Quadrilateral, Numerical Integration, Higher Order Elements; Nine Node Quadrilateral, Eight Node Quadrilaterals, Six Node Triangle. | | | | | | CO2 |
| **Unit 3** | ***Beams*** | | | | | | |
| | Introduction, Finite element modelling formulation, load vector, boundary considerations, shear force and bending moment, beams on elastic supports.<br>Scalar Field Problems: Introduction, Steady-state heat transfer, Torsion | | | | | | CO3 |
| **Unit 4** | ***Dynamic Considerations*** | | | | | | |
| | Dynamic Considerations: Element Mass Matrices, Evaluation of Eigen Values and Eigen Vectors.<br>Computer Implementation: Introduction; Computer Program Organization for Calculation of System Matrices, Introduction to FE software. | | | | | | CO4 |
| Text Books | 1. Chandrupatla, T.R and Belegundu A.D, T.S. Introduction to Finite Elements in Engineering, New Delhi: Pearson Education: 2015. Print.<br>2. Alavala, C. R.Finite Element Methods, New Delhi: PHI Learning Pvt. Ltd.2015.Print.<br>3. Moaveni, S. Finite Element Analysis, New Delhi: PHI Learning Pvt. Ltd. 2015.Print. | | | | | | |
| Reference Books | 1. Seshu, P. Textbook of Finite Element Analysis, New Delhi: PHI Learning Pvt. Ltd. 2015.Print.<br>2. Reddy, J. N.An Introduction to the Finite Element Method, New Delhi: McGraw Hill Education.2015. Print | | | | | | |

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| Online Resources | http://nptel.ac.in/courses/112104116/ | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED ( PROGRAM ELECTIVE I) | | | | | | |
| Course Title | **Tool Design** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To know about material geometry of cutting tools and thermal aspects in machining<br>CO2: To analyze the mechanics of cutting and jigs, fixture design.<br>CO3: To familiar with die design and tool faliour<br>CO4: To know about tooling cost. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Introduction*** | | | | | | |
| | **Materials and Geometry of cutting tools:**<br>Introduction, Desirable Properties of Tool Materials, Characteristics of Cutting Tool Materials, Cutting tool geometry, Chip flow direction, Tool angles specification systems, Cutting parameters and Tool geometry, Index able inserts, chip breakers, Tools of unusual geometry.<br>**Thermal aspects in machining and cutting fluid:**<br>Regions of heat generation; Heat In the Primary Shear Zone, Heat at the Tool/work Interface, Heat Flow at the Tool Clearance Face, Average shear plane temperature; Average chip - tool interface temperature; method of tool temperature measurement, temperature distribution in tool, Cutting Fluid: Types and composition of cutting fluids, selection of cutting fluid. | | | | | | CO1 |
| **Unit 2** | | | | | | | |
| | **Mechanics of metal cutting:**<br>Merchant's circle diagram - determination of cutting and thrust forces; Coefficient of friction; shear plane angle, Velocity and force relationship, shear stress and strain and strain rate in orthogonal cutting, stress distribution along rake face, theories of Lee and Shaffer's, Oxley's, etc. Cutting force measuring techniques i.e. dynamometer<br>**Jigs and Fixture:**<br>Principles of jig and fixture design, Principle of degrees of freedoms, methods of locations and clamping, Various devices for location and clamping, indexing devices, Hydraulic and pneumatic actuation of clamping devices, jig bushes, use of standard parts of jig design, type of drilling jigs, milling fixtures, lathe fixture, grinding fixtures and their classification. | | | | | | CO2 |
| **Unit 3** | ***Design*** | | | | | | |
| | **Die Design:**<br>Components of die design, design of die blocks, punches and strippers, methods of holding punches, sketches of stock stops, Design procedure for progressive dies, compound dies and combination dies for press tool operation forging die design for drop and machine forging parts.<br>**Tool Wear, Tool Life and Machinability:**<br>Tool wear mechanisms, Types of tool damage during cutting, Wear and chipping characteristics of different tool materials, Tool wear equations, tool failure criteria, Tool life equations, Effect of process | | | | | | CO3 |

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| | Parameters on Tool life, Tool life testing, Machinability, Surface finish and surface integrity. | |
| **Unit 4** | ***Surface Finish*** | |
| | **Tooling Costs:**<br>Estimating cost of a product, estimating costs of tools, Economics of tooling, Breakeven point analysis, minimum cost analysis.<br>**Surface Finish:**<br>Elements of surface finish, Factors affecting surface finish, Effect of surface quality on Functional properties of machine parts, Evaluation of surface finish, Indian Standards on surface finish. Measurement of surface finish, Relationship of surface finish to the production methods, finishing operations like honing, lapping, buffing super finishing etc. | CO4 |
| Text Books | 1. Sharma P.C. A Textbook of Production Engineering, New Delhi: S. Chand Publication. Print.<br>2. N. K. Mehta: Machine Tool Design McGraw Hill Publishing<br>3. S.K, Basu Machine Tool Design Oxford and IBH Publishing. | |
| Reference Books | 1. Acherkan Machine Tool Design Mir publishing.<br>2. F. Koenigsberger: Design Principles of Metal-Cutting Machine Tools.<br>3. ASTM, Fundamentals of Tool Design.<br>4. Donaldson C. Tool Design, McGraw Hill. | |

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|---|---|---|---|---|---|---|---|
| **Course Code** | MED ( PROGRAM ELECTIVE I) | | | | | | |
| **Course Title** | **Total Quality Management** | | | | | | |
| **Course Outcomes** | • To equip the students with knowledge about statistical tools.<br>• To provide knowledge about quality levels and different quality management tools.<br>• To provide knowledge about six sigma and quality assurance and systems.<br>• To provide information about different types of audits and the economics of product inspection. | | | | | | |
| **Examination Mode** | **Theory** | | | | | | |
| **Assessment Tools** | **Written Quiz** | **Assignment/ Project Work** | **MSE** | **MTP** | **ESE** | **EPR** | **ABL/PBL** |
| **Weightage** | 10% | 10% | 25% | | 50% | | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | | | | | | | |
| | **Introduction to quality**<br>Introduction, need for quality, evolution for quality, the definition of quality, product quality and service quality, Basic concepts of TQM, review of statistical concepts, test of normality for a given data, causes of variation, chance and assignable causes, statistical basis for control charts, basic control charting principles. TPM- concepts, improvement needs, performance measures. TQM implementation in manufacturing and service sectors. Introduction to control charts for variables and attributes, Process capability analysis: Introduction, specification limits and control limits, process capability indices, the Cp index, upper and lower capability indices, the Cpk index. | | | | | | CO1 |
| **Unit 2** | **Total Quality Management and tools**<br>Principles, leadership, strategic quality planning, Philosophies and frameworks, pillars of TQM: Leadership, Customer focus, Customer orientation and satisfaction, Customer complaints, Customer retention, Costs to quality, Quality Councils, Human Aspects in Management of Quality, Employee Involvement, motivation, Empowerment, team and teamwork, zero defects, quality circles, recognition and reward, Contribution of Deming, Continuous Process Improvement, PDCE cycle, 5S, Kaizen, Supplier partnership, Partnering, supplier rating and selection. TQM Tools: Benchmarking, Quality Function Deployment (QFD) – House of Quality, Taguchi Quality Loss Function, Juran and Crosby, Barriers to TQM, Seven traditional tool of quality, New management tools, PDCA methodology. | | | | | | CO2 |
| **Unit 3** | **Six Sigma**<br>Statistical basis for six sigma, concepts of six sigma, DMAIC methodology, project selection for six sigma, tools and techniques, FMEA- stages and types.<br>**Quality assurance and systems:**<br>Definition, Activities associated with quality assurance, Quality statement, characteristics of quality assurance system Quality systems, need for ISO 9000, ISO 9001-2015, documentation requirement, guidelines for preparation of quality manual. Steps for certification, benefits of ISO –9000 implementation. | | | | | | CO3 |

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| **Unit 4** | **Audit**<br>Quality audit: definition, internal audit, second party, third party audit, pre-assessment and compliance audit, procedure of auditing, audit planning, audit execution. | CO4 |
| Text Books | 1Bansal, V.B. *Industrial Engineering and Production Management.* New Delhi: Kapson Publishers. 2015. Print<br>2Raju, N.V.S. *Industrial Engineering and Management*. New Delhi: Cengage Learning. 2013. Print. | |
| Reference Books | 1Chunawala. *Production and Operation Management.* New Delhi: Himalaya Publication. 2013. Print.<br>2Dalela, and Ali, Mansoor. *Industrial Engineering and Management Systems*. New Delhi: Standard Publishing Distributors. 2010. Print.<br>3Hicks. *Industrial Engineering & Management-A new perspective*. New Delhi: Tata McGraw Hill. 2014. Print.<br>4Shankar, Ravi. *Industrial Engineering and Management*. New Delhi: Galgotia Publishers. 2010. Print.<br>5Jain and Agarwal. *Production Planning & Control.* New Delhi: Khanna Publishers. 2013. Print.<br>6Verma, A.P. *Industrial Engineering and Management*. New Delhi: Katson Books. 2010. Print.<br>7Bill Aulet, “Technology Entrepreneurship”, 4th ed., Tata McGraw Hill, 2014. | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED ( PROGRAM ELECTIVE I) | | | | | | |
| Course Title | **Refrigeration and Air-Conditioning** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: Analyze the reversed Carnot cycle and vapour compression refrigeration cycle (VCR).<br>CO2: Select the air-refrigeration systems for aircraft, and vapour absorption refrigeration system for rural and remote areas and select environmental friendly refrigerants considering the international standards.<br>CO3: Identify the Psychometric processes for different applications and design the parameters of air-conditioning system as per standards.<br>CO4: Estimate cooling load and heating load considering human comfort and optimize the air conditioning system as per requirements. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Introduction to Refrigeration and Air-Conditioning*** | | | | | | |
| | Introduction: Basic Definitions of Refrigeration and Air-Conditioning; History of Refrigeration; Natural and Artificial Refrigeration Methods; Techniques to produce low temperatures; Applications of Refrigeration; Refrigerants- Classification, Nomenclature, Desirable Properties, Selection. Air Refrigeration: Air Refrigeration Cycles - reversed Carnot cycle; Bell-Coleman cycle analysis; various methods of Aircraft Refrigeration: Analysis, Merits and demerits. Vapor Compression Refrigeration System: | | | | | | CO1 |
| **Unit 2** | ***Vapor Compression Refrigeration System*** | | | | | | |
| | Ideal VCR cycle (Working, Analysis and Limitations); Standard VCRS (Working and Analysis); Methods to improve performance of VCR; Multi-Stage VCRS; Cascade Refrigeration. Components of Refrigeration Systems: Compressors: Positive Displacement (Reciprocating and Rotary); Dynamic (Centrifugal and Axial) Compressors; Condensers and Evaporators (Both Natural and Forced Convection type); Expansion Devices and other components of the system. | | | | | | CO2 |
| **Unit 3** | ***Vapor Absorption Systems*** | | | | | | |
| | Working and Analysis; Absorbent - Refrigerant combinations; WaterAmmonia Systems; Water-Lithium Bromide System; Modified Version of Aqua-Ammonia System with Rectifier and Analyzer Assembly. Other Refrigeration systems: Brief Discussion on (i) Steam-Jet refrigeration system; (ii) Vortex tube refrigeration; (iii) Thermoelectric refrigeration system; and (iv) Magnetic refrigeration. | | | | | | CO3 |
| **Unit 4** | ***Psychrometry*** | | | | | | |
| | Classification of Air-Conditioning Systems; ASHRAE Nomenclature; Applications of Air-Conditioning; Psychrometry - Air-water vapor mixtures; Psychrometric Properties; Psychrometric or Air-Conditioning processes; Psychrometric Chart. Air-Conditioning Systems: Classification of Air-Conditioning Systems; Psychrometry of Air Conditioning Systems; Thermal Comfort (Definition and Psychrometric Properties for Thermal | | | | | | CO4 |

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| | Comfort); Mathematical Analysis of Air-Conditioning Systems; Cooling and Heating Load Estimation; a brief discussion on Ventilation. | |
| Text Books | 1. A Text book of Refrigeration and Air conditioning" by Kurmi R S and J K Gupta<br>2. ASHRAE Handbook (Fundamentals) | |
| Reference Books | 1. Manohar Prasad, Refrigeration and Air Conditioning, New Age International, 2004.<br>2. Dossat R.D., Principle of Refrigeration, 4th ed., Prentice-Hall, 1997.<br>3. Arora, C.P., Refrigeration and Air Conditioning, 2nd ed., Tata McGraw-Hill, 2000.<br>Online Resources:<br>1 https://onlinecourses.nptel.ac.in/noc22_me135/preview | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED ( PROGRAM ELECTIVE II) | | | | | | |
| Course Title | **Mechanical Vibrations** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: This course will enable students to fully understand and appreciate the importance of vibration in mechanical design of machine parts that operate in vibratory conditions<br>CO2: Students will able to write the differential equation of motion of vibratory systems<br>CO3: This course will enable students to make free and forced (Periodic, non-periodic, harmonic etc.) vibration analysis of single and multi-degree of freedom linear systems<br>CO4: To know about the continuous systems and Multi Degree Freedom Systems. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Introduction*** | | | | | | |
| | Types of vibrations, Simple Harmonic Motion (S.H.M), principle of super position applied to Simple Harmonic Motions. Beats, Fourier theorem and simple problems<br>Undamped Free Vibrations: Single degree of freedom systems, Mass Undamped free vibration-natural frequency of free vibration, stiffness of spring elements, effect of mass of spring, Compound Pendulum | | | | | | CO1 |
| **Unit 2** | ***Damped Free Vibrations*** | | | | | | |
| | Single degree freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases of under damping, critical and over damping, Logarithmic decrement.<br>Forced Vibrations: Single degree freedom systems, steady state solution with viscous damping due to harmonic force, Solution by Complex algebra, Reciprocating and rotating unbalance, vibration isolationtransmissibility ratio. Due to harmonic excitation and support motion | | | | | | CO2 |
| **Unit 3** | ***Vibration Measuring Instruments*** | | | | | | |
| | Whirling of shafts, Vibrometer meter and accelerometer, Whirling of shafts with and without air damping, Discussion of speeds above and below critical speeds, Combined with shear, strain energy under combined loading.<br>Systems with Two Degrees of Freedom: Introduction, principle modes and Normal modes of vibration, co-ordinate coupling, generalized and principal co-ordinates, free vibration in terms of initial conditions. Geared systems, Forced Oscillations-Harmonic excitation Applications: a) Vehicle suspension b) Dynamic vibration absorber. c) Dynamics of reciprocating Engines. | | | | | | CO3 |
| **Unit 4** | ***Continuous systems*** | | | | | | |
| | Introduction, vibration of string, longitudinal vibration of rods, Torsional vibration of rods, Euler's equation for beams.<br>Numerical Methods for Multi Degree Freedom Systems: Introduction, Influence coefficients, Maxwell reciprocal theorem, Dunkerley's equation, Orthogonality of principal modes, Method of matrix iteration- | | | | | | CO4 |

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| | Method of determination of all the natural frequencies using sweeping matrix and Orthogonality principle, Holzer's method, Stodola method. | |
| Text Books | 1. Leonard, Meirovitch. Elements of Vibrations Analysis. , Tata McGraw Hill,1986. Print.<br>2. Rao, S.S. Mechanical Vibrations. Pearson Education, 2003. Print.<br>3. Kelly, S. G. Mechanical Vibrations: Schaum's Outline Series. New Delhi: Tata McGraw Hill,2007. Print | |
| Reference Books | 1 Bhave, Shrikant.Mechanical Vibrations: Theory and Practice. Pearson Education, New Delhi. 2010. Print.<br>2. Venkatachalam R., Mechanical Vibrations.PHI Learning Pvt. Ltd. New Delhi. 2014. Print. | |
| Online Resources | http://nptel.ac.in/courses/112103111/ | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED ( PROGRAM ELECTIVE II) | | | | | | |
| Course Title | **Flexible Manufacturing System** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To learn about manufacturing system.<br>CO2: To learn about the automated assembly line, about the types of group technology,<br>CO3: To about the types of robotic technology<br>CO4: To about the types of robotic Programming. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Introduction*** | | | | | | |
| | Components of an FMS, types of systems, where to apply FMS technology, FMS work stations, Material handling and storage system: Functions of the handling system, FMS layout configurations. Material handling equipment, Computer control system: Computer function, FMS data file, system reports. Planning the FMS, analysis methods for FMS, applications and Benefits Part families, parts classification and coding, types of classification and coding systems, Machine cell design: The composite part concept, types of cell designs, determining the best machine arrangement, benefits of group technology. | | | | | | CO1 |
| **Unit 2** | ***Automation*** | | | | | | |
| | Types of automation, reasons for automating, automation strategies, Detroit-type automation: Automated flow lines, methods of work part transport, Transfer mechanisms, buffer storage, automation for machining operations.<br>Design for automated assembly, types of automated assembly systems, part feeding devices, quantitative analysis of the delivery system operation, and analysis of a single-station assembly machine, numerical. | | | | | | CO2 |
| **Unit 3** | ***Robotic Technology*** | | | | | | |
| | Joints and links, common robot configurations, work volume, types of robot control, accuracy and repeatability, other specifications, end effectors, sensors in robotics. | | | | | | CO3 |
| **Unit 4** | ***Robot programming*** | | | | | | |
| | Types of programming, lead through programming, motion Programming, interlocks, advantages and disadvantages. Robot languages: Motion programming, simulation and off-line programming, work cell control. | | | | | | CO4 |
| Text Books | 1. Groover, M.P. Automation, Production Systems and computer Integrated Manufacturing. Prentice Hall of India, 2007. Print.<br>2. Singh, Nanua. Approach to Computer Integrated Design and Manufacturing. John Wiley and Sons,2006. Print. | | | | | | |
| Reference Books | 1. Browne, J., Harhen, J. and Shivnan, J. Production Management Systems: A CIM Perspective. Addison Wesley,1989. Print. | | | | | | |
| Online Resources | http://nptel.ac.in/courses/110106044 | | | | | | |

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|---|---|---|---|---|---|---|---|
| **Course Code** | MED ( PROGRAM ELECTIVE II) | | | | | | |
| **Course Title** | **Entrepreneurship Development and Management** | | | | | | |
| **Course Outcomes** | • To know about entrepreneurship and entrepreneurship Support System.<br>• To know the different types of business and market opportunities.<br>• To identify the various components of management and the importance of management process in business.<br>• To impart the knowledge and awareness about various rules, regulations and act concerned with business. | | | | | | |
| **Examination Mode** | **Theory** | | | | | | |
| **Assessment Tools** | **Written Quiz** | **Assignment/ Project Work** | **MSE** | **MTP** | **ESE** | **EPR** | **ABL/PBL** |
| **Weightage** | 10 | 10 | 25 | | 50 | | 5 |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | | | | | | | |
| | **Entrepreneur and Entrepreneurship**<br>Introduction, Definition, Concept, Characteristics, Classification, Types, Functions and Competencies<br>**Entrepreneurship**<br>Definition, Concept, Need, Entrepreneurship as a career option<br>**Entrepreneurship Support System**<br>Concept and Need of entrepreneurship support system | | | | | | CO1 |
| **Unit 2** | **Business Ownership and its Features**<br>Sole proprietorship, Partnership, Joint Stock Companies, Cooperative, Private Limited, Public Limited and PPP mode<br>**Market Survey and Opportunity**<br>Introduction, Industry and its Classification, Small Scale Industries (SSI): Definition, Objectives, Features and importance, Steps for starting SSIs, Procedure for registration of SSIs, Understanding business opportunity, Consideration in product selection, Data collection for setting up small venture**.** | | | | | | CO2 |
| **Unit 3** | **Project Report Preparation**<br>**Project:** Introduction, Definition and Concept<br>**Project identification:** Introduction, Definition and Concept, Ways for selecting a project, Guidelines for selecting a project.<br>**Project Report:** Definition and Concept, Need of project report, Contents of a project report, Salient features of a project report, Uses of the project report, Preliminary Project Report (PPR), Detailed Project Report (DPR)<br>**Project Formulation:** Definition and Concept, Elements of project formulation<br>**Project Appraisal:** Definition and Concept, Objectives, Need, Stages of project appraisal | | | | | | CO3 |
| **Unit 4** | **Wage Payment**<br>Introduction, Wage, Type of wages, Wage differentials, Objective of good wage –incentive plan, Basis of good wage incentive plan, System of wage payment.<br>**Industrial Legislation and Laws**<br>Introduction, Need of industrial legislation, Types of taxes: Income tax, Sales tax, Excise duty, Provident fund, Legal aspects of small business, Factory Act, 1948, Payment of wages act, 1936, Workmen | | | | | | CO4 |

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| | Compensation Act, 1947, Industrial dispute act, 1947, Employee state insurance act, 1948, Minimum wages act, 1948. | |
| Text Books | 1Singh, A.K. ***Entrepreneurship Development and Management,*** New Delhi: Laxmi Publication. . Second Edition. 2009. Print.<br>2Bansal. *Entrepreneurship Development and Management*, New Delhi: Kapson. Print. | |
| Reference Books | 1Negendra. ***Entrepreneurship and Management,*** New Delhi: Pearson.1995. Print.<br>2Saravate, Dilip. ***Entrepreneurship Development and Project Managemen, Pune:*** **Everest** Publication. Print.<br>3Sharma Pritosh. ***Entrepreneurship Development and Management, New Delhi:*** **Dhanpat Rai & Co** Print.<br>4Lal, A. K. *Entrepreneurship Development and Management,* Vayu Education. Print. | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED ( PROGRAM ELECTIVE II) | | | | | | |
| Course Title | **Gas Dynamics** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: Apply the thermodynamics concepts in relation to compressible flows and derive relationships between various compressible flow parameters<br>CO2: Understanding of isentropic compressible flows in variable area ducts and apply in design of static components like nozzles and diffusers<br>CO3: Develop relationship for shocks and determine their characteristics under various conditions<br>CO4: Analyse the performance of aircraft and rocket propulsion engines. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Introduction to basic concept of gas dynamics*** | | | | | | |
| | Energy and momentum equations of compressible fluid flows – Stagnation states – Mach waves and Mach cone – Effect of Mach number on compressibility. Isentropic flows: Isentropic flow through variable area ducts. | | | | | | CO1 |
| **Unit 2** | ***Isentropic Flow*** | | | | | | |
| | Nozzle and Diffusers, compressors and turbines – Use of Gas tables. Flow through ducts: Flow through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – Variation of flow properties – Use of tables and charts – Generalized gas dynamics | | | | | | CO2 |
| **Unit 3** | ***Normal and oblique shocks*** | | | | | | |
| | Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl Meyer relations – Expansion of supersonic flow, Use of table and charts – Applications. | | | | | | CO3 |
| **Unit 4** | ***Jet propulsion and Space propulsion*** | | | | | | |
| | Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operation principle – cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo-prop engines – Aircraft combustors.<br>Types of rocket engines – Propellants – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – Space flights | | | | | | CO4 |
| Text Books | 1.Yahya S. M. "Fundamentals of Compressible Flow with aircraft and rocket propulsion", 5/e,New Age International publishers, 2016.<br>2. John D. Anderson Jr. "Modern Compressible Flow with historical perspective", 2/e, McGraw Hill Publishing company, International Edition, 1990. | | | | | | |
| Reference Books | 1. Balachandran P. "Fundamentals of Compressible Fluid Dynamics", PHI Learning India Private Ltd., 2009.<br>2. Shapiro A. H. "Dynamics and Thermodynamics of Compressible Fluid Flow – Volume I", John Wiley, New York, 1953.<br>3. Cohen. H., G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Longman Group Ltd.,1980<br>4. Ganesan. V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2010. | | | | | | |

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| | 5. Shapiro. A.H.," Dynamics and Thermodynamics of Compressible fluid Flow", John wiley, New York, 1953.<br>6. Sutton. G.P., "Rocket Propulsion Elements", John wiley, New York,2010,.<br>Zucrow. N.J., "Principles of Jet Propulsion and Gas Turbines", John Wiley, New York, 1970. | |
| Online Sources | https://archive.nptel.ac.in/courses/112/106/112106166/ | |

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| Course Code | MED ( PROGRAM ELECTIVE III) | | | | | | |
| Course Title | **Advanced Materials** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: Students will learn about the nano materials<br>CO2: Students will learn about the Composite materials<br>CO3: Students will learn about the Plastic materials<br>CO4: Students will learn about the design and development of composite materials | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Nano materials*** | | | | | | |
| | Carbon nanotubes, structure and properties, chemistry of carbon nanotubes, graphite whiskers, cones and polyhedral crystals, nano crystalline diamond, carbide derived carbon nanotubes in multifunctional polymer nano composites, nano structured materials for field emission devices, nano textured carbons for electrochemical energy storage. | | | | | | CO1 |
| **Unit 2** | ***Composites*** | | | | | | |
| | Introduction, reinforcements, matrix materials, processing, interface, micromechanics, monotonic behaviour, cyclic fatigue, creep, wear, applications, shape memory alloys (SMAs), metallic foam, recemat metal foam etc. | | | | | | CO2 |
| **Unit 3** | ***Plastics*** | | | | | | |
| | Introduction to plastics, polymeric materials (molecular viewpoint),microstructures in polymers, mechanical properties (macro view point) chemical and physical properties (macro view point), designing with plastics, thermoplastic materials (commodity plastics), thermoplastic materials(engineering plastics), thermo set materials, elastomeric (rubber) materials, extrusion, injection moulding, blow moulding, thermoforming, rotational moulding, casting, foaming, compression moulding, transfer moulding, and related processes, radiation, finishing, adhesion and assembly operations and management, Environmental aspects of plastics. | | | | | | CO3 |
| **Unit 4** | ***Development of Advanced Composite Materials*** | | | | | | |
| | Micromechanical behaviour of a lamina, Mechanics of materials and elasticity approach to stiffness, Comparison of approaches, Mechanics of materials approach to strength. Fatigue behaviour in composites, Effect of holes in laminates, Fracture mechanics with reference to composites, transverse shear effects, Post curing shapes of un symmetric laminates, Environmental effects.<br>Design of Composite Materials: Introduction to design of composite structures, structural design, material selection, configuration selection, laminate joints, Design requirements and design failures criteria, optimization concepts, design analysis philosophy for composite structures. | | | | | | CO4 |

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| Text Books | 1Sehgal, Lindberg R.A. Materials, their Nature, Properties and Fabrication. New Delhi: S Chand. Print.<br>2Polmear, I. J. Light alloys: Metallurgy of Light Metals. Arnold. 3rd Edition. 1995. Print. | |
| Reference Books | 1Robert, M. Mechanics of Composite Materials. Print. | |

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| Course Code | MED ( PROGRAM ELECTIVE III) | | | | | | |
| Course Title | **Non Destructive Testing** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To aware the description of non-destructive methods.<br>CO2: To know about liquid penetration testing methods.<br>CO3: To know about magnetic particle testing.<br>CO4: To know about eddy current testing. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Introduction*** | | | | | | |
| | Non-destructive versus destructive testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterization, applications in NDT.<br>**Visual Inspection:** Introduction, basic terms associated with visual inspection, equipment and accessories used for visual inspection, Visual Detection of Discontinuities, Evaluation of test results, application, advantage and limitations. | | | | | | CO1 |
| **Unit 2** | ***Liquid Penetration Testing*** | | | | | | |
| | Introduction, principle, equipment, characteristics of penetrants and their types, developer, hazards precautions, Evaluation of test results, application, advantage and limitations.<br>**Radiographic Testing:** X-ray radiography principle, equipment & methodology-Type of industrial sources and application –Radiographic exposure factor and Technique-gamma ray and X-Ray equipment-Radiographic procedure, interpretation. Precautions against radiation hazards, application, advantage and limitations. | | | | | | CO2 |
| **Unit 3** | ***Magnetic Particle Testing*** | | | | | | |
| | Principle of magnetic particle testing, basic terms associated with magnetic particle testing, different methods to generate fields, Magnetic particle testing equipment, Magnetic particle testing procedures, method of de- agnetization, magnetic particle medium, Evaluation of indication, application, advantage and limitations.<br>**Ultrasonic Testing:** Introduction, principle of operation, basic terms associated with ultrasonic testing, type of ultrasonic propagation and probes, type of transducers, data representation, A-Scan, B-scan, C-scan, and Method for evaluating discontinuities, elastic studyof wood, application, advantage and limitations. | | | | | | CO3 |
| **Unit 4** | ***Eddy Current Testing*** | | | | | | |
| | Introduction, principle of operation,basic terms associated with eddy current testing, Factor effecting eddy current-defect-frequency-geometry-conductivity-Proximity (Lift off & Fill Factor),eddy current flow characteristics, test equipment, types of probes, eddy current application and signal display, advantage and limitations. | | | | | | CO4 |
| Text Books | 1. Davies, Troxell, and Hauck G.F.W.The testing of Engineering materials, New York: McGraw Hill. Print. | | | | | | |

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| Reference Books | 1. Armstrong, W.H. *Mechanical Inspection*, New York: McGraw Hill. Print. | |
| Online Resources | http://nptel.ac.in/courses/113106070/ | |

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| **Course Code** | MED ( PROGRAM ELECTIVE III) | | | | | | |
| **Course Title** | Industrial Safety | | | | | | |
| **Course Outcomes** | • To impart the valuable skills to plan and understand importance of Industrial Safety.<br>• To know the socio-techno-economic aspects related to the Occupational health and safety.<br>• To have the understanding about operational Safety. | | | | | | |
| **Examination Mode** | **Theory** | | | | | | |
| **Assessment Tools** | **Written Quiz** | **Assignment/ Project Work** | **MSE** | **MTP** | **ESE** | **EPR** | **ABL/PBL** |
| **Weightage** | 10% | 10% | 25% | | 50% | | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | | | | | | | |
| | **Safety:** Meaning & need for safety. Relationship of safety with plant design, equipment design and work environment. Industrial accidents, their nature, types and causes. Assessment of accident costs; prevention of accidents. Industrial hazards, Hazard identification techniques, Accident investigation, reporting and analysis. Safety and economics, safety and productivity. Employee's participation in safety. Safety legislation. | | | | | | CO1 |
| **Unit 2** | **Environment:** Environmental factors in industry. Effect of temperature, Illumination, humidity noise and vibrations on human body and mind. Physiology of heat regulation. Thermal environment and its measurement. Thermal comfort. Indices of heat stress. Thermal limits for comfort, efficiency and freedom from health risk. Natural ventilation. Mechanical ventilation. Air conditioning Process ventilation. Control of heat exposures, control at source, insulation, and local exhaust ventilation. Control of radiant heat, dilution ventilation. Local relief. | | | | | | CO2 |
| **Unit 3** | **Industrial Lighting:** Purpose of lighting, benefits of good illumination. Phenomenon of lighting and safety. Lighting and the work. Sources and types of artificial lighting. Principles of good illumination. Recommended optimum standards of illumination. Design of lighting installation.<br>**Noise and Vibrations:** Continuous and impulse noise. The effect of noise on man. Noise measurement and evaluation of noise. Noise isolation. Noise absorption techniques. Silencers Vibrations: Effect, measurement and control measures. | | | | | | CO2 |
| **Unit 4** | **Operational Safety:** General safety considerations in material handling – manual and mechanical, safety in machine shop, safety in use of hand and portable (power) tools, safety in use of electricity, safety in welding and cutting, principles of guarding, safety in grinding, safety in heat treatment shop, safety in gas furnace operation. | | | | | | CO3 |
| Text Books | 1. Krishnan N V, *"Safety management in Industry",* Jaico Publishing House, Delhi (1993).<br>2. Kocurek Dianna and Woodside Gayle, *"Environment, Safety, and Health Engineering"*, John Wiley and Sons, New York (1997). | | | | | | |

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| Reference Books | 1. McCormick J, *"Human Factors in Engineering and Design"*, Tata McGraw Hill Pub Company Limited, New Delhi (1979).<br>2. Willie Hammer, Dennis Price, "Occupational Safety Management and Engineering", 5th Ed., Pearson Edu (2000).<br>3. David Goetsch, "The Safety and Health Handbook", Pearson Education (1999). | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED ( PROGRAM ELECTIVE III) | | | | | | |
| Course Title | **Non-Conventional Energy Sources** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: Know the need of renewable energy resources, historical and latest developments.<br>CO2: Describe the use of solar energy and the various components used in the energy production with respect to applications like-heating, cooling, desalination, power generation, drying, cooking etc.<br>CO3: Appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.<br>CO4: Understand the concept of Biomass energy resources and their classification, types of biogas Plants- applications | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Solar Radiation*** | | | | | | |
| | Energy source, India's production and reserves of commercial energy sources, need for nonconventional energy sources, energy alternatives, solar, thermal, photovoltaic. Water power, wind biomass, ocean temperature difference, tidal and waves, geothermal, tar sands and oil shale, nuclear (Brief descriptions); advantages and disadvantages, comparison (Qualitative and Quantitative).<br>Extra-Terrestrial radiation, spectral distribution of extra-terrestrial radiation, solar constant, solar radiation at the earth's surface, beam, diffuse and global radiation, solar radiation data.<br>Measurement of Solar Radiation: Pyrometer, shading ring pyrheliometer, sunshine recorder, schematic diagrams and principle of working.<br>Solar Radiation Geometry: Flux on a plane surface, latitude, declination angle, surface azimuth angle, hour angle, zenith angle, solar altitude angle expression for the angle between the incident beam and the normal to a plane surface (No derivation) local apparent time. Apparent motion of sum, day length, numerical examples. Beam, diffuse and reflected radiation, expression for flux on a tilted surface (no derivations) numerical examples. | | | | | | CO1 |
| **Unit 2** | ***Performance Analysis of Liquid Flat Plate Collectors*** | | | | | | |
| | General description, collector geometry, selective surface (qualitative discussion) basic energy-balance equation, stagnation temperature, transmissivity of the cover system, transmissivity – absorptivity product, numerical examples. The overall loss coefficient, correlation for the top loss coefficient, bottom and side loss coefficient, problems (all correlations to be provided). Temperature distribution between the collector tubes, collector heat removal factor, collector efficiency factor and collector flow factor, mean plate temperature, instantaneous efficiency (all expressions to be provided). Effect of various parameters on the collector performance; collector orientation, selective surface, fluid inlet temperature, number covers, dust. | | | | | | CO2 |
| **Unit 3** | ***Wind Energy and Tidal Power*** | | | | | | |

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| | Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, wind machines; Types of wind machines and their characteristics, horizontal and vertical axis wind mills, elementary design principles; coefficient of performance of a wind mill rotor, aerodynamic considerations of wind mill design, numerical examples.<br>Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, limitations. | CO3 |
| **Unit 4** | ***Geothermal Energy Conversion*** | |
| | Principle of working, types of geothermal station with schematic diagram, geothermal plants in the world, problems associated with geothermal conversion, scope of geothermal energy.<br>Energy from Bio Mass: Photosynthesis, photosynthetic oxygen production, energy plantation, bio gas production from organic wastes by anaerobic fermentation, description of bio-gas plants, transportation of bio-gas, problems involved with bio-gas production, application of bio-gas, application of bio-gas in engines, advantages. | CO4 |
| Text Books | 1 Non-Convention Energy Resources B H Khan McGraw Hill Education (India) Pvt. Ltd. 3rd Edition.<br>2 Solar energy Subhas P Sukhatme Tata McGraw Hill 2 nd Edition, 1996.<br>3 Non-Conventional Energy Sources G.D Rai Khanna Publishers 2003 | |
| Reference Books | 1 Renewable Energy Sources and Conversion Technology N.K.Bansal, Manfred Kleeman&MechaelMeliss Tata McGraw Hill. 2004<br>2 Renewable Energy Technologies Ramesh R & Kumar K U Narosa Publishing House New Delhi<br>3 Conventional Energy Systems K M, Non Wheeler Publishing Co. Ltd., New Delhi 2003<br>4 Non-Conventional Energy Ashok V Desai Wiley Eastern Ltd, New Delhi 2003<br>https://archive.nptel.ac.in/courses/121/106/121106014/ | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED ( PROGRAM ELECTIVE IV) | | | | | | |
| Course Title | **Mechanical Behaviour of Materials** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: Understand the mechanical behavior of ductile and brittle materials<br>CO2: Analyze creep, fatigue and fracture mechanisms for various materials<br>CO3: Develop fracture mechanism maps and analyze the reasons for failure of materials<br>CO4: Select a characterization technique to evaluate the behavior of materials | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Introduction to mechanical behaviour:*** | | | | | | |
| | A brief review of elastic and plastic deformation, dislocations and their properties. Dislocations in FCC, BCC and HCP metals, interactions with point defects and other dislocations. Tensile behavior, evaluation of strength and ductility parameters, Effect of strain rate and temperature on tensile behavior, and Protevin Le-Chatelier effect.<br>Types and mechanisms of creep deformation, Creep under combined stresses, deformation mechanism maps, Super plasticity, environmental effects, remaining life assessment. | | | | | | CO1 |
| **Unit 2** | ***Fatigue Behaviour:*** | | | | | | |
| | High and low cycle fatigue, process of fatigue fracture, effect of mean stress, Cyclic stress/strain response of materials, establishment of cyclic stress/ strain curve, transition fatigue life, Coffin-Manson relationship, Evaluation of parameters, characterizing resistance against high cycle and Low cycle fatigue, Creep fatigue interaction, environmental effects, thermochemical fatigue. | | | | | | CO2 |
| **Unit 3** | ***Fracture Mechanics & Failure analysis:*** | | | | | | |
| | Brief review of the basic concepts of linear elastic and elastic-plastic fracture mechanics, stress intensity parameter, J- integral and crack tip opening displacement as fracture criteria, standard procedures for experimental determination of these parameters.<br>Analyzing Fractures, Micro mechanisms of brittle and ductile fracture, fracture mechanism maps, fractography, Visual Examination & Management of Applied Failure Analysis, Manage Failure Analysis. | | | | | | CO3 |
| **Unit 4** | ***Materials characterization techniques:*** | | | | | | |
| | Optical microscopy techniques, Quantitative metallography, Scanning electron microscopy: Image formation methods in SEM. Applications. | | | | | | CO4 |
| Text Books | 1. Mechanical Metallurgy, George E. Dieter, McGraw Hill, 2nd Edition, 2005.<br>2. Introduction to Fracture Mechanics, Hellan K, McGraw Hill, 2002.<br>3. Mechanical Behavior of Materials at Elevated Temperatures, J.E.Dorn, McGraw Hill, 2000. | | | | | | |
| Reference Books | 1. Engineering Materials I : Introduction to Properties, Applications and Design, M.F Ashby and David R H Jones :,2010.<br>2. Mechanical behaviour of Materials, Marc Andre Meyers and Krishna Kumar Chawla, 2009. | | | | | | |

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| Course Code | MED ( PROGRAM ELECTIVE IV) | | | | | | |
| Course Title | **Product Design and Development** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To aware the description of non-destructive methods.<br>CO2: To know about liquid penetration testing methods.<br>CO3: To know about magnetic particle testing.<br>CO4: To know about eddy current testing. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Introduction*** | | | | | | |
| | Introduction to product design, Significance of product design, product design<br>and development process, sequential Engineering design method, the challenges of product development, Development Process and Organizations-Generic Development Process, Concept Development, Adapting the generic PD process flows, AMF development Process, Product Development Organizations, The AMF Organization.<br>Product Planning<br>Product Planning and Identifying Customer Needs-Product Planning process, Interpret raw data in terms of customers need, organize needs in hierarchy and establish the relative importance of needs, review of the process. Product Specifications-Establish target specifications, setting final specifications. | | | | | | CO1 |
| **Unit 2** | ***Concept Consideration in Product Design*** | | | | | | |
| | Concept Generation-Activities of concept generation, clarifying problem, search both internally and externally, explore the output,<br>Concept Selection-Overview, concept screening and concept scoring, methods of selection. Concept Testing-Elements of testing: qualitative and quantitative methods including survey, measurement of customers" response.<br>***Designing of product*** Product Architecture-Modular & Integral architecture, implications, establishing the architecture, Delayed differentiation, Platform Planning. Industrial Design-Assessing need for industrial design, Impact of industrial Design, Industrial<br>design process, management of industrial design process, assessing quality of industrial design. | | | | | | CO2 |
| **Unit 3** | ***Value Engineering and product Design*** | | | | | | |
| | Introduction, Historical perspective, what is value? Nature and Measurement of value, Maximum value, normal Degree of value, Importance of value, The value Analysis job plan, Creative, Steps to problem – solving and value Analysis, value Analysis Test, value Engineering Idea Study on Tap Switch Control Assembly, Material and process Selection in value Engineering. Designer contributes, Role of Aesthetics in product Design, Functional Design Practice.<br>**Modern Approaches to Product Design**<br>Concurrent Design, Quality Function Deployment (QFD) | | | | | | CO3 |

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| **Unit 4** | ***Eddy Current Testing*** | |
| | **Human Engineering Considerations in Product Design**<br>Introduction, Human being as Applicator of Forces, Anthropometry: Man as occupant of Space, the Design of Controls, The Design of Displays, Man/Machine Information Exchange.<br>**Embodiment Design:**<br>Design for Manufacturing, prototyping. Robust Design. Intellectual Property and Environmental Guidelines-Intellectual Property: Elements and outline, patenting procedures, claim procedure, Environmental regulations from government, ISO system. | CO4 |
| Text Books | 1. Ulrich Karl T. &Epinger Steven D. *Product Design & Development*– Tata- McGraw Hill - 3 rd Edition, New Delhi, 2004<br>2. Jones Tim, Heinmam Butterworth, *New product Development*, Oxford - UIC, 1997 | |
| Reference Books | 1.EngeneKinetoviczRoland,*New product Development: Design & Analysis*, Wiley and Sons Inc., New York, 1990.<br>2.Hollins Bill, Pugh Stwout,Successful Product Design, Butterworth, London,1990<br>3. Otto Kevin and Wood Kristini. *Product Design,*Pearson India, New Delhi, 2004. | |
| Online Resources | http://nptel.ac.in/courses/112107217/ | |

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| **Course Code** | MED ( PROGRAM ELECTIVE IV) | | | | | | |
| **Course Title** | Ergonomics and Workplace Design | | | | | | |
| **Course Outcomes** | • To impart the knowledge of various principles of ergonomics.<br>• To know various considerable factors of workplace design.<br>• To understand the compatibility of man and machine.<br>• To know various factors affecting life stress. | | | | | | |
| **Examination Mode** | **Theory** | | | | | | |
| **Assessment Tools** | **Written Quiz** | **Assignment/ Project Work** | **MSE** | **MTP** | **ESE** | **EPR** | **ABL/PBL** |
| **Weightage** | 10 | 10 | 25 | | 50 | | 5 |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | | | | | | | |
| | **Introduction to Human Factors**<br>Scope of human factors, Study of human factors as a science, Cost/benefit analysis of human factors contributions, Human factors in the product design lifecycle, User centered design, Sources for design work.<br>**Front End Analysis**<br>User analysis, Environmental analysis, Function and task analysis, Perform, Collect, Summarize and Analyse task data, Identify user preferences and requirements.<br>**Iterative Design and Testing:**<br>Providing input for system specifications, Organization design, Prototype, Heuristic evaluation, Usability testing, final test and evaluation | | | | | | CO1 |
| **Unit 2** | **Human Variability and Statistics:**<br>Human variability, Statistical analysis<br>**Anthropometric Data:**<br>Measurement devices and methods, Civilian and Military data, Structural and functional data, Use of anthropometric data in design.<br>**General Principles of Workspace Design:**<br>Clearance requirements of the largest users, Reach requirements of the smallest users, Special requirement of maintenance people, Adjustability requirements, Visibility and normal line of sight, Component arrangement.<br>**Design of Standing and Seated Work Areas:**<br>Choice between standing and seated work areas, Work surface height, Work surface depth, Work surface inclination. | | | | | | CO2 |
| **Unit 3** | **Muscle Structure and Metabolism:**<br>Muscle Structure, Aerobic and Anaerobic metabolism<br>**Circulatory and Respiratory Systems:**<br>The circulatory systems, the respiratory systems<br>**Energy Cost of Work and Workload Assessment**:<br>Energy cost of work, Measurement of Workload.<br>**Physical Work Capacity and Whole-Body Fatigue:**<br>Short term and Long term work capacity, Causes and Control of whole body fatigue, Static work and Local muscle fatigue | | | | | | CO2 |
| **Unit 4** | **Environmental Stressors:**<br>Motion, Thermal Stress, Air quality<br>**Psychological Stressors:** | | | | | | CO4 |

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| | Cognitive appraisal, Ethical issues, Level of arousal, Performance changes with over arousal, Remedial of psychological stress.<br>**Life Stress**<br>**Workload Overload:**<br>Remediation, Mental workload measurement<br>**Fatigue and Sleep Disruption:**<br>Vigilance and under arousal, Sleep disruption and Performance effects, Remediation of sleep disruption.<br>**Safety Accidents and Human Errors** | |
| Text Books | 1. Wickens and Lee. *An introduction to Human Factor Engineering*. New Delhi: PHI. 2014. Print. | |
| Reference Books | 1. Murrell, K.F.H, Champan& Hall. *Ergonomics: Man in his working environment*. London. 2012.Print.<br>2. Alexander, D.C. *The Practice and Management of Industrial Ergonomics.* Prentice-Hall, Englewood Cliffs, NJ. 1986. Print.<br>3. Astrand, P.O. and Rhodahl, K. *Textbook of Work Physiology.* New York: McGraw-Hill. 2003. Print. | |
| Online Source | http://nptel.ac.in/courses/107103004 | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED ( PROGRAM ELECTIVE IV) | | | | | | |
| Course Title | **Power Plant Engineering** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: Analyze the reversed Carnot cycle and vapour compression refrigeration cycle (VCR).<br>CO2: Select the air-refrigeration systems for aircraft, and vapour absorption refrigeration system for rural and remote areas and select environmental friendly refrigerants considering the international standards.<br>CO3: Identify the Psychometric processes for different applications and design the parameters of air-conditioning system as per standards.<br>CO4: Estimate cooling load and heating load considering human comfort and optimize the air conditioning system as per requirements. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/ Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Introduction to Energy Sources*** | | | | | | |
| | Energy sources for generation of electric power, energy policy of India, present status and future trends, major power plants in India. Thermal Power Plants: Selection of site, general layout of the plant, major components- Boilers, Economisers, Super-heaters, Air pre-heaters, fuels, fuel and ash handling equipment's, High pressure Boilers, steam turbines, station heat balance and plant efficiency. | | | | | | CO1 |
| **Unit 2** | **Thermal Power and Hydro Power Plant** | | | | | | |
| | Diesel Power Plant: Diesel engine, engine performance and operation, super charging, Diesel Electric power plant layout. Gas Turbine Power Plants: Gas turbine power plants, basic cycles, cycle calculation, the ideal and real operating cycles, components and layout. Hydro Power Plants: Classification of hydro-plants, selection of site, rain fall and run off, calculation of storage capacity, plant layout, estimation of power available, selection of hydraulic turbines and their governing. | | | | | | CO2 |
| **Unit 3** | ***Nuclear Power Plants*** | | | | | | |
| | Introduction, Atomic structure and radio-activities nuclear reactions, binding energy, Nuclear Reactors, Types of reactors, Pressurized water reactors, boiling heater reactors, Heavy water-cooled and moderated (CANDU) reactor, Gas-cooled reactors, Liquid metal cooled reactors, Indian Nuclear power installations, comparison between Nuclear and Thermal plants. Non-Conventional Power Plants: Geothermal power plants, Tidal power plants, Wind power plants, solar power plants, M.H.D. Generators, OTEC | | | | | | CO3 |
| **Unit 4** | **Power Plant Economics & environmental aspect** | | | | | | |
| | Plant investment costs, fixed charges, Operation cost, energy cost, depreciation and operating costs on the selection of equipment's, incremental cost, comparison of fixed and operating costs, greenhouse effect, thermal pollution, other pollutants. | | | | | | CO4 |
| Text Books | 1. A Course in Power Plant Engineering: / Arora and S. Domkundwar.<br>2. Power Plant Engineering – P.C.Sharma / S.K.Kataria Pub | | | | | | |
| Reference Books | 1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.<br>2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010. | | | | | | |

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| | 3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998. | |
| Online Resources: | https://onlinecourses.nptel.ac.in/noc22_me73/preview | |

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|---|---|---|---|---|---|---|---|
| Course Code | MED ( PROGRAM ELECTIVE IV)(Open Elective) | | | | | | |
| Course Title | **Automobile Engineering** | | | | | | |
| Course Outcomes | On the completion of the course the student will be able to:<br>CO1: To understand the construction and working principle of various parts of an automobile.<br>CO2: To understand the Lubricating System, Cooling System, Chassis & Transmission<br>CO3: To understand the steering and breaking systems of automobile<br>CO4: To know about the resent advancements in automobiles. | | | | | | |
| Examination Mode | Theory | | | | | | |
| Assessment Tools | Written Quiz | Assignment/Project Work | MSE | MTP | ESE | EPR | ABL/PBL |
| Weightage | 10% | 10% | 25% | - | 50% | - | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | ***Introduction*** | | | | | | |
| | **Introduction:** History of automobiles; Classification of automobiles; Power plant classification; Engine terminology; Types of cycles; Working principle of an IC engine; Advanced classification of engines and multi cylinder engines; Engine balance and firing order.<br>**Fuel System, Ignition System and Electrical system**: *Spark Ignition engines* – fuel tank, fuel filter, fuel pump, air filter, carburetor, direct injection of petrol engines; *Compression Ignition engines* – fuel injection (air and solid), pressure charging, super charging and turbo charging; *Ignition systems* – components, battery ignition, magneto ignition, electronic ignition and ignition timing; *Main electrical circuits* – generating & starting circuit, lighting, indicating devices. | | | | | | CO1 |
| **Unit 2** | ***Lubricating System and Cooling System, Chassis & Transmission*** | | | | | | |
| | **Lubricating System and Cooling System:** Functions & properties of lubricants, methods of lubrication; Oil filters, oil pumps, oil coolers; Characteristics of an effective cooling system; types of cooling systems; Radiator, thermostat, air cooling & water cooling.<br>**Chassis & Transmission:** Parts of automobile body; Automobile frames – functions, constructions, sub frames, materials and defects; Transmission – axles, clutches, propeller shafts, differential, gear boxes, automatic transmission, electronic transmission control, functions and types of front and rear axles, types and functions of clutches, Hotchkiss drive torque tube drive, traction control. | | | | | | CO2 |
| **Unit 3** | ***Steering, Braking and Suspension*** | | | | | | |
| | **Steering, Braking and Suspension:** Steering mechanism, steering gear box types, wheel geometry; Brakes – principle, functions, types, construction, operation and parking brake; Suspension - types of spring shock absorbers, objectives and types of suspension system, rear axle suspension, electronic control and proactive suspension system.<br>**Automotive Air Conditioning:** Ventilation, heating, air condition, refrigerant, compressor and evaporator. | | | | | | CO3 |
| **Unit 4** | ***Wheels and Tyres*** | | | | | | |
| | Wheel quality, assembly, types of wheels, wheel rims. Construction of tyres and tyre specifications.<br>**Recent Trends:** E-vehicles; Satellite-based navigation; Automated steering; Environment effect and mitigation. | | | | | | CO4 |

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| Text Books | 1. A.K. Babu, S.C. Sharma, Automobile Mechanics, Khanna Book Publishing, 2019.<br>2. A.K. Babu, S.C. Sharma, Automobile Engines, Khanna Book Publishing, 2019.<br>3. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997. | |
| Reference Books | 1. Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002.<br>2. Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.<br>3. Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998. | |
| Online Resourses | https://archive.nptel.ac.in/courses/107/106/107106088/ | |

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|---|---|---|---|---|---|---|---|
| **Course Code** | MED ( PROGRAM ELECTIVE IV/Open elective) | | | | | | |
| **Course Title** | **Industrial Engineering Techniques** | | | | | | |
| **Course Outcomes** | • To impart the knowledge of Production and Productivity.<br>• To provide the knowledge of PPC and facility location.<br>• To conduct time and motion study to improve the methods/system and to increase productivity<br>• To impart the valuable skills to plan and understand concepts of material management and Cost Estimation and Control. | | | | | | |
| **Examination Mode** | **Theory** | | | | | | |
| **Assessment Tools** | **Written Quiz** | **Assignment/ Project Work** | **MSE** | **MTP** | **ESE** | **EPR** | **ABL/PBL** |
| **Weightage** | 10% | 10% | 25% | | 50% | | 5% |
| **Syllabus** | | | | | | | **CO Mapping** |
| **Unit 1** | | | | | | | |
| | **Industrial Engineering**<br>Introduction, Definition and concept, Place of industrial engineer in an organization, Activities of Industrial Engineering, Industrial Engineering Approach, Objectives of Industrial Engineering, Functions of the Industrial Engineer, Techniques of Industrial Engineering, Industrial Engineering in Services Sector, Qualities of Industrial Engineer<br>**Production and Productivity**<br>Introduction, Production & Productivity Concept, Difference between production and productivity, Expectations from productivity, Tools of productivity, Reasons of low productivity, Productivity Measurement System, Technical Methods to Improve Productivity, Advantages from Increased Productivity. | | | | | | CO1 |
| **Unit 2** | **Production Planning and Control**<br>Introduction, Key Terms - Production; Planning; Control, Production Planning and Control, Difference between production planning and production control, Objectives and Functional Elements of PPC, Types of Production System (Job, Batch and Continuous), Break even analysis<br>**Plant Location and Layout**<br>Introduction, Site Selection, Reasons for appropriate location selection, Factors to choose site of plant, Urban, Rural and Suburban areas, Economic survey of site selection, Plant Layout, Objectives and Principles of plant layout, Factors affecting plant layout, Plant layout procedure, Types of plant layout, Flow patterns, Symptoms of bad layout, Work Station Design. | | | | | | CO2 |
| **Unit 3** | **Work Study**<br>Introduction, Work Study: Need, Applications, Advantages, Work Study Procedure<br>**Method Study:** Definition, Objectives, Procedure, Charts, Diagrams, Motion and Film Analysis, Therbligs, Models, Principles of Motion Economy<br>**Work Measurement:** Definition, Objectives, Procedure, Techniques of work measurement (Time Study, PMTS), Performance Rating, and Allowance. | | | | | | CO2 |
| **Unit 4** | **Cost Estimation and Control**<br>Introduction, Cost and Its Classification, Costing, Cost Estimation, Difference between Cost Estimation and Costing, Elements of Cost, | | | | | | CO4 |

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| | Ladder of Cost, Overhead Expenses, Mathematical Formulae to Calculate Volume of Components, Densities of Metals, Depreciation, Cost Control<br>**Material Management**<br>Material Management (Functions, Advantages, Objectives), Purchasing (Functions, Objectives, VPR, Purchasing Procedure), Store Management (Functions and Duties, Location and Layout of Stores, Principles of efficient store layout, Approaches of store location, Types of store layouts,) Inventory (Inventory Control, Classification, Need, Benefits, Disadvantage, Objectives), Various levels of Inventory Control, Inventory Control Techniques, Introduction to JIT | |
| Text Books | 1. Bansal, V.B. *Industrial Engineering and Production Management.* New Delhi: Kapson Publishers. 2015. Print.<br>2. Raju, N.V.S. *Industrial Engineering and Management*. New Delhi: Cengage Learning. 2013. Print. | |
| Reference Books | 1. Chunawala. *Production and Operation Management.* New Delhi: Himalaya Publication. 2013. Print.<br>2. Dalela, and Ali, Mansoor. *Industrial Engineering and Management Systems*. New Delhi: Standard Publishing Distributors. 2010. Print.<br>3. Hicks. *Industrial Engineering & Management-A new perspective*. New Delhi: Tata McGraw Hill. 2014. Print.<br>4. Shankar, Ravi. *Industrial Engineering and Management*. New Delhi: Galgotia Publishers. 2010. Print.<br>5. Jain and Agarwal. *Production Planning & Control.* New Delhi: Khanna Publishers. 2013. Print.<br>6. Verma, A.P. *Industrial Engineering and Management*. New Delhi: Katson Books. 2010. Print. | |
| Online Source | http://nptel.ac.in/courses/112107143/<br>http://nptel.ac.in/courses/112107142/ | |

## Open elective course syllabus provided by other departments as passed in respective BOS meetings with L T P 3 0 0 3.