

**Curriculum**

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| --- | --- |
| **School:** | **School of Engineering and Technology** |
| **Program Code:** | **123** |
| **Program Name:** | **B. Tech Mechanical Engineering** |
| **Academic Year:** | **2024-25** |

**Vision of School:**

The vision of Mechanical Engineering Department is to get recognized as outstanding program, producing well-qualified and employable Mechanical Engineers who are innovative, entrepreneurial and responsible to the society.

**Mission of School:**

**•** Imparting a quality interdisciplinary education through strong theoretical foundation and practical training to make competitive engineers.

• To follow the vision of NUV “Be what you want to be”, provide a choice based education by offering a good number of core electives.

• Motivating the students for innovation, leadership and entrepreneurial approaches for constant learning.

• Developing responsible citizen through awareness and acceptance of ethical values by promoting holistic development

**Program Outcomes (POs):**

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| **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, 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 t h e 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 Teamwork:** 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. |

**Program Specific Outcome (PSO):**

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| --- | --- |
| **PSO1:** | Apply fundamental technical knowledge and skills to find workable solutions to technological challenges and problems in core and allied areas of mechanical engineering |
| **PSO2:** | Undertake challenges in design and development related to mechanical engineering put forth by the academia and industry |
| **PSO3:** | Enhance their professional career through continual learning to take-up challenging task in the organization they work with good technical competency, communication skills and team spirit |
| **PSO4:** | Design and develop Engineering system components with the sense of ethics, professionalism for the benefit of the industry as well as society. |

**Course Structure**

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| --- | --- | --- | --- | --- | --- |
| **L = Lecture** | **T = Tutorial** | | **P = Practical** | | **C = Credit** |
| number of hours per week | number of hours per week | number of hours per week | | Total Credits | |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Semester** | **I** | **II** | **III** | **IV** | **V** | **VI** | **VII** | **VIII** | **Total** |
| **Credits** | 13 | 16 | 16 | 17 | 20 | 22 | 19 | 12 | **135** |

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| --- | --- |
| **Discipline Specific Courses =** | 135 Credits |
| **Common Foundation Courses =** | 15 Credits |
| **University Elective =** | 26 Credits |
| **Total Credits =** | 176 Credits |

**CURRICULUM AND TEACHING SCHEME**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Semester - I** | | | **Teaching Scheme** | | | | | | | | | | | | | | | | | | | | | | | | | | | | **Relevance to** Local (L)/  National (N)/  Regional(R)/  Global  developmental needs (G) | | | **Elements of** Employability (Emp)/  Entrepreneurship (Ent)/  Skill Development (SD) | | | | | **Relation to** Gender (G)/  Environment and Sustainability (ES)/  Human Values (HV)/  Professional Ethics (PE) | |
| ***Sr.*** | ***Course Code*** | ***Course Name*** | **L** | | | **T** | | **P** | | | **C** | | | **Theory Course** | | | | | | | **Practical Course**  **Viva** | | | | | | | | **Total Marks** | |
|  |  |  |  | | |  | |  | | |  | | | **Internal Examination**  **(%)** | | | **End semester Examination**  **(%)** | | | | **Internal Examination**  **(%)** | | | | **End semester Examination**  **(%)** | | | | **100** | |
| 1 | STU101 | Foundation Studio 1 | 6 | | | 0 | | 0 | | | 6 | | | 60 | | | 40 | | | |  | | | |  | | | | 100 | |  | | | Emp/SD | | | | |  | |
| 2 | CME101 | Mathematics – 1 | 3 | | | 0 | | 0 | | | 3 | | | 60 | | | 40 | | | |  | | | |  | | | | 100 | |  | | |  | | | | |  | |
| 3 | CME103 | Engineering Graphics | 2 | | | 0 | | 0 | | | 2 | | | 60 | | | 40 | | | |  | | | |  | | | | 100 | |  | | | SD | | | | |  | |
| 4 | CME102 | Applied Mechanics | 2 | | | 0 | | 0 | | | 2 | | | 60 | | | 40 | | | |  | | | |  | | | | 100 | |  | | |  | | | | |  | |
|  |  | **Total Credits** | **13** | | | **0** | | **0** | | | **13** | | |  | | |  | | | |  | | | |  | | | |  | |  | | |  | | | | |  | |
| **Semester - II** | | | | | **Teaching Scheme** | | | | | | | | | | | | | | | | | | | | | | | | | | | **Relevance to** Local (L)/  National (N)/  Regional(R)/  Global  developmental needs (G) | | | | **Elements of** Employability (Emp)/  Entrepreneurship (Ent)/  Skill Development (SD) | | **Relation to** Gender (G)/  Environment and Sustainability (ES)/  Human Values (HV)/  Professional Ethics (PE) | | |
| ***Sr.*** | ***Course Code*** | ***Course Name*** | | | **L** | | **T** | | **P** | | | | **C** | | | **Theory Course** | | | | | | | **Practical Course**  **Viva** | | | | | | **Total Marks** | | |
|  |  |  | | |  | |  | |  | | | |  | | | **Internal Examination**  **(%)** | | | **End semester Examination**  **(%)** | | | | **Internal Examination**  **(%)** | | | | **End semester Examination**  **(%)** | | **100** | | |
| 1 | STU201 | Foundation Studio 2 | | | 6 | | 0 | | 0 | | | | 6 | | | 60 | | | 40 | | | |  | | | |  | | 100 | | |  | | | | Emp/SD | |  | | |
| 2 | CME202 | Mathematics – II | | | 3 | | 0 | | 0 | | | | 3 | | | 60 | | | 40 | | | |  | | | |  | | 100 | | |  | | | |  | |  | | |
| 3 | CME203 | Basic Electrical & Electronics | | | 3 | | 0 | | 0 | | | | 3 | | | 60 | | | 40 | | | |  | | | |  | | 100 | | |  | | | | SD | |  | | |
| 4 | THE201 | Thermodynamics | | | 4 | | 0 | | 0 | | | | 4 | | | 60 | | | 40 | | | |  | | | |  | | 100 | | |  | | | |  | |  | | |
|  |  | **Total Credits** | | | **16** | | **0** | | **0** | | | | **16** | | |  | | |  | | | |  | | | |  | |  | | |  | | | |  | |  | | |
| **Semester - III** | | | | | **Teaching Scheme** | | | | | | | | | | | | | | | | | | | | | | | | | | | **Relevance to** Local (L)/  National (N)/  Regional(R)/  Global  developmental needs (G) | | | **Elements of** Employability (Emp)/  Entrepreneurship (Ent)/  Skill Development (SD) | | | **Relation to** Gender (G)/  Environment and Sustainability (ES)/  Human Values (HV)/  Professional Ethics (PE) | | |
| ***Sr.*** | ***Course Code*** | ***Course Name*** | | | **L** | | **T** | | **P** | | | | **C** | | | **Theory Course** | | | | | | **Practical Course**  **Viva** | | | | | | | **Total Marks** | | |
|  |  |  | | |  | |  | |  | | | |  | | | **Internal Examination**  **(%)** | | **End semester Examination**  **(%)** | | | | **Internal Examination**  **(%)** | | | | **End semester Examination**  **(%)** | | | **100** | | |
| 1 | DES302 | Design Studio | | | 6 | | 0 | | 0 | | | | 6 | | | 60 | | 40 | | | |  | | | |  | | | 100 | | |  | | | Emp/SD | | |  | | |
| 2 | DES303 | Strength of Material | | | 3 | | 0 | | 0 | | | | 3 | | | 60 | | 40 | | | |  | | | |  | | | 100 | | |  | | | SD | | |  | | |
| 3 | MEC301 | Basic Mechatronics | | | 2 | | 0 | | 2 | | | | 3 | | | 60 | | 40 | | | |  | | | |  | | | 100 | | |  | | | SD | | |  | | |
| 4 | PDR301 | Engineering Materials and Metallurgy | | | 4 | | 0 | | 0 | | | | 4 | | | 60 | | 40 | | | |  | | | |  | | | 100 | | |  | | | SD | | |  | | |
|  |  | **Total Credits** | | | **16** | | **0** | | **0** | | | | **16** | | |  | |  | | | |  | | | |  | | |  | | |  | | |  | | |  | | |
| **Semester - IV** | | | | | **Teaching Scheme** | | | | | | | | | | | | | | | | | | | | | | | | | | | **Relevance to** Local (L)/  National (N)/  Regional(R)/  Global  developmental needs (G) | | | **Elements of** Employability (Emp)/  Entrepreneurship (Ent)/  Skill Development (SD) | | | **Relation to** Gender (G)/  Environment and Sustainability (ES)/  Human Values (HV)/  Professional Ethics (PE) | | |
| ***Sr.*** | ***Course Code*** | ***Course Name*** | | | **L** | | **T** | | **P** | | | | **C** | | | **Theory Course** | | | | | | **Practical Course**  **Viva** | | | | | | | **Total Marks** | | |
|  |  |  | | |  | |  | |  | | | |  | | | **Internal Examination**  **(%)** | | **End semester Examination**  **(%)** | | | | **Internal Examination**  **(%)** | | | | **End semester Examination**  **(%)** | | | **100** | | |
| 1 |  | Automation and Robotics Studio | | | 6 | | 0 | | 0 | | | | 6 | | | 60 | | 40 | | | |  | | | |  | | | 100 | | |  | | | Emp/SD | | |  | | |
| 2 |  | Machine Design I | | | 3 | | 0 | | 0 | | | | 3 | | | 60 | | 40 | | | |  | | | |  | | | 100 | | |  | | | Emp/SD | | |  | | |
| 3 |  | Fluid Mechanics | | | 3 | | 0 | | 0 | | | | 3 | | | 60 | | 40 | | | |  | | | |  | | | 100 | | |  | | | Emp/SD | | |  | | |
| 4 |  | Fluid Mechanics Lab | | | 0 | | 0 | | 2 | | | | 1 | | |  | |  | | | | 60 | | | | 40 | | | 100 | | |  | | |  | | |  | | |
| 5 |  | Manufacturing Technology I | | | 3 | | 0 | | 2 | | | | 4 | | | 60 | | 40 | | | |  | | | |  | | | 100 | | |  | | | Emp/SD | | |  | | |
|  |  | **Total Credits** | | | **15** | | **0** | | **4** | | | | **17** | | |  | |  | | | |  | | | |  | | |  | | |  | | |  | | |  | | |
| **Semester - V** | | | | **Teaching Scheme** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | **Relevance to** Local (L)/  National (N)/  Regional(R)/  Global  developmental needs (G) | | | | **Elements of** Employability (Emp)/  Entrepreneurship (Ent)/  Skill Development (SD) | | | **Relation to** Gender (G)/  Environment and Sustainability (ES)/  Human Values (HV)/  Professional Ethics (PE) | |
| ***Sr.*** | ***Course Code*** | ***Course Name*** | | **L** | | | **T** | | | **P** | | **C** | | | **Theory Course** | | | | | | | | | **Practical Course**  **Viva** | | | | | | **Total Marks** | | |
|  |  |  | |  | | |  | | |  | |  | | | **Internal Examination**  **(%)** | | | | | **End semester Examination**  **(%)** | | | | **Internal Examination**  **(%)** | | | | **End semester Examination**  **(%)** | | **100** | | |
| 1 |  | Thermal System Design Studio | | 6 | | | 0 | | | 0 | | 6 | | | 60 | | | | | 40 | | | |  | | | |  | | 100 | | |  | | | | Emp/SD | | |  | |
| 2 |  | Kinematics and dynamics of Machine | | 4 | | | 0 | | | 0 | | 4 | | | 60 | | | | | 40 | | | |  | | | |  | | 100 | | |  | | | | Emp/SD | | |  | |
| 3 |  | Heat & Mass Transfer | | 3 | | | 0 | | | 0 | | 3 | | | 60 | | | | | 40 | | | |  | | | |  | | 100 | | |  | | | | Emp/SD | | |  | |
| 4 |  | Manufacturing Technology II | | 4 | | | 0 | | | 0 | | 4 | | | 60 | | | | | 40 | | | |  | | | |  | | 100 | | |  | | | | Emp/SD | | |  | |
| 5 |  | Engineering Measurement and Metrology | | 3 | | | 0 | | | 0 | | 3 | | | 60 | | | | | 40 | | | |  | | | |  | | 100 | | |  | | | | Emp/SD | | |  | |
|  |  | **Total Credits** | | **20** | | | **0** | | | **0** | | **20** | | |  | | | | |  | | | |  | | | |  | |  | | |  | | | |  | | |  | |
| **Semester - VI** | | | | **Teaching Scheme** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | **Relevance to** Local (L)/  National (N)/  Regional(R)/  Global  developmental needs (G) | | | | **Elements of** Employability (Emp)/  Entrepreneurship (Ent)/  Skill Development (SD) | | | **Relation to** Gender (G)/  Environment and Sustainability (ES)/  Human Values (HV)/  Professional Ethics (PE) | |
| ***Sr.*** | ***Course Code*** | ***Course Name*** | | **L** | | | **T** | | | **P** | | **C** | | | **Theory Course** | | | | | | | | | **Practical Course**  **Viva** | | | | | | **Total Marks** | | |
|  |  |  | |  | | |  | | |  | |  | | | **Internal Examination**  **(%)** | | | | | **End semester Examination**  **(%)** | | | | **Internal Examination**  **(%)** | | | | **End semester Examination**  **(%)** | | **100** | | |
| 1 |  | Design and Manufacturing Studio | | 6 | | | 0 | | | 0 | | 6 | | | 60 | | | | | 40 | | | |  | | | |  | | 100 | | |  | | | | Emp/SD | | |  | |
| 2 |  | Machine Design II | | 4 | | | 0 | | | 0 | | 4 | | | 60 | | | | | 40 | | | |  | | | |  | | 100 | | |  | | | | Emp/SD | | |  | |
| 3 |  | Energy Conversion | | 3 | | | 0 | | | 0 | | 3 | | | 60 | | | | | 40 | | | |  | | | |  | | 100 | | |  | | | | Emp/SD | | |  | |
| 4 |  | Industrial Engineering & Operations Research | | 4 | | | 0 | | | 0 | | 4 | | | 60 | | | | | 40 | | | |  | | | |  | | 100 | | |  | | | | Emp/SD | | |  | |
| 5 |  | Advance Manufacturing Technology | | 1 | | | 0 | | | 2 | | 2 | | | 60 | | | | | 40 | | | |  | | | |  | | 100 | | |  | | | | Emp/SD | | |  | |
| 6 |  | Core Electtive 1 | | 3 | | | 0 | | | 0 | | 3 | | | 60 | | | | | 40 | | | |  | | | |  | | 100 | | |  | | | | Emp/SD | | |  | |
|  |  | **Total Credits** | | **21** | | | **0** | | | **2** | | **22** | | |  | | | | |  | | | |  | | | |  | |  | | |  | | | |  | | |  | |

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| **Semester - VII** | | | **Teaching Scheme** | | | | | | | | | **Relevance to** Local (L)/  National (N)/  Regional(R)/  Global  developmental needs (G) | **Elements of** Employability (Emp)/  Entrepreneurship (Ent)/  Skill Development (SD) | **Relation to** Gender (G)/  Environment and Sustainability (ES)/  Human Values (HV)/  Professional Ethics (PE) |
| ***Sr.*** | ***Course Code*** | ***Course Name*** | **L** | **T** | **P** | **C** | **Theory Course** | | **Practical Course**  **Viva** | | **Total Marks** |
|  |  |  |  |  |  |  | **Internal Examination**  **(%)** | **End semester Examination**  **(%)** | **Internal Examination**  **(%)** | **End semester Examination**  **(%)** | **100** |
| 1 |  | Machine Design III | 3 | 0 | 0 | 3 | 60 | 40 |  |  | 100 |  | Emp/SD |  |
| 2 |  | Fluid Machinery | 3 | 0 | 0 | 3 | 60 | 40 |  |  | 100 |  | Emp/SD |  |
| 3 |  | Core Elective 2 | 3 | 0 | 0 | 3 | 60 | 40 |  |  | 100 |  | Emp/SD |  |
| 4 |  | Quality Management | 3 | 0 | 0 | 3 | 60 | 40 |  |  | 100 |  | Emp/SD |  |
| 5 |  | Research Studio | 0 | 0 | 8 | 4 |  |  | 60 | 40 | 100 |  | Emp/SD/Ent |  |
| 6 |  | Khoj | 3 | 0 | 0 | 3 | 60 | 40 |  |  | 100 |  | Emp/SD | ES |
|  |  | **Total Credits** | **15** | **0** | **8** | **19** |  |  |  |  |  |  |  |  |

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| **Semester - VIII** | | | **Teaching Scheme** | | | | | | | | | **Relevance to** Local (L)/  National (N)/  Regional(R)/  Global  developmental needs (G) | **Elements of** Employability (Emp)/  Entrepreneurship (Ent)/  Skill Development (SD) | **Relation to** Gender (G)/  Environment and Sustainability (ES)/  Human Values (HV)/  Professional Ethics (PE) |
| ***Sr.*** | ***Course Code*** | ***Course Name*** | **L** | **T** | **P** | **C** | **Theory Course** | | **Practical Course**  **Viva** | | **Total Marks** |
|  |  |  |  |  |  |  | **Internal Examination**  **(%)** | **End semester Examination**  **(%)** | **Internal Examination**  **(%)** | **End semester Examination**  **(%)** | **100** |
| 1 |  | Internship/Collaborative Research Project | 0 | 0 | 24 | 12 |  |  | 60 | 40 | 100 |  | Emp/SD |  |
|  |  | **Total Credits** | **0** | **0** | **24** | **12** |  |  |  |  |  |  |  |  |

**Minor Program - Mechatronics**

An academic minor is a university student’s secondary declared academic discipline or field of study for their undergraduate degree. In other words, it is a subject that compliments the major subject’s in a related and unrelated manner.

To Pursue the minor degree, student needs to complete minimum of 18 credits from the courses that are offered as a part of Minor. Moreover, students can also take up over and above extra credits to strengthen their knowledge in the domain taken as Minor Subject.

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| **Name** | **Minor in Mechatronics** | | |
| **Description** | Mechatronics is a multidisciplinary field that offers the skill sets needed in the industry. At the intersection of mechanics and electronics; mechatronics helps to create simpler and smarter systems. Examples of mechatronic systems are robots, digitally controlled engines, machines with self-adaptive tools, automated guided vehicles, etc. It is used in manufacturing, health care, space exploration, and in tools that make our lives easier on a day-to-day basis. | | |
| **Learning Objectives** | Minor in Mechatonics will provide Introductory knowledge of sensors, automation systems and robotics. The students will learn how to select appropriate sensors, actuators and control systems for various applications. | | |
| **Pre-requisites and Eligibility** | This minor is open to students other than students enrolled in Mechanical & Electrical & Electronics Engineering. | | |
|  | **Mandatory Requisites** | | |
| **Course Structure** | **Course Codes** | **Course Name** | **Credits** |
| TEC102 | Sensor Technology | 2 |
| EE433 | Analog Circuits and Sensors | 3 |
| EE434 | Analog Circuits and Sensors Laboratory | 1 |
| MEC301 | Basic Mechatronics | 3 |
| ME323 | Automation and Control Systems | 3 |
| MEC403 | Automation and Control Laboratory | 1 |
| CMP104 | Robotics and Automation | 2 |
| **Mandatory Credits:** | | **Total : 15** |
|  | |  |
| **Electives (Choose Any one of 3 Credit Course )** | | |
| ME443 | Engineering System Design - 1 | 3 |
| EE328 | Internet of Things | 3 |
| **Elective Credits** | | **03** |
|  |  |  |
|  | **Total- 18 Credits needs to be Completed** | |  |

**Core Elective Subjects**

|  |  |
| --- | --- |
| **Course code** | **Course Name** |
|  | Composite as Tribo Material |
|  | Operations and Supply Chain Management |
|  | Cryogenic Engineering |
|  | Pressure Vessel Design |
|  | Computer Aided Manufacturing |
|  | Robotics & Automation |
|  | Advance Welding Technology |
|  | Problem Solving with Lean Six Sigma Methodology |
| THE001 | Air-Conditioning |
|  | Introduction to I. C. Engines |
| ENG 202 | 3d Modeling - Design & Development |
| CME301 | Introduction To Materials |

**Common Foundation Courses with Credits**

|  |  |
| --- | --- |
| **CFP COURCES** | **CREDITS** |
| Writing and Communication | 4 |
| Environmental Studies and climate change | 3 |
| Critical Thinking and Research | 2 |
| Data Science | 3 |
| Humanities | 3 |
| **Total Credits** | **15** |

**Articulation Matrix COs and POs Mapping**

| **C. Code** | **Course Name** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| STU101 | Foundation Studio 1 |  |  |  |  |  |  |  |  |  |  |  |  |
| CME101 | Mathematics – 1 |  |  |  |  |  |  |  |  |  |  |  |  |
| CME103 | Engineering Graphics |  |  |  |  |  |  |  |  |  |  |  |  |
| CME102 | Applied Mechanics |  |  |  |  |  |  |  |  |  |  |  |  |
| STU201 | Foundation Studio 2 |  |  |  |  |  |  |  |  |  |  |  |  |
| CME202 | Mathematics – II |  |  |  |  |  |  |  |  |  |  |  |  |
| CME203 | Basic Electrical & Electronics |  |  |  |  |  |  |  |  |  |  |  |  |
| THE201 | Thermodynamics |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Design Studio |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Strength of Material |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Basic Mechatronics |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Engineering Materials and Metallurgy |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Machine Design I |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Automation and Robotics Studio |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Fluid Mechanics |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Fluid Mechanics Lab |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Manufacturing Technology I |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Kinematics and dynamics of Machine |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Thermal Studio |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Heat & Mass Transfer |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Manufacturing Technology II |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Engineering Measurement and Metrology |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Design and Manufacturing Studio |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Machine Design II |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Energy Conversion |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Industrial Engineering & Operations Research |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Advance Manufacturing Technology |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Machine Design III |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Fluid Machinery |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Quality Management |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Research Studio |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Khoj |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Internship |  |  |  |  |  |  |  |  |  |  |  |  |

**PSO's - PO's Mapping**

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **PSO-1** |  |  |  |  |  |  |  |  |  |  |  |  |
| **PSO-2** |  |  |  |  |  |  |  |  |  |  |  |  |
| **PSO-3** |  |  |  |  |  |  |  |  |  |  |  |  |
| **PSO-4** |  |  |  |  |  |  |  |  |  |  |  |  |

**SEMESTER I**

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| **School: School of Engineering and Technology** | | | | **Program: B.Tech (Mechanical, Electrical & Electronics and Civil engineering)** | | | | | | |
| **Course Code: STU 101** | | | | **Course Name: Foundation Studio – I** | | | | | | |
| **Year** | | **2023-24** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | | | **6** | | |
| **Semester** | | **1st** | **Elective Subject(Yes/No):** | **No** | **Tutorial** | | | **0** | | |
| **Typology of Course** | | **Studio** | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | | | **0** | | |
| **Year of Syllabus Revision:** |  | **Total Credit:** | | | **6** | | |
| **Year of Introduction** | **2022-23** | **Prerequisites**  **(If any)** | | | **NIL** | | |
| **Course Description**:  The studio will develop a basic understanding of Engineering Graphics, Applied Mechanics and Design Thinking. The offered studio will cover fundamental of engineering graphics such as sketching, first angle projection, third angle projection, orthographic projections, isometric projection and engineering curves. Along with this, hand – on practice of AutoCAD will also be covered in this studio. Fundamental principle of Applied mechanics such as use of SI unit, free body diagram, types of support and calculation of support reaction and application of these principles on Beam and Truss will also be covered.  **Course objectives:**   1. To guide students for thinking, designing and optimization of the design idea. 2. To learn the application of fundamental principles of Applied Mechanics 3. To apply the learning of engineering graphics in designing and dimensioning the drawing   **Course Outcome (CO):**  **CO1:** Develops the capability to think, design and optimize the idea of design.  **CO2**: Provides exhaustive practical exposure to various industrial drawing.  **CO3**: Learn about the dimensioning, dimension symbols and proportion.  **CO4:** Capability of reading and understanding the engineering drawing.  **CO5**: To be able to draw Free Body Diagram of any engineering system/component/assembly.  **CO6:** Develop ability to apply fundamental principles to resolve forces in a rigid body. | | | | | | | | | | |
| **Unit No.** | **Topic** | | | | | **Contact Hours** | **BT**  **Level** | | **CO** | **PSO** | |
| 1 | Introduction to Design thinking, basics of design and thinking process and optimization of the ideas | | | | |  | 1,3,4,6 | | CO1 | PSO1,  PSO2,  PSO3,  PSO4, | |
| 2 | Introduction to engineering graphics, Sketching of various engineering components, Orthographic and Isometric Projections, Engineering Curves, Development of Surfaces, Basics of Dimensioning System, Symbols and Proportions, Case Study on Complex Industrial Drawing | | | | |  | 1,3,4,6 | | CO2, CO3,  CO4, | PSO1,  PSO2,  PSO3,  PSO4 | |
| 3 | Application of SI units in engineering drawings, Free Body Diagram of the engineering components, Equilibrium of forces and moments using Equilibrium equations, understanding of various types of support their symbols and determining support reaction. Application of these principles. | | | | |  | 1,3,4,6 | | CO5  CO6 | PSO1,  PSO2,  PSO3,  PSO4 | |

**Example of Problem Statement**

1. Design a Manually Operated Load Transfer (MOLT) Mechanism for the following conditions

1. Load capacity: 4Kg (max)
2. Span:1000 mm
3. Height difference between two ends: 150 mm.
4. Minimum ground clearance of the load: 1000 mm
5. Bi-directional load transfer
6. Manual operation
7. Design to be portable and self-supported (no anchoring, no tethering)

**Text Books:**

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| 1. Bhavikatti, S. S., and K. G. Rajashekarappa. Engineering mechanics. New Age International, 1994. |
| 1. F.P. Beer, E. R. Jhonston, D. F. Mazurek, P. Cornwell and E. Eisenberg: Vector Mechanics for Engineers: Statics and Dynamics, 9th Ed. Tata McGraw Hill, New Delhi, 2009. |
| 1. N. D. Bhat and V. M. Panchal, Engineering Drawing , Charotar Publishing House, 2011 |
| 1. K. Venugopal, Engineering Drawing and Graphics + AutoCAD, New Age International, 2011 |
| 1. B. Agrawal and C. M. Agrawal, Engineering Drawing, Tata McGraw-Hill Publishing Company Limited, 2008. |

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| **School: SET** | | | **Program: BTech Mechanical** | | |
| **Course Code: CME 101** | | | **Course Name: Mathematics I** | | |
| **Year** | **I** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **3** |
| **Semester** | **I** | **Elective Subject(Yes/No):** |  | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **0** |
| **Year of Syllabus Revision:** | **2020** | **Total Credit:** | **3** |
| **Year of Introduction** | **2012** | **Prerequisites**  **(If any)** | **12th** |
| **Course Description:**  This course includes the fundamentals of Differential and Integral Calculus along with linear Algebra. In Differential Calculus concepts of limit, continuity and differentiability are included for functions of single as well as several variables along with their applications. In Integral Calculus concepts include Rieman integrals, Improper integrations, Fundamental Theorem of Calculus and applications. Also it includes applications of integrals in finding area and volumes along with the concepts from line, surface and volume integrals.  In Linear Algebra, the topics include matrices, rank of a matrix and elementary row operations, solving system of equations, eigenvalues and eigen vectors of a matrix and their applications in diagonalisation of a matrix.  **Course Objectives:**   1. To develop logical understanding of the subject. 2. To develop mathematical skill so that students are able to apply mathematical methods & principals in solving problem from Engineering fields.   **Course Outcome (CO):**  CO1 The students learn to conceptualise the mathematical terms of limits, continuity and differentiability  for functions of single and several variables.  CO2 They also learn the applications of differentiability for evaluating for finding the maximum and minimum  values of functions, along with finding the points of inflection and saddle points.  CO3 They learn to evaluate the gradient, divergence and curl of scalar and vector fields. The usage of integral  calculus in evaluating the areas and volumes with the help of integration.  CO4 They learn about various types of matrices and their properties, rank of a matrix and method of  reduction of a matrix into row reduced echelon form of a matrix.  CO5 They learn to solve a system of equations by reducing the coefficient matrix into echelon form. | | | | | |

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| **Unit No.** | **Topic/Unit** | | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | **Unit 1: Differential Calculus**  Review of limits, continuity and differentiability, Mean value theorem, Maxima and Minima for functions of single variable.  Limits and continuity for functions of several variables, partial derivatives, scalar and vector fields, gradient, divergence and curl, directional derivatives, tangent planes and normal lines, maxima, minima and saddle points, Lagrange multipliers. | | 15 | 1,2,3,5 | CO1, CO2,  CO3 | PSO1 |
| 2 | **Unit II: Integral calculus**  Review of methods of indefinite and definite integrals, Riemann integrals, fundamental theorem of calculus, Improper integrals, double and triple integration and it’s applications to find area and volume.   Line, Surface and Volume integrals and examples, Green’s theorem and applications, Divergence theorem, Stoke’s theorem and their applications in problems. | | 15 | 1,2,3,5 | CO3 | PSO1 |
| 3 | **Unit III: Linear Algebra**  Special types of matrices and their properties, Elementary operations and Elementary matrices, Rank of a matrix and invariance of rank under elementary operations, Row reduced echelon form of a matrix, Homogeneous and Non-homogeneous linear equations.  Eigen values and Eigen vectors of a matrix, Orthogonality of eigen vectors associated with distinct eigen values, Properties of eigen vectors of a real symmetric matrix, Diagonalization of a symmetric matrix, application to reductions of quadrics to principal axes, Cayley-Hamilton theorem (without proof). | | 15 | 1,2,3,5 | CO4, CO5 | PSO1 |
| **Reference books** | | | | | | |
| 1. | | Erwin Kreyszig: Advanced Engineering Mathematics, 9th Ed.Wiley India Pvt. Ltd. | | | | |
| 2. | | Joel Hass, George B. Thomas, Maurice D Weir, Thomas’s Calculus, 12th Edition, Pearson. | | | | |
| 3. | | Introduction to Linear Algebra – Serge Lang. Springer (India). | | | | |
| 4. | | Discrete mathematics and its applications (4th edition) by K.H. Rosen (Mc Graw Hill International Edition) | | | | |

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| **School: School of Engineering and Technology** | | | **Program: B. Tech Program** | | |
| **Course Code: CME 103** | | | **Course Name: Engineering Graphics** | | |
| **Year** | **I** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **2** |
| **Semester** | **I** | **Elective Subject(Yes/No):** | **No** | **Tutorial** | **0** |
| **Typology of Course** | Lectures  and  Practicals | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **0** |
| **Year of Syllabus Revision:** | **2019** | **Total Credit:** | **2** |
| **Year of Introduction** | **2012** | **Prerequisites**  **(If any)** | **NA** |
| **Course Description:**  An Engineering Graphics is used to fully and clearly define requirements for engineered items. More than merely drawing of pictures, it is also a language - a graphical language that communicates ideas and information from one mind to another. The subject shall help students to understand the fundamentals and applications of Engineering Drawing, prepare 2D Drawings on drawing sheet as well as using Software (AutoCAD), Understand different types of drawings and its features, Use of drawing instruments. Introduced about standard methods of the drawing used worldwide. Also, to improve imagination power and creative  **Course Objectives:**  1. To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.  2. To expose them to existing national standards related to technical drawings.  3, Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.  **Course Outcome (CO):**  CO1 Understand standard concepts related drawings and tools used.  CO2 Understand methods of representing standard objects in 2D.  CO3 Understand the mathematics and methodologies behind designing of various curves  CO4 Understand visualization and standard methods of representation.  CO5 Reading and making of technical drawings  CO6 Understand 2D CAD software such as AutoCAD and introduction to 2D Modeling in Creo. | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | Introduction to drawing instruments, lettering, lines and dimensioning, construction of simple geometrical figures. | 4 | 1, 2, 3 | CO1  CO2 | PSO1 |
| 2 | Simple orthographic projections, orthographic projections of points and lines. Orthographic projections of planes and solids, sections of solids. isometric views | 10 | 1, 2, 3 | CO2 | PSO1 |
| 3 | Development of surfaces, intersection of surfaces, isometric projections of combined solids, special curves | 10 | 1, 2, 3,6 | CO3  CO4 | PSO1 |
| 4 | Introduction to visualization and conceptual drawing concepts  Introduction to different types of drawing used in industries.  Different standards used in industries to make different drawings of a component/part or assembly. Reading of different drawings by providing examples from industry. | 6 | 1, 2, 3 | CO5 | PSO1  PSO3 |
| 5 | Introduction to 2D CAD software, use of 2D CAD software for topics mentioned in Unit1 to 3 | 45 | 1, 2, 3,6 | CO6 | PSO1  PSO5 |

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| **Reference Books** | |
|  | N. D. Bhat and V. M. Panchal, Engineering Drawing , Charotar Publishing House, 2011 |
|  | K. Venugopal, Engineering Drawing and Graphics + AutoCAD, New Age International, 2011 |
|  | B. Agrawal and C. M. Agrawal, Engineering Drawing, Tata McGraw-Hill Publishing Company Limited, 2008. |
|  | K. R. Gopalakrishna, Engineering Drawings, Subhas Stores, Bangalore, 2001. |
|  | N. Sidheswar, P. Kanniah and V. V. S. Sastry, Machine Drawing, Tata-McGraw Hill, New Delhi, 1980. |
|  | T. E. French, C. J. Vireck and R. J. Foster, Engineering Drawing and Graphic Technology, 14th Ed, McGraw Hill, New York, 1993. |
|  | W. J. Luzadder and J. M. Duff, Fundamentals of Engineering Drawing, Prentice-Hall India, New Delhi, 2001. |
|  | Arunoday Kumar Engineering Graphics I and II, Tech–Max Publication, Pune. |

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| **School: School of Engineering and Technology** | **Program: B.Tech Mechanical Engineering, Navrachana University** | | | | |
| **Course Code: CME 102** | **Course Name: Applied Mechanics** | | | | |
| **Year** | I | **Core Subject(Yes/No):** | Yes | **Lecture:** | 02 |
| **Semester** | I | **Elective Subject(Yes/No):** | No | **Tutorial** | 00 |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | Yes | **Practical:** | 00 |
| **Year of Syllabus Revision:** | 2019 | **Total Credit:** | 02 |
| **Year of Introduction** | 2012 | **Prerequisites**  **(If any)** | High school level physics |
| **Course Description:**  Applied mechanics bridges the gap between physical theory and its application to technology. It is the basis for most of engineering fields. This course will impart basic knowledge of engineering mechanics where in laws of physics are applied to solve engineering problems. This course covers rigid bodies and statics portion of mechanics. It provides a comprehensive knowledge and insight into the study of mechanics and its real life applications in the various fields of engineering.  **Course Objectives:**   * To familiarize students about the forces, moments, couples and its corresponding components. * To develop understanding of a rigid system and vector algebra. * To enable students to draw understand and analyze a free body diagram. * To enable students to obtain centroid and centre of gravity for two and three dimensional bodies. * To develop understanding on analysis of trusses, friction and hydrostatic forces.   **Course Outcome (CO):**   |  |  | | --- | --- | | CO1 | Understanding role and application of Mechanics in engineering discipline, Analysis of the rigid body, Resolution of forces, evaluating the resultant and determining the unknown forces by applying law of equilibrium and through knowledge of vector algebra. | | CO2 | To be able to calculate moments in equivalent system of rigid bodies, Resolution of the moments and determination of couple of forces. | | CO3 | Analyse trusses for determining the unknown support reactions and forces through the application of principle of equilibrium. | | CO4 | Computation of concept of centre of gravity and centroid by different approaches. | | CO5 | Understanding the laws of dry Friction, coefficients of friction, angles of friction and hydrostatics. | | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | **Statics of Particles:**  Forces in a Plane: Force on a Particle. Resultant of Two Forces, Vectors, Addition of Vectors, Resultant of Several Concurrent Forces, Resolution of a Force into Components, Rectangular Components of a Force. Equilibrium of a Particle, Free-Body Diagrams. Forces in Space: Rectangular Components of a Force in Space, Equilibrium of a Particle in space. | 06 | 1,2,3 | CO1 | PSO1  PSO3 |
| 2 | **Rigid Bodies:**  Equivalent system of forces; Principle of Transmissibility. Equivalent Forces, Vector Moment of a Force about a Point, Varignon’s Theorem, Rectangular Components of the Moment of a Force, Moment of a Force about a Given Axis, Moment of a Couple, Equivalent Couples ,Addition of Couples, Resolution of a Given Force into a Force at O and a Couple. | 08 | 1,2,3 | CO2 | PSO1  PSO3 |
| 3 | **Equilibrium of Rigid Bodies:**  Free-Body Diagram, Equilibrium in Two and three Dimensions: Reactions at Supports and Connections for a Two-Dimensional and three dimensional Structure, Equilibrium of a Rigid Body in Two and three Dimensions. | 06 | 2,3,4 | CO3 | PSO1  PSO2  PSO3 |
| 4 | **Distributed Forces:**  Centroids and center of Gravity: Areas and Lines: Center of Gravity of a Two-Dimensional Body, Centroids of Areas and Lines, First Moments of Areas and Lines, Composite Plates and Wires, Determination of Centroids by Integration | 08 | 2,3,4 | CO4 | PSO1  PSO2  PSO3 |
| 5 | **Trusses, Friction and Hydrostatic forces:**  Definition of a Truss, Simple Trusses, Analysis of Trusses by the Method of Joints, Joints under Special Loading Conditions, Analysis of Trusses by the Method of Sections, Friction and Hydrostatic forces. | 04 | 1,2,3 | CO5 | PSO1  PSO3 |
| **Reference Books** | | | | | |
| 1. | F.P. Beer, E. R. Jhonston, D. F. Mazurek, P. Cornwell and E. Eisenberg: Vector Mechanics for Engineers: Statics and Dynamics, 9th Ed. Tata McGraw Hill, New Delhi, 2009. | | | | |
| 2. | J L Meriam and L. G. Kraige: Engineering Mechanics Statics and dynamics, 7th Ed., John Wiley and Sons, USA. 2006. | | | | |
| 3. | Bhavikatti, S. S., and K. G. Rajashekarappa. Engineering mechanics. New Age International, 1994. | | | | |
| 4. | R. C. Hibbeler, Ashok Gupta Engineering Mechanics - Statics and Dynamics 11th Edition, Pearson Education, 2009 | | | | |
| 5. | Veenu Kumar, K. L. Kumar, Engineering Mechanics 4th Edition, Tata McGraw Hill Education, 2010. | | | | |
| 6. | Jacob P. DenHartog, Mechanics, Dover Publications, 1961. | | | | |
| 7. | M.S. Sivakumar, Stephen Crandall, Thomas Lardner, Norman Dahl, an Introduction to Mechanics of Solids, Tata McGraw Hill Education, 2012. | | | | |
| 8. | F.P. Beer, E. R. Jhonston, D. F. Mazurek, P. Cornwell and E. Eisenberg: Vector Mechanics for Engineers: Statics and Dynamics, 9th Ed. Tata McGraw Hill, New Delhi, 2009. | | | | |

**SEMESTER II**

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| **School: School of Engineering and Technology** | | | | **Program: B.Tech (Electrical& electronics, Mechanical, Civil Engineering)** | | | | | | |
| **Course Code: STU 201** | | | | **Course Name: Foundation studio-2** | | | | | | |
| **Year** | | **2023-24** | **Core Subject(Yes/No):** | **Yes** | | **Lecture:** | | | **6** | |
| **Semester** | | **2nd** | **Elective Subject(Yes/No):** | **No** | | **Tutorial** | | | **0** | |
| **Typology of Course** | | **Studio** | **Foundation Subject(Yes/No):** | **Yes** | | **Practical:** | | | **0** | |
| **Year of Syllabus Revision:** |  | | **Total Credit:** | | | **6** | |
| **Year of Introduction** | **2022-23** | | **Prerequisites**  **(If any)** | | | **NIL** | |
| **Course Description**:  This course develops a fundamental understanding of the principles and applications of Machine Tools, Machine Drawing, Digital circuits and Electronic devices through a studio based pedagogy which includes lectures, practical, hands-on, self-learning and peer to peer learning. The learnings of this studio will help students in realizing the designs they will be making in the subjects offered in senior years. The understanding developed in this course will be critical step towards designing an engineering system which will have mechanical, electrical and electronics components.  **Course objectives:**   1. To understand and practice the Safety while working in Shop Floor Environment 2. To understand the fundamentals of machine drawing, electrical drawing and Various Symbols Used in Engineering Drawings 3. To understand and learn the operations performed on Machine Tools like Lathe, Milling, Drilling etc. 4. To make the students understand the basic concepts of electrical and electronics circuits 5. To learn and apply practical application of electrical circuits to solve the real-time system. 6. To learn the system's design specification and selection criteria to be solved with real-time problem. 7. To design and make the system integrative of Mechanical, Electrical and Electronics Components.   **Course Outcome (CO):**  **CO1:** The capability to use abstractions to design the system to solve the given problem.  **CO2**:  Provides exhaustive practical exposure to digital logic gates and digital circuits.  **CO3**:  Using different machine and electric drawing symbols and language in Engineering Drawing  **CO4**: Selection of different machines as per application.  **CO5:** Provides practical exposure to use various machine tools like lath machine, milling machine and drilling machine along with power tools. | | | | | | | | | | |
| **Unit No.** | **Topic** | | | | **Contact Hours** | | **BT**  **Level** | **CO** | | **PSO** |
| 1 | * Safety and precautions in Shop Floor Environment and electric Appliances and Circuits * Fundamentals of Machine Drawing and Electrical Drawing * Introduction to Geometric Dimensioning and Tolerances * Introduction to machine tools like lathe, milling, drilling and grinding and different operations performed on these machine tools * Introduction to cutting tools and their materials * Application of AC/DC supply in various electrical circuits and machines. * Design-based learning of electrical and electronics components (like resistor, diode, thyristor, transistors) their functionality and application along with standard identification practices * Hands-on preparation of circuit and its design in Software as well as on PCB * Introduction to AC/DC electrical machines along with their selection criteria for given application | | | | 84 | | 1,2,3,4,5,6 | CO1, CO2,  CO3,  CO4,  CO5 | | PSO1,  PSO2,  PSO4 |

**Text Books:**

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| --- |
| 1. Hayt W. H., Kemmerly J. E, Durbin S. M., “Engineering Circuit Analysis”, Tata McGraw Hill, 6th Edition, 2006. |
| 1. Boylestad & Nashlesky, “Electronic Devices & Circuit Theory”, PHI Publication, 2nd edition, 2000. |
| 1. Edminister Joseph A., “Electrical circuits”, Schaum’s outline series, McGraw hill, 2nd edition, 1983. |
| 1. G. K. Mithal , “ Electronic Devices And Circuits”  KHANNA PUBLISHERS. ISBN 9788174091777. |
| 1. H. S. Bawa: Workshop Practice, Tata McGraw Hill |
| 1. Achuthan S. K. Hajra Choudhury et. al.: Elements of Workshop Technology, Vol. I and 2, 14th Ed. Media Promoters and Publishers |

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| **School: School of Engineering and Technology** | | | | **Program: B.Tech (Civil, Mechanical and Electrical)** | | |
| **Course Code: CME 202** | | | | **Course Name: Mathematics II** | | |
| **Year** | **I** | **Core Subject(Yes/No):** | **Yes** | | **Lecture:** | **3** |
| **Semester** | **II** | **Elective Subject(Yes/No):** | **No** | | **Tutorial** | **0** |
| **Typology of Course** | Lectures  and  Discussions | **Foundation Subject(Yes/No):** | **No** | | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | | **Total Credit:** | **3** |
| **Year of Introduction** |  | | **Prerequisites**  **(If any)** | **None** |
| **Course Description:** Ordinary and Partial Differential Equations, Laplace Transforms and it’s applications to solving differential equations, Fourier Series and Fourier Transforms and applications  **Course Objectives:** The objective of the course is to learn   * Ordinary Differential Equations, existence and uniqueness of solutions * Methods of Solving Ordinary Differential Equations * Partial Differential Equations * Properties of Laplace Transforms and it’s application to solving differential equations * Fourier Series and Fourier Transforms   **Course Outcome (CO):**  CO1 Learn about differential equations, the existence and uniqueness of solutions  CO2 Solve first order differential equations  CO3 Solve homogeneous and non homogeneous second order differential equations  CO4 Learn various methods of solving differential equations  CO5 Learn about partial differential equations  CO6 Find Laplace and inverse Laplace transforms and solve differential equations using them  CO7 Find Fourier series expansions of functions and Fourier transforms  CO8 Learn about Discrete time Fourier Transforms | | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | Differential equations (first order), Existence, uniqueness, General and particular solutions, boundary values, Initial values | 1 | 1,2 | CO1 | PSO1,  PSO3 |
| 2 | First order linear differential equations with constant coefficients, Separable differential equations. | 4 | 1,2,3,5 | CO2 | PSO1,  PSO3 |
| 3 | Differential equations of the 2nd order, Ordinary linear differential equations of nth order. Solution of homogeneous and non homogeneous equations. | 4 | 1,2,3,5 | CO3 | PSO1,  PSO3 |
| 4 | Operator method, Methods of undetermined coefficients and variation of parameters. Systems of differential equations | 4 | 1,2,3,5 | CO4 | PSO1,  PSO3 |
| 5 | First order partial differential equations, solutions of first order linear and non-linear PDE | 2 | 1,2,3,5 | CO5 | PSO1,  PSO3 |
| 6 | Definition, Linearity property, Laplace transforms of elementary functions, Shifting theorem Inverse Laplace transforms of derivatives and integrals | 7 | 1,2,3,5 | CO6 | PSO1,  PSO3 |
| 7 | Convolution theorem, Application of Laplace transforms in solving ordinary differential equations, Laplace transforms of periodic, Unit step and Impulse function | 8 | 2,3,4,5 | CO6 | PSO1,  PSO3 |
| 8 | Periodic functions, Dirchlet’s conditions, Fourier series, Euler’s formulae, Fourier expansion of periodic functions with period 2, Fourier series of even and odd functions, Fourier series of periodic functions with arbitrary periods, half range Fourier series, Harmonic analysis | 6 | 2,3,4,5 | CO7 | PSO1,  PSO3 |
| 9 | Introduction to Fourier transform, Frequency response of LTI systems , FT of important signals, Properties of FT, time and frequency scaling, Linearity, shifting, Differentiation and Integration, convolution, multiplication and scaling properties | 7 | 2,3,5 | CO7 | PSO1,  PSO3 |
| 10 | Introduction to Discrete time Fourier transform (DTFT), Fourier transform of periodic signals, Properties | 2 | 2,3,4,5 | CO8 | PSO1,  PSO3 |

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| **Reference Books** | |
| 1. | Numerical methods for Engineers, Sixth Edition, Steven C. Chapra and Raymond P. Canale, McGraw-Hill, 2010 |
| 2. | Joel Hass, George B. Thomas, Maurice D Weir, Thomas’s Calculus, 12th Edition, Pearson |
| 3. | Erwin Kreszig, Advanced Engineering Mathematics, Wiley, India |
| 4. | G. V. Kumbhojkar, Applied Mathematics-I, C Jamnadas& company |

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| **School: School of Engineering & Technology** | | | | **Program: B.Tech (Electrical& electronics, mechanical, civil engineering)** | | |
| **Course Code: CME 203** | | | | **Course Name: Basic electrical & electronics** | | |
| **Year** | **I** | **Core Subject(Yes/No):** | **no** | | **Lecture:** | **3** |
| **Semester** | **II** | **Elective Subject(Yes/No):** | **no** | | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **yes** | | **Practical:** | **0** |
| **Year of Syllabus Revision:** | **-** | | **Total Credit:** | **3** |
| **Year of Introduction** | **2020-21** | | **Prerequisites**  **(If any)** | **NA** |
| **Course Description:**  This course develops a basic understanding of the fundamentals and principles of digital circuits and electronic devices in electrical and electronic engineering. This understanding is a critical step towards being able to design new electronic circuits or use them appropriately as part of a larger engineering system. Hence the course seeks to develop foundational concepts and skills. This course covers the working principle and construction of different AC/DC machines. The main contents are: the basic principles of operation, terminal characteristics, and equivalent circuit models for diodes, transistors. Empower the student with enough analytical tools to carry out Electrical transient AC and DC analysis.  **Course Objectives:**  1)To identify polarities voltage and direction of current in loops and nodes.  2) The capability to use abstractions to analyse and design circuits.  3)To be able to design different wave shaping circuits and mathematically analyzes the circuits.  4) To be able Apply concepts of Junction Transistor to design and analyze BJT circuits.  5) To understand different machine behaviour against dynamics produced while in operation.  6) Provides an exhaustive practical exposure to digital logic gates and digital circuits  **Course Outcome (CO):**  CO1: Alternating voltages and currents and their vector and time domain presentations.  CO2: R -L, R-C and R-L-C series and parallel circuits, impedance and admittance, series and parallel resonance.  CO3: star and delta connections and transformations  CO4: Construction, Working and Principles of Different electrical machines.  CO5: Forward and reverse biased characteristics of Diode  CO6: Half-wave and Full wave diode rectifier characteristics  CO7: Transistor Characteristic-NPN and PNP Configurations (CE, CB, CC).  CO8: Introduction to Logic gates, Boolean Algebra, SOP & POS canonical form. | | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | **Unit-1**  **AC Circuits:**  Alternating voltages and currents and their vector and time domain presentations, average and rms values, form factor, phase difference, power and power factor, purely resistive inductive and capacitive circuits, R -L, R-C and R-L-C series and parallel circuits, impedance and admittance, series and parallel resonance, star and delta connections and transformations. | 12 | 2,3,4,5 | CO1,  CO2,  CO3 | PSO1  PSO3 |
| 2 | **Unit-2**  **Electrical Machines:**  Construction and Working Principles of Single phase Transformer, DC Machine, Single phase and Three phase Induction motor. | 12 | 1,2,4,5 | CO4 | PSO1  PSO4 |
| 3 | **Unit-3**  **Electronics Devices and Circuits:**  PN Junction, Forward and reverse biased characteristics of Diode, Halfwave and Full wave diode rectifier, Transistor Characteristic-NPN And PNP Configurations (CE, CB, CC) | 10 | 1,2, 3, 4 | CO5,  CO6,  CO7 | PSO1  PSO2  PSO3  PSO5 |
| 4 | **Unit-4**  **Digital Electronics:**  Digital logic and Boolean algebra; Introduction of Logic Gates; truth table verification; Simplification of Boolean Function using Boolean theorems; Canonical and Standard Forms (SOP and POS) for Boolean Functions; implementation of simple SOP & POS logic circuits. | 11 | 2, 3,4,5 | CO8 | PSO1  PSO2  PSO3 |
| **Reference Books** | | | | | |
| 1. | Hayt W. H., Kemmerly J. E, Durbin S. M., “Engineering Circuit Analysis”, Tata McGraw Hill, 6th Edition, 2006. | | | | |
| 2. | Boylestad & Nashlesky, “Electronic Devices & Circuit Theory”, PHI Publication, 2nd edition, 2000. | | | | |
| 3. | Edminister Joseph A., “Electrical circuits”, Schaum’s outline series, McGraw hill, 2nd edition, 1983. | | | | |
| 4. | G. K. Mithal , “ Electronic Devices And Circuits” KHANNA PUBLISHERS. ISBN 9788174091777. | | | | |

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| **School: School of Engineering & Technology** | | | | **Program: B.Tech (Mechanical Engineering)** | | |
| **Course Code: THE 201** | | | | **Course Name: Thermodynamics** | | |
| **Year** | **I** | **Core Subject(Yes/No):** | **no** | | **Lecture:** | **4** |
| **Semester** | **II** | **Elective Subject(Yes/No):** | **no** | | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **yes** | | **Practical:** | **0** |
| **Year of Syllabus Revision:** | **-** | | **Total Credit:** | **4** |
| **Year of Introduction** | **2012** | | **Prerequisites**  **(If any)** | **nil** |
| **Course Description:** This course introduces the work and heat interactions. Prepares students to look at these interactions with the mathematical perspective. It delves into such perspective to see how they spring forth from the observed scientific laws, i.e. first and second laws. It investigates these laws to better understand real processes. It shows how and why the law beyond first and second is required in the study of Thermodynamics.  **Course Objectives:**   1. This course aims to provide a good platform to mechanical engineering students to understand, model and appreciate concept of energy transformation. 2. To prepare them to carry out theoretical and experimental investigation and analysis at later stages of graduation.   **Course Outcome (CO):**  CO:1 To apply the knowledge of mathematics, science and engineering fundamentals to model the energy conversion phenomenon.  CO:2 To identify and formulate power production based on the fundamentals laws of thermal engineering.  CO:3 To instill upon to envisage appropriate experiments related to heat engines.  CO:4 To investigate the effectiveness of energy conversion process in mechanical power generation for the benefit of mankind.  CO:5 To appreciate concepts learnt in fundamentals laws of thermodynamics from which learning ideas how to sustain in energy crisis and think beyond curriculum in the field of alternative and renewable sources of energy.  CO:6 To communicate effectively the concepts of internal combustion engines and try to think beyond curriculum in alternative sources of energy. | | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | **Basic Concepts & Definitions:**  Classical (Equilibrium) and Statistical thermodynamics – macroscopic and microscopic points of view, thermodynamic system, surroundings, system boundary, control mass and control volume – thermodynamic properties, processes and cycles, thermal equilibrium, quasi-static process – pure substance, simple compressible substance, continuum concept.  Matter–its phases, working medium/substance/agent–its definition, definition of thermodynamic equilibrium–mechanical, thermal, chemical, representation of thermodynamic processes and cycles on 2-property plots.  Ideal gas equation – Van-der-waal equation of state, Berthelot equation of state, Dieterici equation of state, Beattie-Bridgeman equation of state, virtual expansion etc. – Amagat isotherms – compressibility factor – compressibility chart.Zeroth law of thermodynamics – reproducible reference points – ideal gas temperature and ideal gas thermometer  **Energy and Various Forms:**  Thermodynamic definitions of work and heat – work done at the moving boundary of a simple compressible substance-displacement (pdV) work and other types of work interactions – net work done by a system, free expansion with zero work done, work interaction: a path function, Energy – its definitions, forms of its occurrence in various fields – mechanical, electrical, electronics, chemical, atomic, nuclear, thermal, - the units of energy measurements and their equivalents.  **Learning Outcome**:  Understanding of methods for determining thermodynamic properties of simple compressible substances, incompressible substances, and ideal gases.  Proper use of the ideal gas law.  Know the absoluteness of the temperature  Calculate changes in internal energy and enthalpy using specific heats. | 20 | 1,2 | CO1,  CO2, | PSO1  PSO2 |
| 2 | **First Law Analysis:**  Statements of first law of thermodynamics for a control mass undergoing a cycle and for a change in state – internal energy as a thermodynamic property – heat energy as path function, perpetual motion machine of first kind, different forms of energy – enthalpy – specific heat at constant pressure and constant volume, First law analysis of elementary processes such as isochoric, isobaric, isothermal, adiabatic and polytropic undergone by an ideal gas.  First law applied to control volume – steady flow processes – mass and energy balance in simple steady flow process – application of steady flow energy equation to systems like nozzle, diffuser, throttling devices, pumps, compressors, turbine and heat exchanger – general form of energy equation. First law applied to transient processes.  **Learning Outcome:**  1. ability to identify closed and open systems.  2. ability to identify work interactions and heat transfer.  3. apply the principles of conservation of energy to a given problem  4. Analyze the Carnot thermodynamic cycle | 16 | 1,2,,3,4 | CO4 | PSO1  PSO4 |
| 3 | **Second Law Analysis:**  Thermodynamic definition of heat engine, direct and reversed heat engine, diagrammatic representation of heat engine, performance parameters of direct and reversed heat engines – Kelvin-Plank and Clausius statements of second law – their equivalence – perpetual motion machine of the second kind – Concept of reversibility, reversible process and reversible cycle - conditions of reversibility – irreversibility –factors that render a process irreversible – concept of reversible heat transfer process – examples – Carnot reversible cycle – Carnot theorem and its consequences – definition of thermodynamic (Absolute) temperature scale using the concept of reversible engines  Inequality of Clausius – definition of entropy as property – temperature – entropy diagram – entropy change during irreversible adiabatic process – reversible adiabatic process – entropy principle & applications - change of entropy during processes undergone by ideal gas - entropy generation – principle of increase of entropy, entropy as a rate equation.  Second law applied to a control volume- steady state and transient processes- reversible steady state process- Concept of available energy, reversible work and irreversibility- availability (exergy) and second law efficiency- Guoy-stodola theorem – simple engineering applications.  **Learning Outcome:**   1. Understanding of the concepts of the second law including entropy, irreversibility, and the isentropic efficiency. 2. apply a second law analysis to the solution of problems involving closed and open systems for both steady and transient processes. | 16 | 1,2,,3,4,5,6 | CO1,  CO2,  CO3  CO4,  CO5,  CO6 | PSO1  PSO2  PSO3  PSO4 |
| 4 | **Thermodynamic Relations:**  Maxwell relation, T-dS relations, volume coefficient of expansion and isothermal compressibility, specific heat relations, Joule-Thompson coefficient and their relation, Clausius-Clapeyron equation  **Learning Outcome:** Express obscure quantity in terms of known quantity as needed in the analysis. | 08 | 1,2, 3,4 | CO1,  CO2,  CO3  CO4,  CO5,  CO6 | PSO1  PSO2  PSO3  PSO4 |

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| **Reference Books** | |
| 1. | Sonntag, R.E., Borknakke,C & Van Wylen, G. J, “Fundamental of Thermodynamics”, 6th Ed., Wiley Student Edition, 2003 |
| 2. | Nag, P.K., “Engineering Thermodynamics”, 3rd ed., Tata McGraw Hill Pub.,2005 |
| 3. | Cengel, Y., A., and Boles, M.A, “Thermodynamics- An Engineering Approach”, McGraw Hill, 2nd Revised Ed., 1997 |
| 4. | Achuthan, M, “Engineering Thermodynamics”, Prentice Hall India, 2002 |
| 5. | Rao, Y.V.C.,”An Introduction to Thermodynamics”, University Press, India P Ltd., Revised Ed., 2004. |
| 6. | Chattopadhyay, P., “Engineering Thermodynamics”, Revised 1st Ed., Oxford University press, 2011 |
| 7. | Zemensky, M.W., “Heat and Thermodynamics”, 7th Ed., McGraw Hill Pub., 1997 |
| 8. | Dittman, R.H., &Zemensky, M.N., ”Heat & Thermodynamics”, Tata McGraw Hill, New Delhi,2008 |
| 9. | Rogers, G.F.C., &Mayhew,Y.R., ”Engineering Thermodynamics, Work and Heat Transfer”, 4th Ed., Longman |

**SEMESTER III**

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| **School: School of Engineering and Technology** | | | **Program: B.Tech (Mechanical Engineering)** | | |
| **Course Code: DES302** | | | **Course Name: Design Studio** | | |
| **Year** | **2023-24** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **6** |
| **Semester** | **3rd** | **Elective Subject(Yes/No):** | **No** | **Tutorial** | **0** |
| **Typology of Course** | **studio** | **Foundation Subject(Yes/No):** | **No** | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **6** |
| **Year of Introduction** | **2023-24** | **Prerequisites**  **(If any)** | **NIL** |
| **Course Description**:  The design studio is focuses on the applications of design principles and engineering concepts in creation of various mechanisms. Studio based pedagogy provides students with hands on experience and encourages creative thinking and problem solving skills in the design and development of mechanisms. Throughout the course, students will learn about the various mechanisms and explore the fundamental principles behind their working. They will explore wide range of mechanisms commonly used in mechanical engineering, including but not limited to gears and gear trains, belt, rope and chain drive, cam and follower mechanisms….  **Course objectives:**  1) Develop problem solving skill – studio offers a problem statement and the objective is to develop an ability to identify, analyze and solve the problem through mechanical design concepts.  2) Apply theoretical knowledge to practical projects.  3) Enhance technical skill with various design tools and software.  Top of Form  **Course Outcome (CO):**  CO 1: Understanding different types of elements for motion transmission.  CO 2: Understanding the designing of different mechanisms  CO 3: Criteria for Material selection  CO 4: Brainstorm on the Designing process (based on load and stress analysis)  CO 5: Use of Tools (Creo): Solid modeling | | | | | |

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| **Unit No.** | **Topics to be covered** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | * Types of Materials and material section criteria. * Linkages, Joints, Inversion of mechanisms, Degree of freedom of mechanism. * Various elements used to transfer motion. * Synthesis of Mechanisms * Design tool – 3D modelling software * Detailed drawing and production drawing of the mechanism * Development of Assembly | 84 | 1,2,3,5 | CO1,  CO2,  CO3,  CO4,  CO5 | PSO1,  PSO2,  PSO4 |

**Text Books:**

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| 1. Rattan S.S.: Theory of Machines Tata McGraw-Hill Publishing Co. Ltd. New Delhi |
| 1. Theory Of Machines by V.P.Singh, Dhanpatrai Pub., Delhi |
| 1. Rao J.S. and Dukkipati R.V: Mechanisms and theory Machines theory, Wiley Eastern Ltd. |
| 1. Theory Of Machines & Mechanisms by P.L.Ballaney , Khanna Publishers, Delhi |
| 1. Mabie H.H and Ocvirk, F.W: Kinematic and Dynamics of Machinery, 3rd Edition, John wiley and sons. |
| 1. Shigley, J.E and Uicker, J.J: Theory of Machines and Mechanisms, Oxford University Press |
| 1. Green, W.G: Theory of Machines, 2nd Edition, Blackie, London, 1992. |

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| **School: School of Engineering and Technology** | | | **Program: B. Tech Mechanical** | | |
| **Course Code:DES303** | | | **Course Name:** **Strength of Material** | | |
| **Year** | **II** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **3** |
| **Semester** | **III** | **Elective Subject(Yes/No):** | **No** | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **3** |
| **Year of Introduction** | **2013** | **Prerequisites**  **(If any)** | **No** |
| **Course Description:** The course covers the following topics; stress and strain concepts, axial load, statically indeterminate axially loaded members, thermal stress, torsion, angle of twist, statically indeterminate torque-loaded members, bending, eccentric axial loading of beams, transverse shear, shear flow in build-up members, combined loadings, stress and strain transformation, deflection of beams and shafts, statically indeterminate beams and shafts.  **Course Objectives:** Understand fundamental concepts of mechanics of deformable solids including static equilibrium, geometry of deformation, the concepts of stress and strain and their use in the analysis and design of machine members and structures, determine the stresses acting on the beam. Utilize appropriate materials in design considering engineering properties, sustainability, cost and weight. Build the necessary theoretical background for further structural analysis and design courses  **Course Outcome (CO):**   1. Student will gain knowledge of various material properties, different types of load, different types of stress and strain, stress-strain curve of different material. 2. Student will be able to evaluate the axially loaded member and will be able to determine the stress and strain generated due to axial load. Apart from these students will be able to evaluate stress and misfits which are generated in the member subjected to thermal conditions. 3. The concept of torsion will make sure that students are able to understand the concept of twisting load and twisting moment. They will be able to apply the knowledge of Torsion equation to determine the twisting moment or angle of twist generated in the member. 4. Knowing how to evaluate supports reaction for beams subjected to varied loading condition, students will be able to draw the shear force and bending moment diagram. 5. Student will also be able to determine the stresses which will be generated in the beam as a result of bending forces acting on beam. They will be able to resolve induced bending stress for different cross section of beams. 6. On the basis of Mohr’s circle, students will be able to identify different stresses on the surface. The same will be implemented to determine the stresses in different types of pressure vessel. 7. Given a beam student will be able to determine induced deflection in beam using different methods. Also student will be able to resolve the forces and deflection generated in curve bars 8. Apart from this student will be able to examine the buckling, crushing ad stability of the columns with different end supports. | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | **Tension, Compression, and Shear**  Introduction to Mechanics of Materials, Normal Stress and Strain, Mechanical Properties of Materials, Elasticity, Plasticity, and Creep, Linear Elasticity, Hooke’s Law, and Poisson’s Ratio, Shear Stress and Strain, Allowable Stresses and Allowable Loads, Design for Axial Loads and Direct Shear.  **Axially Loaded Members**  Introduction, Changes in Lengths of Axially Loaded Members, Changes in Lengths under Non uniform Conditions, Statically Indeterminate Structures, Thermal Effects, Misfits, and Prestrains, Stresses on Inclined Sections.  **Torsion**  Introduction, Torsional Deformations of a Circular Bar, Circular Bars of Linearly Elastic Materials, Non uniform Torsion, Stresses and Strains in Pure Shear, Relationship Between Moduli of Elasticity *E* and *G,* Transmission of Power by Circular Shafts, Statically Indeterminate Torsional Members. | 14 | 1, 2, 3, 4, 5 | CO1  CO2  CO3 | PSO 1  PSO 2  PSO 3 |
| 2 | **Shear Forces and Bending Moments**  Introduction, Types of Beams, Loads, and Reactions, Shear Forces and Bending Moments, Relationships between Loads, Shear Forces and Bending Moments, Shear-Force and Bending-Moment Diagrams.  **Stress**  Longitudinal Strains in Beams, Normal Stresses in Beams (Linearly Elastic Materials), Design of Beams for Bending Stresses, Shear Stresses in Beams of Rectangular Cross Section Shear Stresses in Beams of Circular Cross Section, Shear Stresses in the Webs of Beams with Flanges, Composite Beams. | 14 | 1, 2, 3, 4, 5 | CO4  CO5 | PSO 1  PSO 2  PSO 3 |
| 3 | **Analysis of Stress and Strain** Introduction, Principal Stresses and Maximum Shear Stresses, Mohr’s Circle for Plane Stress, Hooke’s Law for Plane Stress, Triaxial Stress | 09 | 1, 2, 3, 4, 5 | CO6 | PSO 1  PSO 2  PSO 3 |
| 4 | **Deflections of Beams** Introduction, Differential Equations of the Deflection Curve, Deflections by Integration of the Bending-Moment Equation, Deflections by Integration of the Shear-Force and Load Equations, Method of Superposition  **Columns** Introduction, Buckling and Stability, Columns with Pinned Ends, Columns with Other Support Conditions. | 08 | 1, 2, 3, 4, 5 | CO7  CO8 | PSO 1  PSO 2  PSO 3 |

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| **Reference Books** | |
| 1. | S.H. Crandall, N.C. Dahl and T.V. Lardner, Mechanics of Solids: An Introduction, McGraw Hill International, Tokyo, 1994. |
| 2. | R. C. Hibbeler, Mechanics of Materials (SI Units), 6th Edition, Pearson Education, 2007. |
| 3. | W A Nash, Strength of Materials 4 Edition, Tata McGraw-Hill Education, 2010. |
| 4. | Robert L. Mott, Applied Strength of Materials 5th Edition, Paperback, Prentice-Hall, 2009. |
| 5. | G. H. Ryder, Strength of Materials, 3rd Edition, Macmillan, 2002. |
| 6. | E. Russell Johnston, David F. Mazurek, John T. Dewolf, Ferdinand P. Beer, Mechanics of Materials (SI Units), Tata McGraw-Hill Education, 2009. |
| 7. | S. P. Timoshenko, History of Strength of Materials New ed Edition (Paperback), Dover Publications, 1983. |
| 8. | J P Den Hartog, Strength of Materials, Dover Publications, 1961. |

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| **School: School of Engineering & Technology** | | | | **Program: B.Tech Mechanical** | | | | | | |
| **Course Code: MEC301** | | | | **Course Name: Basic Mechatronics** | | | | | | |
| **Year** | | **II** | **Core Subject(Yes/No):** | **Yes** | | **Lecture:** | | | **2** | |
| **Semester** | | **III** | **Elective Subject(Yes/No):** | **No** | | **Tutorial** | | | **0** | |
| **Typology of Course** | | Lectures | **Foundation Subject(Yes/No):** | **Yes** | | **Practical:** | | | **2** | |
| **Year of Syllabus Revision:** | **2020** | | **Total Credit:** | | | **3** | |
| **Year of Introduction** | **2020** | | **Prerequisites**  **(If any)** | | | **NA** | |
| **Course Description:**  To understand and learn about automation and control of systems. The course will introduce basics of Mechatronics and Automation. The course gives understanding of various components of systems Automated using Mechatronics  **Course Objectives:**  The objective of the course is to that at the end of the course students should be able to identify, design and troubleshoot various components of Automated systems.  **Course Outcome (CO):**  CO1 To understand concept of Mechatronics and Automation  CO2 To understand various components of Mechatronics system  CO3 To understand various sensors and its working and principles  CO4 To understand use of Programmable Logic Designs | | | | | | | | | | |
| **Unit No.** | **Topic/Unit** | | | | **Contact Hours** | | **BT**  **Level** | **CO** | | **PSO** |
| 1 | Introduction to Mechatronics: Definition, Mechatronics in manufacturing, products and design. Comparison between Traditional and Mechatronics approach. Design and fabrication of Mechatronics systems, Ball screws, linear motion bearings, transfer systems.  Components of Automation system: Actuators, controllers, sensors | | | | 10 | | 1,2 | CO1  CO2 | | PSO1 |
| 2 | Working, Specification and selection of Transducers. Phototransistor, Potentiometer, Temperature Sensor. Displacement Transducers, Linear Variable Differential Transformer, Capacitance Sensors. Temperature transducers RTD, Thermistors, Thermocouples- Their Ranges, and Applications. Transducers for Pressure, Level and Flow Measurement, Strain Measurement | | | | 10 | | 2,3 | CO3 | | PSO1 |
| 3 | Introduction to PLC, Microprocessor and Microcontroller, microcontrollers, hardware architecture, input/output pins, I/O ports and circuits, on chip ram, general purpose registers, arithmetic and logical instructions, loop and call instructions, concepts of subroutines. Timers-counters, introduction to data communication, ADC/DAC interfacing, speed control of DC motor.  Introduction to various controllers used on field: eg. FAGOR, FANUC, Arduino, etc. | | | | 10 | | 2, 3, 6 | CO4 | | PSO1  PSO2 |
| **Reference Books** | | | | | | | | | | |
| 1. | Electronic Devices and Circuit Theory by Robert Boylestad and Louis Nashelsky [Ninth Edition] | | | | | | | | | |
| 2. | A. K. Sawhney, “Electrical and electronic Measurements and Instrumentation”, Dhanpat Rai & co., 17th Edition. | | | | | | | | | |
| 3. | M. Mazidi and others, “The 8051 Microcontroller and Embedded Systems”, PRENTICE Hall Of India, 3rd edition. | | | | | | | | | |

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| **School: School of Engineering and Technology** | | | **Program: B. Tech Mechanical** | | |
| **Course Code: PRD301** | | | **Course Name: Engineering Materials and Metallurgy** | | |
| **Year** | **II** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **4** |
| **Semester** | **III** | **Elective Subject(Yes/No):** | **No** | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **4** |
| **Year of Introduction** | **2013** | **Prerequisites**  **(If any)** | **No** |
| **Course Description:** This course primarily designs to expose the students to metallurgical processes. The central point of this course is to provide a physical basis that links the structure of materials with their properties, focusing primarily on metals. The course covers solidification of metals and alloys, phase diagrams, Iron- Iron carbide diagram, cast iron, its structures and properties. With this understanding, concepts of heat treatment, microstructure and mechanical properties are also discussed, various methods of material testing especially defect finding methods, powder metallurgy a unique way of making parts from metal powders and basics associated with composite materials are also discussed.  **Course Objectives:** After successful completion of the course, student will be able to-   1. Strengthen of knowledge for materials and able to select the material for engineering application. 2. Acquire knowledge on phase diagram and able to describe types of heat-treating techniques and how they are performed. 3. Recognize properties of cast iron from their microstructure study 4. Understand the relationship between microstructure and mechanical properties. 5. Understand the various material testing methods. 6. Understand the technological and metallurgical principles of powder metallurgy. 7. Understand the concepts of advance materials.   **Course Outcome (CO):**  CO1 Understand the properties, composition, and application fields of engineering materials.  CO2 Apply the knowledge of mechanical behavior for selection of materials.  CO3 Understand the complex interplay between microstructure, processing and engineering properties in ferrous material.  CO4 Apply the knowledge of phase diagram for selection of heat treatment processes and prediction of resulting properties  CO5 Understand the various Non destructive material testing methods.. Acquire knowledge of metallurgical principles of powder metallurgy. | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | Introduction to Material Science and Metallurgy: Classification of Engineering Materials, Engineering requirements of materials, Properties of engineering materials, Criteria for selection of materials for engineering applications. Miller indices, Crystallization of metals, Solidification of an alloy, solid solution types. Thermal Equilibrium diagrams of binary alloys. Effects of Structure on Physical Properties, Iron-Carbon diagram, plain carbon steels, Allotropy of iron. | 20 | 1, 2,4 | CO1  CO2 | PSO1  PSO2 |
| 2 | Ferrous metal and its alloys .Cast Iron: Grades, Alloy Cast Iron, Malleable Iron, S. G. Iron. Wrought Iron: Properties and uses.Steel: Classification of Steels, Properties and uses, Effects of alloying metals. Heat Treatment of Steels: Study of Heat-Treatment processes such as Normalizing, Annealing, spheroidizing, hardening, tempering, austempering, martempering, case-hardening, nitriding, cyaniding, induction hardening, flame-hardening, ageing. | 25 | 1, 2, 3 | CO2  CO3 | PSO1  PSO2  PSO3 |
| 3 | Non-destructive testing such as Radiography Testing, Dye Penetration Testing, Magnetic Particle Testing, Ultrasonic Testing. Etc.Powder Metallurgy: introduction, manufacturing of parts using powder metallurgy, powder manufacturing techniques, applications.  Composites materials, superconductors, nanomaterials, dielectric and magnetic materials introduction, classification, Applications. | 15 | 1, 2, 3,4 | CO4  CO5 | PSO1  PSO2  PSO3 |

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| **Reference Books** | |
| 1. | Sidney Avner, Introduction to Physical Metallurgy 2nd Edition (Paperback), Tata McGraw-Hill Education,2011. |
| 2. | George Dieter, Mechanical Metallurgy 3rd Edition, Tata McGraw-Hill Education (1997) |
| 3. | Reza Abbaschian, Lara Abbaschian, Robert E. Reed- Hill, Principles of Physical Metallurgy 1st Edition (Paperback, Cengage Learning India,2010 |
| 4. | R. Balasubramaniam, “Callister's Materials Science and Engineering” 2nd Edition. Wiley publication. |
| 5. | Subramanian R, Angelo P. C., “Powder Metallurgy: Science, Technology and Applications”, Phi Learning Pvt Ltd,2009 |

**SEMESTER IV**

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| **School: School of Engineering and Technology** | | | **Program: B.Tech Mechanical Engineering** | | |
| **Course Code:** | | | **Course Name: Automation Studio** | | |
| **Year** | **2023-24** | **Core Subject(Yes/No):** |  | **Lecture:** | **6** |
| **Semester** | **4** | **Elective Subject(Yes/No):** |  | **Tutorial** | **0** |
| **Typology of Course** | **Studio** | **Foundation Subject(Yes/No):** |  | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **6** |
| **Year of Introduction** |  | **Prerequisites**  **(If any)** |  |
| **Course Description**:  From Banking ATMs to Fast Tags, to surgery to production, to food processing, to home services are just a few examples where we see automation. Automation and robots have occupied a very significant place in the modern day bringing about an entire industrial revolution aka IR4.0  Automation systems are complex, and are a result of an amalgamation of concepts from the various engineering disciplines like mechanical, electrical, electronics, and software.  This course in automation is taught with a “top-down” approach, keeping a complex automation system in the center and gradually dissecting it to the component level while studying & understanding each component, its purpose, its design, & it’s working.  Students gain understanding of how different disciplines of engineering come together and work in synergy to create an automation system. The course also includes the study, and a critical appreciation of a 4 joint articulating arm robot. Students learn to program the robot to execute basic tasks.  Concepts students learn, but not limited to include design appreciation, design process, component selection including mechanical, electrical & electronics, industrial communication, controllers and processors. Students are introduced to programming languages like LabVIEW.  During this course students learn to convert their ideas into a simple automation system by going through the design process and designing, building, assembling and testing a simple automation system.  **Course objectives:**   1. Appreciate design & the synergy between the various disciplines of engineering 2. Learn, understand & practice the design process – taking concepts to reality 3. Learn about components of automation including mechanical, electrical & electronics 4. Learn to be able to use design & measurement tools   **Course Outcome (CO):**  **CO1:** Understanding the process of design & building an automation system  **CO2**:  Ability for component selection for an automation system  **CO3**:  Build a simple automation system  **CO4**: Understanding robots and ability to program  **CO5:** Basic programming in industry standard language | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | IR4.0 & Home Automation  Components of automation (Mechanical & Electronics)  How to review component specification sheets  How to identify manufacturers, vendors and select components  Types of motors & motor selection & sizing  Engineering drawings (reading & creating) | 20 |  | CO1  CO2  CO3 |  |
| 2 | Introduction to types of Robots  Industrial application of robots  Working with igus – 4 joint articulating arm robot  Design analysis of the robot  About digital io’s & relays  Robot programming | 20 |  | CO1  CO2  CO3  CO4 |  |
| 3 | Other machines  Programming & use of CNC Laser Cut, CNC Lathe, CNC Router & 3D Printer  Process from CAD to Part  Design appreciation of the CNC machines including component study and manufacturer & vendor | 20 |  | CO1  CO2  CO3 |  |
| 4 | LabVIEW – a graphical programming language for automation, control, data acquisition & analysis.  Control of stepper motors, data acquisition from sensors, data representation and storage  Design and build a simple automation system | 20 |  | CO1  CO2  CO3  CO5 |  |

**Text Books:**

This is an industry connected course

Study material will include compilation of machine data in form of pdf, machine manuals, machine specification sheets, and application notes and white papers by manufacturers.

The material will be made available to students prior to the commencement of the unit.

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| **School: School of Engineering and Technology** | | | **Program: B. Tech Mechanical** | | |
| **Course Code:** | | | **Course Name: Machine Design I** | | |
| **Year** | **II** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **3** |
| **Semester** | **IV** | **Elective Subject(Yes/No):** | **No** | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **3** |
| **Year of Introduction** | **2013** | **Prerequisites**  **(If any)** | **No** |
| **Course Description:** This is the first course in an in-depth three course series of “Machine Design.” The “Machine Design” Coursera covers fundamental mechanical design topics, such as static and fatigue failure theories, the analysis of shafts, fasteners, power screw and Levers.  Students will learn robust analysis techniques to predict and validate design performance and life. Students will start by reviewing critical material properties in design, such as stress, strength, and the coefficient of thermal expansion. Then transition into static failure theories such as von Mises theory, which can be utilized to prevent failure in static loading applications such as the beams in bridges.  **Course Objectives:** After successful completion of the course, student will be able to-   1. Develop the fundamental concepts of mechanical design process, 2. Design simple machine components like lever, springs, power screws, 3. Design power transmitting elements such as shaft keys and couplings.   **Course Outcome (CO):**  CO1 Understand the fundamental of machine design and various components of machines  CO2 Design a system, component or process to meet desired needs within realistic constraints  CO3 Understand the various type of design considerations, design morphology, types of stress, concept of stress concentration, and methods of reliving stress concentration  CO4 Design and interpret of shaft, couplings and keys for safety used  CO5 Design and interpret of Power screw and Levers for safety used  CO6 Design and interpret of various welded joints and riveted joints for industrial applications. | | | | | |

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| **Unit No.** | | **Topic/Unit** | | | | **Contact Hours** | | **BT**  **Level** | **CO** | | **PSO** |
| 1 | | **Introduction to Machine drawing**  Free hand sketches of m/c elements such as bolts, nuts, washers, studs, tapped holes. Conventional representation of assembly of threaded parts in external and sectional views Types of Drawings, Lines and Dimensioning, Surface roughness: Fits and Tolerance, allocation of fits for various mating parts, tolerance data sheet, and tolerance table preparation Geometric tolerance, Roughness and Machining symbols, indication on drawings. | | | | 03 | | 1, 2 | CO1  CO2 | | PSO1  PSO2  PSO3 |
| 2 | | **Design consideration of Machine Parts**  Definition and understanding of various types of design, Morphology of design, Design procedure, Selection of materials, Properties and I.S. coding of various materials, factors of safety, Stress Concentration and methods of relieving stresses, Types of stresses-tensile, compressive, shear, bending, bearing, crushing, Eccentric axial stresses, principle stress, Standardization and preferred numbers, Residual stresses.  **Fatigue Loading:**  Design for fluctuating stresses, Endurance limit, Estimation of Endurance strength, Goodman’s Line, Soderberg’s line, Modified Goodman’s line. | | | | 12 | | 1, 2, 4 | CO2  CO3 | | PSO1  PSO2  PSO3 |
| 3 | | **Design of Shaft, Keys and Couplings**  Design of solid and hollow shaft for transmission of torque, bending moment and axial forces, Design of shaft for critical speed, design of shaft for rigidity and stiffness, Design of different types of keys, design of a muff and clamp coupling, Rigid coupling, Flange Coupling, Flexible coupling- Oldham, universal coupling. | | | | 10 | | 1, 2, 4, 5 | CO4 | | PSO1  PSO2 |
| 4 | | **Design of Fasteners:**  Design of Riveted Joints: Types of riveted joints, design of double and triple riveted butt joints with equal and unequal cover plates, Design of Circumferential joint, Longitudinal Butt Joint, Eccentric loading.Welded Joints:Types of welded joints, stresses in welded joints, Design for various loading conditions in torsion, shear, or direct load, eccentrically loaded welded joints, welding symbols.  Miscellaneous Joints: Design of Gibb and cotter, and knuckle joint, Design of Spigot and socket Joint, Design of Turn buckle. | | | | 10 | | 1, 2, 4, 5 | CO5 | | PSO1  PSO2 |
| 5 | | **Power Screws:**  Types of power screw threads, design of screw with different types of threads used in practice, Design of nuts, Design of C clamp, Screw jack  **Levers:**  General Procedure for design of levers, designs of lever for safety valve, design of bell crank lever, design of rocker arm for exhaust valves. | | | | 10 | | 1, 2, 4, 5 | CO6 | | PSO1  PSO2 |
| **Reference Books** | | | | | | | | | | | |
| 1. | S. G. Kulkarni, “Machine Design - Solved Problems", Tata McGraw Hill Publishing Company Ltd., New Delhi. | | | | | | | | | | |
| 2. | Joseph Edward Shigley and Charles R. Mischke, "Mechanical Engineering Design", McGraw Hill International Edition. | | | | | | | | | | |
| 3. | Mechanical System Design by Farazdakhaideri Nirali Prakashan | | | | | | | | | | |
| 4. | Machine Design by U.C. Jindal Pearson Education | | | | | | | | | | |
| 5. | Machine Design by Shigley Tata McGraw hill. | | | | | | | | | | |
| **School: School of Engineering and Technology** | | | | | **Program: B. Tech Mechanical** | | | | | | |
| **Course Code:** | | | | | **Course Name: Fluid Mechanics** | | | | | | |
| **Year** | | | **II** | **Core Subject(Yes/No):** | **Yes** | | **Lecture:** | | | **3** | |
| **Semester** | | | **III** | **Elective Subject(Yes/No):** | **No** | | **Tutorial** | | | **0** | |
| **Typology of Course** | | | Lectures | **Foundation Subject(Yes/No):** | **Yes** | | **Practical:** | | | **0** | |
| **Year of Syllabus Revision:** |  | | **Total Credit:** | | | **3** | |
| **Year of Introduction** | **2013** | | **Prerequisites**  **(If any)** | | | **No** | |
| **Course Description:** This is a first course in fluid mechanics and covers the basic principles upon which the course is based. These principles will be illustrated with numerous examples which allow students to develop their problem-solving skills.  **Course Objectives:** Understand the properties of fluids, principles of buoyancy, stability conditions and apply principles of fluid statics and dynamics. Understand about dimensional stability and similarity considerations in the design and interpretation of scale model.  **Course Outcome (CO):**   1. Ability to solve manometer problems, and calculate forces on submerged and floating bodies 2. Ability to calculate accelerations and associated pressure variations in moving fluids using Euler’s and Bernoulli’s equations. 3. Ability to use dimensional analysis and similarity considerations in the design and interpretation of scale model experiments. 4. Ability to use conservation of mass principle to calculate flow rates through control volumes. 5. Ability to calculate local and overall skin friction drag in laminar and turbulent flat plate boundary layers using approximate empirical formula. 6. Ability to calculate lift and drag forces for simple aerodynamic shapes such as airfoils, cylinders and spheres using published charts of aerodynamic coefficients 7. Ability to solve hydraulic pipe flow problems using Moody’s diagram for skin friction to calculate flow rate/ pressure loss / pipe diameter. 8. Introduction to compressible flow | | | | | | | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | **Concepts & Definitions:**  Introduction – ideal and real fluids, fluid continuum – classification and properties of fluid. Control volume, control mass, fluid element – continuum concept - Newton’s law of viscosity – Newtonian and non-Newtonian fluids, compressibility of fluids-bulk modulus-compression and expansion of gases-speed of sound, vapour pressure, surface tension.  **Fluid at Rest:**  Pressure at a point, basic equation for pressure field, pressure variation in a fluid at rest for incompressible and compressible fluids – Pressure variation in a fluid with rigid body motion- linear motion- rigid body rotation. Pressure head- absolute and gauge pressures- measurement of pressure- manometry – simple, differential, inclined manometers.  **Hydrostatic Forces on Surfaces:**  Total pressure and centre of pressure – forces on horizontal, vertical, inclined submerged surfaces.  **Buoyancy and Floatation:**  Buoyancy,-centre of buoyancy, equilibrium of floating bodies – metacentric height, oscillation of floating bodies. | 16 | 1, 2, 3, 4, 5 | CO 1 | PSO 1  PSO 2  PSO 3 |
| 2 | **Fluid Kinematics:**  Eulerian and Lagrangian methods of describing flow – Reynolds transport theorem- substantial derivative and acceleration- translation, rotation and deformations – Types of fluid flow - Velocity field, steady and unsteady flows – one, two and three dimensional flows -uniform and non-uniform flows – stream line, stream tube, path lines and streak lines. Equation of continuity in differential form in Cartesian, cylindrical and spherical co-ordinate systems – Equation of stream line.  **Kinematic considerations of Vortex flows**: vorticity dynamics, Kelvin’s circulation theorem, Irrotational flows- velocity potential – stream function - complex velocity, sources and sinks, doublet. Plane source, source-sink pair, doublet and free vortex in a uniform flow. | 14 | 1, 2, 3, 4, 5 | CO 2 | PSO 1  PSO 2  PSO 3 |
| 3 | **Fluid Dynamics: Ideal Fluid Flow – Inviscid Incompressible Flows:**  Flow analysis using control volume: Bernoulli’s equation – practical application of Bernoulli equation- orificemeter, venturimeter – rotameter – pitot tube, Impulse momentum equation – kinetic energy and momentum correction factors, momentum of momentum equation.  Flow analysis using differential methods: Discharge in terms of stream function and velocity potential function Laplace equation – boundary conditions – flow net  Principles of conservation, Conservation equations - mass, momentum and energy - differential and integral forms of equations – Bernouilli equation - Euler equation - linear motion and deformation, angular motion and deformation, differential form of continuity equation- some basic plane potential flows. | 12 | 1, 2, 3, 4, 5 | CO 3  CO 4 | PSO 1  PSO 2  PSO 3 |
| 4 | **Fluid Dynamics - Viscous Incompressible Flows:**  Laminar flow - two-dimensional flows without rotation- flow of viscous fluid between parallel flat plates, Couette flow, plane Poiseuille flow, flow through pipes, Hagen Poiseuille flow. Flow through pipes, laminar flow between parallel moving and stationary plates – measurement of viscosity – Turbulent flow through pipes – characteristics, shear stress in turbulent flow, concept of eddy viscosity, Prandtl mixing length theory, hydrodynamically smooth and rough pipes, Nikuradse’s experiment, Moody’s chart.  **Losses in Pipe Flow**  Pipe system major and minor losses , losses in fittings, transmission through pipes, pipes connected in series and parallel, branched pipes, total energy line , hydraulic graidient lines. Flow in pipes and bends, study of various losses**.** | 14 | 1, 2, 3, 4, 5 | CO 5  CO 6  CO 7 | PSO 1  PSO 2  PSO 3 |
| 5 | **Compressible Flow Concepts**  Compressibility -Continuity, Momentum, Energy and state equations, Velocity of sound, realms of fluid motion, physical differences between incompressible, subsonic and supersonic flow, Karman’s rules of supersonic flow, Mach number and Mach angle, Classifications of compressible flow, Characteristic Mach number | 04 | 1, 2, 3, 4, 5 | CO8 | PSO 1  PSO 2  PSO 3 |

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| **Reference Books** | |
| 1. | Streeter V. L., and Wylie, E.B., “Fluid Mechanics”, McGraw Hill Book Co., Singapore, 2001 |
| 2. | SukumarPati, “A Textbook on Fluid mechanics and Hydraulic Machines”, 1st Ed., Tata McGraw Hill Pub., New Delhi, 2012 |
| 3. | Rajput, R.K., “ A Textbook of Fluid Mechanics”, 3rd Ed., S Chand & Co. Ltd., New Delhi, 2006 |
| 4. | Rathakrishnan, E,”Fluid Mechanics- An Introduction”, Prentice Hall of India P Ltd., New Delhi, 2007 |
| 5. | Kundu, P.K and Cohen, I.M, “Fluid Mechanics”, 3rd Ed., Academic Press, Elsevier, India print 2005 |
| 6. | Munson, B.R, Young, D.F. and Okiishi, T.H, “ Fundamental of Fluid Mechanics”, 5th Ed., Wiley Student Ed., 2006 |
| 7. | Douglas, J.F., Gasiorek, J.M., and Swaffield, J.A., “ Fluid Mechanics”, Pearson Education ( Singapore) P Ltd., New Delhi, 4th ed., 2001 |

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| **School: School of Engineering and Technology** | | | **Program: B. Tech Mechanical** | | |
| **Course Code:** | | | **Course Name: Fluid Mechanics Laboratory** | | |
| **Year** | **II** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **0** |
| **Semester** | **III** | **Elective Subject(Yes/No):** | **No** | **Tutorial** | **0** |
| **Mode of Transaction** | Laboratory | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **2** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **1** |
| **Year of Introduction** | **2013** | **Prerequisites**  **(If any)** |  |
| **Course Description:** The laboratory course work (only for incompressible fluids)   1. Acquaints the students with the physical configuration of various fluid machines 2. Trains them for studying and determining the behavior and characteristics of these machines and makes them understand the effects of design and operating parameters   **Course Outcome (CO):**  CO1 Verify the principles of incompressible fluid flow  CO2 Understand basic concept of fluid flow and its application to industries including pipe flow. | | | | | |

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| **No.** | **Experiment** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | Verification of Bernoulli theorem | 03 | 1, 2, 3, 4, 5 | CO1  CO2 | PSO 2  PSO 3  PSO 4 |
| 2 | Calibration of Pitot Static tube | 03 | 1, 2, 3, 4, 5 | CO1  CO2 | PSO 2  PSO 3  PSO 4 |
| 3 | Determination of friction factor of pipes | 03 | 1, 2, 3, 4, 5 | CO1  CO2 | PSO 2  PSO 3  PSO 4 |
| 4 | Flow measurement by Orifices, venturimeter and rotameter, | 03 | 1, 2, 3, 4, 5 | CO1  CO2 | PSO 2  PSO 3  PSO 4 |
| 5 | Computations of various coefficients involving jet flow through orifice | 03 | 1, 2, 3, 4, 5 | CO1  CO2 | PSO 2  PSO 3  PSO 4 |
| 6 | Reynolds apparatus, Magnus effect | 03 | 1, 2, 3, 4, 5 | CO1  CO2 | PSO 2  PSO 3  PSO 4 |
| 7 | Experiments on Free and forced vortex apparatus | 03 | 1, 2, 3, 4, 5 | CO1  CO2 | PSO 2  PSO 3  PSO 4 |
| 8 | Calibration of pressure gauge | 03 | 1, 2, 3, 4, 5 | CO1  CO2 | PSO 2  PSO 3  PSO 4 |
| 9 | Friction loss in pipes | 03 | 1, 2, 3, 4, 5 | CO1  CO2 | PSO 2  PSO 3  PSO 4 |

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| **Reference Books** | |
| 1. | Streeter V. L., and Wylie, E.B., “Fluid Mechanics”, McGraw Hill Book Co., Singapore, 2001 |
| 2. | SukumarPati, “A Textbook on Fluid mechanics and Hydraulic Machines”, 1st Ed., Tata McGraw Hill Pub., New Delhi |
| 3. | Som, S. K., and Biswas, G., “Introduction to Fluid Mechanics and Fluid Machines”, Tat Mcgraw Hill P Ltd., New Delhi ,2002 |
| 4. | Rajput, R.K., “ A Textbook of Fluid Mechanics”, 3rd Ed., S Chand & Co. Ltd., New Delhi, 2006 |
| 5. | Rathakrishnan, E,”Fluid Mechanics- An Introduction”, Prentice Hall of India P Ltd., New Delhi, 2007 |
| 6. | Kundu, P.K and Cohen, I.M, “Fluid Mechanics”, 3rd Ed., Academic Press, Elsevier, India print 2005 |
| 7. | Munson, B.R, Young, D.F. and Okiishi, T.H, “ Fundamental of Fluid Mechanics”, 5th Ed., Wiley Student Ed., 2006 |
| 8. | Douglas, J.F., Gasiorek, J.M., and Swaffield, J.A., “ Fluid Mechanics”, Pearson Education ( Singapore) P Ltd., New Delhi, 4th ed., 2001 |
| 9. | Kumar, K.L., “Engineering Fluid Mechanics”, Eurasia Pub. House, New Delhi, Reprint, 2008 |
| 10. | Mohanty, A. K., “ Fluid Mechanics”, Prenice Hall India, New Delhi, 1994 |
| 11. | White, F. M., “ Fluid Mechanics” McGraw Hill Pub., 3rd Ed., New York, 1994, |

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| **School: School of Engineering and Technology** | | | **Program: B. Tech Mechanical** | | |
| **Course Code:** | | | **Course Name: Manufacturing Technology I** | | |
| **Year** | **II** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **3** |
| **Semester** | **IV** | **Elective Subject(Yes/No):** | **No** | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **2** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **4** |
| **Year of Introduction** | **2013** | **Prerequisites**  **(If any)** | **No** |
| **Course Description:** All conventional machines are included in this course to understand the basic concepts in machining science. Course cover Metal Cutting Principles, Mechanics of Machining,conventional machine leaning like turning,milling,drilling,boaring etc. Course also cover finishing and supper finishing processes like Honing, lapping.  **Course Objectives:** After successful completion of the course, student will be able to-   1. To understand the basic principles, construction and working of conventional machine tools 2. To acquire proficiency in manufacturing of the variety of products 3. Ability to use mathematics, experimentation and computation in solving engineering problems 4. To explain the students basic understanding of different types of tools and its material specifications 5. To understand sequence of machining operation to produce the end product 6. To understand the features and operation of CNC lathe   **Course Outcome (CO):**  CO1 To Get the fundamental knowledge and principles in material removal processes  CO2 To Understand the mechanics to metal machining based on cutting force and power consumption  CO3 To apply the fundamentals and principles of metal cutting to practical applications  CO4 To understand the working of lathe, milling, drilling, grinding etc  CO5 To understand the finishing process such as non conventional machining process and CNC machining. | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | Introduction: Introduction to manufacturing, classification of manufacturing processes and machine tools, Primary cutting motions, feed and auxiliary motion, gearing diagram, transmission ratio of drives  Mechanics of Machining: Geometry of single point cutting tool, tool signature systems and its conversion, mechanism of chip formation, orthogonal and oblique cutting, chip breakers, machining forces and merchant’s diagram, Cutting temperature- causes, effects,, assessment & control, cutting fluid.  Machinability: Concept of machinability and its improvement, failure of cutting tool and its life, cutting tool materials | 15 | 1, 2 | CO1  CO2 | PSO1  PSO2 |
| 2 | Turning: basic principle, purpose and application, turning allied operations like facing, taper turning, setting of machines for various jobs – special attachments and accessories. | 20 | 1, 2, 4 | CO3  CO4 | PSO1  PSO2  PSO3  PSO5 |
| 3 | Drilling, reaming and Boring: basic principle, purpose and application, mechanisms- attachments and accessories – tools  Milling: Classification, kinematic diagram of column and knee type of milling machine – types of milling operations – holding of tool and work, indexing.  Grinding machines and operations, selection of grinding wheel and their conditioning. | 15 | 1, 2, 3,4 | CO4 | PSO1  PSO2  PSO3 |
| 4 | Broaching: basic principle, purpose and application.  Super finishing Operations: Honing, lapping, Interferometry.  Importance of non conventional machining process-abrasive water jet, laser beam machining, types of laser, basic principle, purpose and application.  Computer Numerical Control (CNC) machine tools, constructional details, special features, CNC Control systems, Work and tool holding methods, Program planning, G and M codes, Manual part programming for CNC machining centers and Turning centers, Setting up a CNC machine for machining. | 10 | 1, 2, 3,4 | CO5 | PSO1  PSO2  PSO3 |

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| **Reference Books** | |
| 1. | Ghosh, Amitabh andMallik, Ashok Kumar.”Manufacturing Science”, 2nd Edition, East West Press (2010) |
| 2. | Rao, P N. “Manufacturing Technology: Foundry, Forming and Welding (Volume - 1) 3rd Edition.Tata McGraw-Hill Education (2008) |
| 3. | Sharma, P. C.”A Textbook of Production Engineering”, 7th Edition, S. Chand Publisher (2008) |
| 4. | Kalpakjian, Serope and Schmid, Steven R.”Manufacturing Engineering and Technology”, 4th Edition. Pearson publications (2002) |
| 5. | V. Chiles, S. Black, A. Lissaman, S. Martin, “Principles of Engineering Manufacture”, 3 rd Edition, Viva Publications |

**SEMESTER V**

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| **School:** School of Engineering and Technology | | | | **Program:** B. Tech. Mechanical Engineering | | | | | | |
| **Course Code:** | | | | **Course Name: Thermal System Design Studio** | | | | | | |
| **Year** | | 3rd | **Core Subject (Yes/No):** | Yes | | **Lecture:** | | | 6 | |
| **Semester** | | 5th | **Elective Subject (Yes/No):** | No | | **Tutorial** | | | 0 | |
| **Typology of Course** | | Studio | **Foundation Subject (Yes/No):** | No | | **Practical:** | | | 0 | |
| **Year of Syllabus Revision:** | -- | | **Total Credit:** | | | 6 | |
| **Year of Introduction** | 2023-24 | | **Prerequisites**  **(If any)** | | | Thermal System Design | |
| **Course Description:** The design of thermal systems requires an integrated approach that treats thermodynamics, fluid mechanics, and heat transfer as parts of one interconnected area, in which appropriate solutions to real-life design and analysis problems can be obtained only when all these aspects are considered simultaneously. This approach must be implemented through open-ended problems and design project oriented teaching. Topics related to thermal systems include fluid flow networks, heat exchanger design, design and selection of pumps, fans and compressors, heat recovery systems, psychrometrics, air-conditioning systems, electronic cooling systems, fuels and combustion, solar thermal systems, and power plant design. This course is specifically designed to model the thermal system design mentioned above. The students will learn the effect of individual component design on overall system performance.  **Course Objectives:** Topics common to the design of all thermal systems will be taught briefly in an interactive lecture format, but the main emphasis will be on open-ended design problems to be formulated and solved in discussion format. The course will begin with the development of skills for the modeling and parametric investigation of individual thermal system components. As proficiency is gained in these exercises, the students will develop the capability to design overall thermal systems in projects of larger scope. The methodology of translating a problem statement into design tasks and executing them will be illustrated. The understanding of thermal component and system design will be encouraged by requiring the students to view the “solution” to the problem as the beginning rather than the end of a design. Discussion of the effects of changes in design conditions (flow rates, inlet temperatures, etc.) and component geometry (diameter, length, other features) on performance will be emphasized.  **Course Outcome (CO):**  CO1: Understanding various thermal systems.  C02: Analytical solution of thermal systems.  CO3: Selection of components for developing Thermal Systems.  CO4: Design Analysis of Thermal System.  CO5: Development of Thermal System and parameter optimization.  **Samples of Open Ended Problems:**   * Calculate heat load of a school / University and recommend cost effective HVAC sytems. * Design and development of an AC system of a room of given dimensions. * Design and fabrication of heat exchanger for given load and operating conditions. * Design and development of pumps, turbines for given head and discharge requirements. | | | | | | | | | | |
| **No.** | **Activities** | | | | **Hrs.** | | **BT**  **Level** | **CO** | | **PSO** |
| 1 | Problem explanations and discussions for clarification of doubts | | | | **06** | | **1** | CO1 | | PSO4,  PSO5,  PSO6 |
| 2 | Understanding the theory behind the system under discussion. Understand the principle of operations and the cycle on which system works. | | | | **02** | | **1** | CO1 | | PSO1,  PSO2,  PSO4 |
| 3 | Carry out the hand calculations for analytical solution of the system | | | | **06** | | **2** | CO2 | | PSO4,  PSO5,  PSO6 |
| 4 | Analysis of the system using open source software or by other means. | | | | **10** | | **3** | CO4 | | PSO4,  PSO5 |
| 5 | System development, selection of components and fabrication | | | | **24** | | **4** | CO3  CO5 | | PSO4,  PSO5 |
| 6 | Performance Testing and Optimization | | | | **18** | | **4** | CO5 | | PSO4,  PSO5 |

**Textbooks:**

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| 1. The students may refer to various books available in the field of Thermal and Fluid Systems, however they will be informed about the books based on nature of the problems for further reading and understanding. 2. The students may have to refer various standards used in Industries. |

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| **School of Engineering & Technology** | | | | **Program: BTech Mechanical Engineering** | | |
| **Course Code:** | | | | **Course Name: Kinematics and Dynamics of Machines** | | |
| **Year** | **III** | **Core Subject(Yes/No):** | **Yes** | | **Lecture:** | **4** |
| **Semester** | **I** | **Elective Subject(Yes/No):** | **NO** | | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **NO** | | **Practical:** | **0** |
| **Year of Syllabus Revision:** | **--** | | **Total Credit:** | **4** |
| **Year of Introduction** | **2012** | | **Prerequisites**  **(If any)** | **--** |
| **Course Description:**  The subject kinetics and dynamics of machines deals with the study of relative motion between the various parts of a machine, and forces which act on them. The knowledge of this subject is very essential for mechanical engineer in designing the various parts of a machine. The purpose of this course is to explore the topics of kinematics and dynamics of machinery in respect to the synthesis of mechanisms in order to accomplish desired motions or tasks, and also the analysis of mechanisms in order to determine their rigid-body dynamic behavior.  **Course Objectives:**   * To understand the basic components and layout of linkages in the assembly of a system /machine. * To understand the motion resulting from a specified set of linkages, design few linkage mechanisms for specified output motions. * To understand the basic concepts of balancing in automobiles * To understand the importance of various theory with practice through engineering case studies.   **Course Outcome (CO):**  CO1 Strengthening of presentation skills  CO2 Strengthening of creative ideas.  CO3 Strengthening of mathematical skills  CO4 Strengthening of knowledge base for various elements of mechanical engineering | | | | | | |

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| **Unit No.** | **Topic/Unit** | | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | Introduction to dynamics of machines | | 1 | 2,3 | CO2,CO4 | PSO1,PSO2 |
| 2 | **Unit 1: Governors:** Introduction, Function and types of governors, | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 3 | Centrifugal governors, Watt governor | | 1 | 1,2 | CO2,CO4,CO3 | PSO1,PSO4 |
| 4 | Porter governor, Proell governor | | 1 | 1,2 | CO2,CO4,CO3 | PSO1,PSO4 |
| 5 | Hartnell governor | | 1 | 1,2 | CO2,CO4, CO3 | PSO1,PSO4 |
| 6 | Characteristics of governor | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 7 | Revision of the chapter | | 1 | 1,2 | CO1 | PSO1,PSO4 |
| 8 | **Unit 3 : Balancing:** Need for balancing, Static balance, balancing of rotating masses in same and different planes | | 1 | 2 | CO2,CO4 | PSO1,PSO4 |
| 9 | Dynamic balancing, , | | 1 | 2,3 | CO2,CO4 | PSO1,PSO2 |
| 10 | Balancing of reciprocating masses | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 11 | Balancing of locomotives | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 12 | Partial balancing of locomotives | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 13 | swaying couple, hammer blow, variation in tractive effort | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 14 | Balancing of multi cylinder in line engines, | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 15 | direct and reverse crank concept | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 16 | Examples on reciprocating balancing | | 1 | 1,2 | CO2,CO4, CO3 | PSO1,PSO4 |
| 17 | Examples on locomotive balancing | | 1 | 1,2 | CO2,CO4, CO3 | PSO1,PSO4 |
| 18 | Examples on multi cylinder engine | | 1 | 1,2 | CO2,CO4, CO3 | PSO1,PSO4 |
| 19 | **Unit 2 : Inertia forces in reciprocating parts**: Introduction, D –Alberts’s Principle, Effect of number of forces on a rigid. | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 20 | Velocity and acceleration of the piston | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 21 | Forces on the reciprocating parts of an engine considering friction and inertia of moving parts- piston effort , , | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 22 | **Unit : 4 Mechanical Vibrations :** Introduction, Degree of freedom, Types of vibrations | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 23 | Uses effects and remedy; free natural vibrations | | 1 | 2 | CO2,CO4 | PSO1,PSO4 |
| 24 | Damped vibrations; under damped | | 1 | 2,3 | CO2,CO4 | PSO1,PSO4,PSO3 |
| 25 | critically damped and over damped systems | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 26 | Forced vibrations with and without damping in single degree of freedom | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 27 | rotating and reciprocating unbalance | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 28 | Longitudinal and Transverse Vibrations | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 29 | whirling of shaft with a single disc with and without damping, Dunkerley's method for simply supported beams | | 1 | 2,3 | CO2,CO4 | PSO1,PSO4,PSO3 |
| 30 | Torsional vibrations | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 31 | torsionally equivalent system | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 32 | stepped shafts Vibration measuring instruments, | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4 |
| 33 | vibrometer, accelerometer and frequency measuring instruments. | | 1 | 1,2 | CO2,CO4 | PSO1,PSO4,PSO3 |
| 34 | Examples on free vibration | | 1 | 1,2 | CO2,CO4, CO3 | PSO1,PSO4 |
| 35 | Examples on forced vibration | | 1 | 1,2 | CO2,CO4, CO3 | PSO1,PSO4 |
| 36 | Examples on damped vibration system | | 1 | 1,2 | CO2,CO4,CO3 | PSO1,PSO4 |
| **Reference Books** | | | | | | |
| 1. | | Rattan S.S.: Theory of Machines Tata McGraw-Hill Publishing Co. Ltd. New Delhi | | | | |
| 2. | | Theory Of Machines by V.P.Singh, Dhanpatrai Pub., Delhi | | | | |
| 3. | | Rao J.S. and Dukkipati R.V: Mechanisms and theory Machines theory, Wiley Eastern Ltd. | | | | |
| 4. | | Theory Of Machines & Mechanisms by P.L.Ballaney , Khanna Publishers, Delhi | | | | |
| 5. | | Mabie H.H and Ocvirk, F.W: Kinematic and Dynamics of Machinery, 3rd Edition, John wiley and sons. | | | | |
| 6. | | Shigley, J.E and Uicker, J.J: Theory of Machines and Mechanisms, Oxford University Press | | | | |
| 7. | | Green, W.G: Theory of Machines, 2nd Edition, Blackie, London, 1992. | | | | |

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| **School: School of Engineering and Technology** | | | **Program: B. Tech Mechanical** | | |
| **Course Code: ME 302** | | | **Course Name: HEAT AND MASS TRANSFER** | | |
| **Year** | **II** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **3** |
| **Semester** | **III** | **Elective Subject(Yes/No):** | **No** | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **3** |
| **Year of Introduction** | **2013** | **Prerequisites**  **(If any)** | **No** |
| **Course Description:** This course provides an introduction to the basic concepts and techniques of heat transfer and application of mathematical principles in heat transfer. Understanding the fluid kinematics & boundary layer concepts with respect to heat transfer.  **Course Objectives:**   * + To understand the modes of heat transfer and their applications.   + To educate the students with the heat exchangers and heat transfer problems in combustion and nozzle of aerospace propulsive systems.   **Course Outcome (CO):**   |  |  | | --- | --- | | CO1 | Apply heat conduction equations for real time problems. | | CO2 | Solve convective heat transfer problems on open and closed conduits. | | CO3 | Apply radiative heat transfer concepts to solve the various black body problems. | | CO4 | Estimate the performance of heat exchangers by different methods. | | CO5 | Apply the knowledge of heat transfer in aerospace. | | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | HEAT CONDUCTION Basic Modes of Heat Transfer – One dimensional steady state heat conduction: Composite Medium – Critical thickness – Effect of variation of thermal Conductivity – Extended Surfaces – Unsteady state. Heat Conduction: Lumped System Analysis – Heat Transfer in Semi-infinite and infinite solids – Use of Transient – Temperature charts – Application of numerical techniques. | 20 | 1, 2, 3, 4, 5 | CO1  CO2  CO3 | PSO 1  PSO 2  PSO 3 |
| 2 | CONVECTIVE HEAT TRANSFER Introduction – Free convection in atmosphere free convection on a vertical flat plate – Empirical relation in free convection – Forced convection – Laminar and turbulent convective heat transfer analysis in flows between parallel plates, over a flat plate and in a circular pipe. Empirical relations, application of numerical techniques in problem solving. | 12 | 1, 2, 3, 4, 5 | CO4  CO5 | PSO 1  PSO 2  PSO 3 |
| 3 | **RADIATIVE HEAT TRANSFER**  Introduction to Physical mechanism – Radiation properties – Radiation shape factors – Heat exchange between non – black bodies – Radiation shields. | 12 | 1, 2, 3, 4, 5 | CO5 | PSO 1  PSO 2  PSO 3 |
| 4 | HEAT EXCHANGERS Classification – Temperature Distribution – Overall heat transfer coefficient, Heat Exchange Analysis – LMTD Method and E-NTU Method, problems using LMTD and E-NTU methods. | 12 | 1, 2, 3, 4, 5 | CO4  CO5 | PSO 1  PSO 2  PSO 3 |

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| **Reference Books** | |
|  | 1. Yunus A. Cengel., “Heat Transfer – A practical approach”, Second Edition, Tata McGraw-Hill, 2002. 2. Sachdeva, S.C., “Fundamentals of Engineering Heat & Mass Transfer”, Wiley Eastern Ltd., New Delhi, 1981 3. Incropera. F.P.andDewitt.D.P. “Introduction to Heat Transfer”, John Wiley and Sons – 2002. 4. Lienhard, J.H., “A Heat Transfer Text Book”, Prentice Hall Inc., 1981. 5. Holman, J.P. “Heat Transfer”, McGraw-Hill Book Co., Inc., New York, 6thEdn. 1991. 6. Mathur, M. and Sharma, R.P. “Gas Turbine and Jet and Rocket Propulsion”, Standard Publishers, New Delhi 1988. |

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| **School: School of Engineering and Technology** | | | | | **Program: B. Tech Mechanical** | | | | | | |
| **Course Code:** | | | | | **Course Name: Manufacturing Technology 2** | | | | | | |
| **Year** | | | **III** | **Core Subject(Yes/No):** | **Yes** | | **Lecture:** | | | **4** | |
| **Semester** | | | **VI** | **Elective Subject(Yes/No):** | **No** | | **Tutorial** | | | **0** | |
| **Typology of Course** | | | Lectures | **Foundation Subject(Yes/No):** | **Yes** | | **Practical:** | | | **0** | |
| **Year of Syllabus Revision:** |  | | **Total Credit:** | | | **4** | |
| **Year of Introduction** | **2014** | | **Prerequisites**  **(If any)** | | | **No** | |
| **Course Description:** Manufacturing technology 2 provides the tools that enable production of all manufactured Goods. These master tools of industry magnify the effort of individual workers and give an  industrial nation the power to turn raw materials into the affordable, quality goods essential to today's society. Many components we used in our everyday life are made by one or other type of manufacturing process. This second edition of manufacturing technology includes some of the vital manufacturing processes used in industry. This subject encompasses various manufacturing processes like metal casting, joining processes, metal forming, and sheet metal working. Metal casting is considered to be primary manufacturing process and it is very extensively used in manufacturing industry. Joining processes include processes like welding, soldering, brazing and braze welding. Joining processes are large part of fabrication industry and are used to create permanent joints between similar or dissimilar materials. Metal forming processes use energy to cause plastic and permanent deformation of the material to give desire size and shape. Rolling, wire drawing, tube drawing, extrusion, forging etc. are various metal forming processes which are used commonly and extensively. Sheet metal processes are used to produce various products from sheet metals. Punching, blanking, deep drawing, bending are few examples of sheet metal operations.  **Course Objectives:** After successful completion of the course, student will be able to-   * To understand the fundamentals, process details and applications of welding, casting, metal forming and sheet metal working. * To empower the student with enough analytical tools to carry out process analysis of welding, casting, metal forming and sheet metal working. * To expose students to the various manufacturing practices in industry pertaining to above processes. * To make students understand the importance of linking theory with practice through engineering case studies through tutorial work.   **Course Outcome (CO):**   * CO1 Understanding of mechanism of welding. Student will be able to identify correct process for given application. Students will be able to analyze various welding processes. Students will be able to describe the basic metallurgy of the melted and heat-affected zone of a metal or alloy. Able to understand causes behind defects in weldment and their remedies. * CO2 Understanding of mechanism of casting. Student will be able to identify correct process for give application. Able to explain design and allowances of pattern. Able to describe the process of core, mold and core and mold making. Able to analyze various gating systems and design risers. Able to understand causes behind defects in casting and their remedies. * CO3 Understating mechanism of various metal forming processes. Able to do force analysis of various metal forming processes. Able to identify correct metal forming process for given application. Able to understand causes behind defects in metal formed components and their remedies. * CO4 Able to understand basic mechanism of Sheet metal working processes. Able to do Force analysis of sheet metal working processes and will be identify correct process for given application. Students will have understanding of various types of dies used in sheet metal working. Able to understand causes behind defects in sheet metal worked components and their remedies. | | | | | | | | | | | |
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| **Unit No.** | | **Topic/Unit** | | | | **Contact Hours** | | **BT**  **Level** | **CO** | | **PSO** |
| 1 | | Introduction: Principle of welding, Applications, Classification of welding processes. Gas welding Processes such as Oxy acetylene, air acetylene, Oxy- hydrogen and Atomic H2 gas welding. Manual metal arc (MMA) or shielded metal arc (SMA) welding: Equipment requirement, electrodes, coating constituents and their functions, types of coatings; current and voltage selection for electrodes. Submerged arc welding (SAW): Process details, consumables such as fluxes and wires for welding and field of applications. Gas metal arc welding (GMAW) or MIG/MAG welding: Process details, shielding gases, electrode wires, their sizes, and welding current ranges. TIG welding: Process details, power sources requirements, electrode sizes and materials, current carrying capacities of different electrodes, shielding gases, application of process. Resistance welding: General principle of heat generation in resistance welding, application of resistance welding processes. Process details and working principle of spot, seam, and. projection welding, electrode materials, shapes of electrodes, electrode cooling, selection of welding currents, voltages. Brazing, braze welding and soldering. Welding defects and its remedies. | | | | 20 | | 1, 2,3,4 | CO1 | | PSO1  PSO2  PSO3 |
| 2 | | Metal Casting: Brief History, Advantages and Limitations, Applications. Patterns: Pattern materials, allowances, types of pattern, color code scheme. Sand Casting: Green and dry sand casting process, types of sand, molding sand and its properties, molding sand composition. Cores: Use, core material, types of cores, advantages and limitations, core prints, chaplets. Gating and Riser System: Element of gating systems, types of gates, Riser design considerations. Special Molding Processes: Carbon dioxide molding process, Investment casting process, Die casting process, shell molding process, Full molding process, Vacuum-Sealed casting process. Casting defects: Causes and remedies of defects such as blowholes, pinholes, blisters, hot tears, cold shut, metal penetration | | | | 20 | | 1, 2, 3,4 | CO2 | | PSO1  PSO2  PSO3 |
| 3 | | Metal Forming Processes: Elastic and plastic deformation of metals and alloys, Concept of strain hardening. Hot and cold working processes - rolling, forging, extrusion, swaging, wire and tube drawing. Machines and equipment for the processes. | | | | 10 | | 1, 2, 3, 4 | CO3 | | PSO1  PSO2  PSO3 |
| 4 | | Sheet Metal Working: Applications of sheet formed products.  Shearing mechanism, Processes like blanking, piercing, punching, trimming, etc. Forming processes like bending, cup drawing, coining, embossing, etc. Presses for sheet metal working; Part feeding systems; Elements of die; punch and die clearances; Progressive, compound and combination dies. High energy rate forming processes. | | | | 10 | | 1, 2,3, 4 | CO4 | | PSO1  PSO2  PSO3 |
| **Reference Books** | | | | | | | | | | | |
| 1. | Black, J. T and Ronald, K.A., “Degarmo'S Materials And Processes In Manufacturing”, 11th edition, Wiley publication,. | | | | | | | | | | |
| 2. | Groover, M.P., “Principles of modern manufacturing”, 5th Edition, Wiley publication. | | | | | | | | | | |
| 3. | Kalpakjian**,**Serope and Schmid, Steven R.”Manufacturing Engineering and Technology”. 4th Edition. Pearson publications. | | | | | | | | | | |
| 4. | Rao, P N. “Manufacturing Technology: Foundry, forming and welding” (Volume - 1) 4th Edition, Tata McGraw-Hill Education. | | | | | | | | | | |
| 5. | Ghosh, Amitabh and Mallik, Ashok Kumar.”Manufacturing Science”, 2nd Edition, East West Press | | | | | | | | | | |
| 6. | Little, M.N., “welding & welding technology”, 1st edition, Tata Mcgraw Hill Education Private Limited | | | | | | | | | | |
| 7. | Dixit, U.S and Narayanan, R.G,” Metal Forming: Technology and Process Modelling”, 1st Edition, Tata Mcgraw Hill Education Private Limited. | | | | | | | | | | |

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| **School: School of Engineering and Technology** | | | | | **Program: B. Tech Mechanical** | | | | | | |
| **Course Code:** | | | | | **Course Name: Engineering Metrology and Measurement** | | | | | | |
| **Year** | | | **II** | **Core Subject(Yes/No):** | **Yes** | | **Lecture:** | | | **3** | |
| **Semester** | | | **IV** | **Elective Subject(Yes/No):** | **No** | | **Tutorial** | | | **0** | |
| **Typology of Course** | | | Lectures | **Foundation Subject(Yes/No):** | **Yes** | | **Practical:** | | | **0** | |
| **Year of Syllabus Revision:** |  | | **Total Credit:** | | | **3** | |
| **Year of Introduction** | **2013** | | **Prerequisites**  **(If any)** | | | **No** | |
| **Course Description:** This course deals with the basic principles of dimensional measuring instruments and precision measurement techniques. This course deals with the basic concepts of metrology and measurement standards. Then, linear, angular, geometrical shape metrology along with interferometry techniques and various types of comparators are explained in the subsequent modules. The concepts of limits, fits and tolerances and surface finish measurement, screw thread and gear measurements are also presented in detail.  **Course Objectives:** After successful completion of the course, student will be able to-   1. understand the basic principles, construction and working of engineering mechanical measurement science. 2. acquire proficiency in using, calibrating various measurement systems. 3. understand the problems in measurement system and develop the competency to resolve the problems. Equip with knowledge of limits, fits, tolerances and gauging 4. know all the measuring instruments and to measure different parameters in day-today work.   **Course Outcome (CO):**  CO1 Understand objectives of metrology, its advancements & measuring instruments, selection of measuring instruments, standards of measurement and calibration of end bars  CO2 Understand the principle  and application of various linear measurement instruments  CO3 Understand the tolerance, limits of size, fits, geometric and position tolerances, gauges and their design  CO4 Understand angle measurement using various angular measurement devices  CO5 Understand the measurement of surface, precisely and accurately with latest instruments | | | | | | | | | | | |
| **Unit No.** | | **Topic/Unit** | | | | **Contact Hours** | | **BT**  **Level** | **CO** | | **PSO** |
| 1 | | Introduction to Metrology & Quality control. Meaning, Necessity and Objectives of Metrology; Standards of Measurement; Elements of Measuring System; Methods of Measurement; Precision and Accuracy; Sources of Errors; Selection and Care of instruments; Standardizing organizations Linear Measurement Introduction & classification of Linear Measuring Instruments; Least count; Engineer’s Steel rule; Callipers; Vernier Calliper: working principle, construction, types & precautions to be taken; Vernier Height Gauge; Vernier Depth Gauge, Micrometers: principle, construction, Sources of errors and precautions to be taken, types of micrometers, Miscellaneous linear measuring instruments like bore gauge, telescopic gauge, slip gauges, Dial indicators: construction & working; comparators; calibration of various linear measuring instruments; Applications, Advantages & Limitations of commonly used linear measuring instruments.= | | | | 10 | | 1, 2,3 | CO1  CO2 | | PSO1  PSO2 |
| 2 | | Limits Fits & Tolerances Definition of tolerance, specification in assembly, principle of inters changeability and selective assembly. Concept of limits of size and tolerances, compound tolerances, accumulation of tolerances. Definition of fits, types of fits. Hole basis system and shaft basis system. Classification of gauges, brief concept of design of gauges (Taylor's principles), wear allowance on gauges. Types of gauges -plain plug gauge, ring gauge, snap gauge, gauge materials | | | | 10 | | 1, 2,3 | CO3 | | PSO1  PSO2  PSO3 |
| 3 | | Angular & Taper Measurement Introduction; Working principle & construction of Angular Measuring instruments like Protractors, Sine bars, Sine centre, Angle gauges, Spirit level, Clinometers, Applications, Advantages & limitations of commonly used angular measuring instruments; Taper Measuring instruments: Measurement of taper shafts. Screw Tread measurement Introduction & classification of Threads; Elements, Specification & forms of Screw Threads; Various Methods for measuring elements of External & Internal Screw Thread; Screw Thread Gauges; Errors in Threads. Gear Measurement Introduction & Classification of gears; Forms of gear teeth; Gear tooth terminology; Measurement and testing of spur gear: Various methods of measuring tooth thickness, tooth profile & pitch; Gear Errors. Straightness, Flatness, Squareness & Parallelism Introduction; Measurement of Straightness, Flatness, Squareness and Parallelism; run out and concentricity. | | | | 15 | | 1, 2, 3,4 | CO4 | | PSO1  PSO2  PSO3 |
| 4 | | Measurement of surface finish Introduction; Surface Texture; Methods of Measuring Surface finish- Comparison Methods & Direct Instrument Measurement; Sample Length; Numerical Evaluation of Surface Texture; Indication of Surface roughness Symbols used; Adverse effects of poor surface finish. Interferometry Interferometry & its application Introduction to CMM. | | | | 10 | | 1,2,3,4 | CO5 | | PSO1  PSO2  PSO3 |
| Reference Books | | | | | | | | | | | |
| 1. | Metrology And Measurementby [Vinay A Kulkarni](http://www.flipkart.com/author/vinay-a-kulkarni), [Anand K Bewoor](http://www.flipkart.com/author/anand-k-bewoor), published by Tata McGraw - Hill Education (2009) | | | | | | | | | | |
| 2. | Holman, J.P., Experimental Methods for Engineers,Tata McGraw Hill Book Company, New Delhi, 2010 | | | | | | | | | | |
| 3. | Industrial instrumentation and control, by S K singh, published by McGrawhill | | | | | | | | | | |
| 4. | Engineering Metrology by [R. K. Jain](http://www.flipkart.com/author/r-k-jain), Khanna Publishers (2009) | | | | | | | | | | |

**SEMESTER VI**

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| **School: School of Engineering and Technology** | | | **Program: B.Tech Mechanical** | | |
| **Course Code:** | | | **Course Name: Design and Manufacturing Studio** | | |
| **Year** | **2023-24** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **6** |
| **Semester** | **6th** | **Elective Subject(Yes/No):** | **No** | **Tutorial** | **0** |
| **Typology of Course** | **Studio** | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **6** |
| **Year of Introduction** | **2022-23** | **Prerequisites**  **(If any)** | **NIL** |
| **Course Description**:  In order to make products and need based solutions, it is necessary to have adequate knowledge of design and manufacturing. The design should be done with constraints of availability of manufacturing processes. The goal of the Design and Manufacturing studio is to incorporate the thinking of Design for Manufacturing. In this studio students will be able to apply the fundamentals of the subjects they have learnt under design and manufacturing specialization. Since design and manufacturing both the processes are constrained by material selection, students will also have exposure to material selection for mechanical design.  **Course objectives:**   1. To apply fundamentals of mechanical design to solve the given problem statement. 2. To learn and apply the fundamentals of material selection for given application 3. To prepare the production ready drawing which can be used on shop floor. 4. To apply different manufacturing methods to make the designed assembly/product/solution. 5. To test the made assembly/product/solution under prescribed operating condition.   **Course Outcome (CO):**  **CO1:** Students will be able to design object/system for mechanical design  **CO2**:  Development of ability to select the material for specific design criteria.  **CO3**: Development of an ability to make production ready drawing.  **CO4**: Development of skills to choose appropriate manufacturing process under constraints. | | | | | |
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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
|  | * Mechanical Design under different failure criteria * Material Selection for Mechanical Design * Manual and Finite Element Analysis (FE Tools) for the Design and Design Optimization * Preparation of Production Ready Drawing with Geometric Dimensioning and Tolerances * Fabrication of Designed Product/Assembly/Object by Manufacturing Processes | 84 | 1,2,3,4,5,6 | CO1, CO2,  CO3, CO4 | PSO1,  PSO3,  PSO4 |

**Text Books:**

1. Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, McGraw-Hill International

Editions, 2007

1. Norton R.L, “Design of Machinery”, McGraw-Hill Book co, 2004.
2. Hamrock B.J., Jacobson B., Schmid S.R., “Fundamentals of Machine Elements”, McGraw- Hill Book Co
3. Black, J. T and Ronald, K.A., “Degarmo'S Materials And Processes In Manufacturing”, 11th edition, Wiley publication.
4. Kalpakjian**,**Serope and Schmid, Steven R.”Manufacturing Engineering and Technology”. 4th Edition. Pearson publications.
5. Ashby Michael., “Material selection in Mechanical Design”, Elsevier Publication

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| **School: School of Engineering and Technology** | | | **Program: B. Tech Mechanical** | | |
| **Course Code:** | | | **Course Name: Machine Design II** | | |
| **Year** | **III** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **4** |
| **Semester** | **VI** | **Elective Subject(Yes/No):** | **No** | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **4** |
| **Year of Introduction** | **2013** | **Prerequisites**  **(If any)** | **ME 217** |
| **Course Description:** Machine design-II is a course which helps one to understand the types of forces coming on the machine parts, stresses generated in them and the ways to design them so that they can withstand the stresses without failure. Design procedure of different machine parts such as Bearings, Breaks, Clutches, springs etc. can be learned in the subject along with the selection of suitable material. The design procedure is taught as per standard textbooks and design data book which is handy in industry.  **Course Objectives:** After successful completion of the course, student will be able to-   1. Develop the fundamental concepts of mechanical design process, 2. Understanding the working of simple machine components like brake, clutch, pressure vessels, springs, bearings 3. Design of simple machine components like brake, clutch, pressure vessels, springs, bearings   **Course Outcome (CO):**  CO1 Understand the fundamental of machine design and various components of machines  CO2 Design a system, component or process to meet desired needs within realistic constraints  CO3 Understand the various type of design considerations, design morphology, types of stress, concept of stress concentration, and methods of reliving stress concentration  CO4 Design and analysis of brake, clutch, pressure vessels, bearings, springs and different machine elements. | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | **Design Considerations**:  Manufacturing and assembly considerations, Design of components for casting, Welding, Forging, hot and cold working, machining, Welding etc. Thermal considerations, Wear considerations in design, Contact Stresses, Standardization and preferred numbers. | 03 | 1, 2 | CO1  CO2 | PSO1  PSO2  PSO3 |
| 2 | **Design of springs:**  Classification, spring materials and its selection, Wahls' factor and its use in design of spring, cylindrical helical spring with axial loading, buckling of compression spring, Design of compression spring, design of leaf spring. | 10 | 1, 2, 4 | CO2  CO3  CO4 | PSO1  PSO2  PSO3 |
| 3 | **Design of Pressure Vessels**  Classification of pressure vessels, Design of thick cylindrical and spherical shells subjected to internal pressure and external pressure, Compound cylinders subjected to internal and external pressure. | 10 | 1, 2, 4, 5 | CO2  CO3  CO4 | PSO1  PSO2 |
| 4 | **Design of clutches and brakes**  Function , Classification, Material selection, Design of positive clutches, Friction clutches -cone, single, Multiple and centrifugal clutches, Design of band brake, External and internal shoe brakes, Internal expanding shoe brakes, Design of disc brakes. | 15 | 1, 2, 4, 5 | CO2  CO3  CO4 | PSO1  PSO2 |
| 5 | **Design of sliding and Journal bearing**  Method of lubrication, hydrodynamic, Hydrostatic, boundary, etc., Minimum film thickness and thermal equilibrium, Selection of anti-friction bearings for different loads and load cycles, Design of thrust bearing, Rolling contact bearing, Ball bearing, Rolling contact bearing under variable loading, Mounting of the bearings, Method of lubrication, Selection of oil seals. | 15 | 1, 2, 4, 5 | CO2  CO3  CO4 | PSO1  PSO2 |

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| **Reference Books** | |
| 1. | S. G. Kulkarni, “Machine Design - Solved Problems", Tata McGraw Hill Publishing Company Ltd., New Delhi. |
| 2. | Joseph Edward Shigley and Charles R. Mischke, "Mechanical Engineering Design", McGraw Hill International Edition. |
| 3. | Mechanical System Design by Farazdakhaideri Nirali Prakashan |
| 4. | Machine Design by U.C. Jindal Pearson Education |
| 5. | Machine Design by Shigley Tata McGraw hill. |

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| **School: School of Engineering & Technology** | | | **Program: B. Tech (Mechanical Engineering)** | | |
| **Course Code:** | | | **Course Name: Energy Conversion** | | |
| **Year** | **III** | **Core Subject(Yes/No):** | **yes** | **Lecture:** | **3** |
| **Semester** | **VI** | **Elective Subject(Yes/No):** | **no** | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **no** | **Practical:** | **0** |
| **Year of Syllabus Revision:** | **-** | **Total Credit:** | **3** |
| **Year of Introduction** | **2013** | **Prerequisites**  **(If any)** | Thermodynamics |
| **Course Description:** This course mainly covers ‘Electrical Power Generation’ in different power plants. Which also includes brief introduction and working principle of different types of equipment, thermodynamic cycles, power plant safety and features, application, Different fuel used Advantages of Thermal power plant, Nuclear power plant, Combine Gas cycle Power plants, Hydro power plants and Solar based Power plant, comparison of various power plants. The subject includes various non-conventional sources of energy. The ways of teaching will be as follows, class room presentation, Power point presentation, Animation videos, hands on classroom project, individual and group activities, poster and model presentation and Industrial Visit.  **Course Objectives:**  To develop understanding of energy scenario in the world and in India, study various types of power plants and learn about various conventional and non-conventional sources of power generation.  **Course Outcome (CO):**   |  |  | | --- | --- | | CO1: | This course will give introductory knowledge of various power plant. | | CO2: | The students will have detailed knowledge about thermal power plant and various component used in the thermal power plant. | | CO3: | The student will be in position to analyse various systems in the thermal power plant. | | CO4: | This course will give introductory knowledge of nuclear, hydro and gas turbine power plant. | | CO5: | The students will be made aware about various non-conventional systems to generate power. | | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | **Introduction to Power plants**  Layout of different power plants - Steam, Hydro, Diesel, Nuclear and Gas turbine Power Plants. Combined Power cycles – comparison of different power plants and selection of site, Load duration Curves.  **Boilers**  Steam boilers and cycles – Fire tube & Water tube boilers, Boiler Mounting & Accessories, High pressure and Super Critical Boilers, Economizer, Super heater.  **Steam Power plan**  Fuel and ash handling, Combustion Equipment for burning coal, Mechanical Stokers.  Pulveriser, Electrostatic Precipitator, Draught-Different Types, Surface condenser types, cooling Towers. Modified Rankine cycle, reheating and regeneration.  **Nuclear and Hydro power plants**  Nuclear Energy-Fission, Fusion Reaction, Types of Reactors, Pressurized water reactor, Boiling water reactor, Waste disposal and safety Hydro Power plant- Essential elements, Selection of turbines, governing of Turbines- Micro hydro developments  **Learning Outcome**   1. This module will give introductory knowledge of various power plant. 2. The students will have detailed knowledge about thermal power plant and various component used in the thermal power plant. 3. The student will be in position to analyze various systems in the thermal power plant. | 25 | 1,2,3,4 | CO1,  CO2,  CO3,  CO4 | PSO1 |
| 2 | **Solar Power Generation:**  Solar Thermal Power Plants, Solar photovoltaic energy conversion. Solar Applications e.g. Solar Distillation, Solar AC systems, Solar lights, Solar cooker.  **Wind energy:** Sources and potentials, horizontal and vertical axis windmills.  **Power Generation** using other non-sources like Biomass, Geothermal Energy, Ocean Energy  .  **Learning Outcome**   1. The students will be made aware about various non-conventional systems to generate power. | 20 | 1,2,,3 | CO5 | PSO1  PSO2 |

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| **Reference Books** | |
| 1. | Arora S.C and Domkundwar S, “A Course in Power Plant Engineering”, Dhanpat Rai Sons, 2001 |
| 2. | Nag P.K ,”Power Plant Engineering”. Third edition Tata McGraw- Hill, 2007 |
| 3. | EI-Wakil M.M, Power “Plant Technology,” Tata McGraw-Hill 1984 |
| 4. | G.D.Rai, “Introduction to Power Plant Technology” Khanna Publishers,1995 |

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| **School: School of Engineering and Technology** | | | **Program: B. Tech Mechanical** | | |
| **Course Code:** | | | **Course Name: Industrial Engineering and Operations research** | | |
| **Year** | **III** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **4** |
| **Semester** | **VI** | **Elective Subject(Yes/No):** | **No** | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **4** |
| **Year of Introduction** | **2014** | **Prerequisites**  **(If any)** | **No** |
| **Course Description:** Operations Research now a day widely used in the area of decision making for the real life problems. Managers and decision makers get idea for optimizing and approximating industrial problems. They not only strive to devise appropriate measures for problem solving but also apply scientific techniques to monitor the organizations ongoing activities such as production mix, transportation, queuing, and assignment problem. Industrial Engineering course is to prepare students to understand different aspects like: Plant location and its selection, Plant layout within the plant. It also helps to understand and apply different concept of production planning and control. Study of productivity and Work-study are important tools, after studying it student are able to apply it in the industry for productivity improvement.  **Course Objectives:** After successful completion of the course, student will be able to-   * Learn to analyze any real life system with limited resources, depict in mathematical model form and to solve it manually which also includes Transportation and Assignment Problem * Learn to analyze various quantitative and probabilistic inventory models used in industry. * To introduce students to the various stages of production planning and control. * To understand fundamentals and principals of industrial engineering and their applications in work environment   **Course Outcome (CO):**   * CO1 To Analyze any real life system with limited resources, depict in mathematical model form and to solve it manually with various quantitative methods and to analyze the outcomes which also includes Transportation and Assignment Problems * CO2 Understanding the importance of inventory in various industries and to be able to apply various quantitative and probabilistic models * CO3 To understand stages of production planning and control. Understanding of various forecasting methods, Material requirement planning, scheduling, sequencing, assembly line balancing. * CO4 Able to understand various principals and fundamentals of industrial engineering and applying them to work environment to improve productivity | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | **Operations Research:**  Linear programming – problem formulation, simplex method, transportation and assignment models; network flow models; simple queuing models; PERT and CPM, time-cost trade-off | 25 | 1, 2,3,4 | CO1 | PSO1  PSO2  PSO4 |
| 2 | **Inventory:**  Functions, costs, classifications, deterministic and probabilistic inventory models, quantity discount; perpetual and periodic inventory control systems | 10 | 1, 2, 3,4 | CO2 | PSO1  PSO2  PSO4 |
| 3 | **Production Planning and Control:**  Types of production systems and their characteristics functions and objectives of P.P.C, Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality, master production scheduling; MRP and MRP-II; routing, scheduling and priority dispatching, sequencing, assembly line balancing | 14 | 1, 2, 3,4 | CO3 | PSO1  PSO2  PSO4 |
| 4 | **Industrial Engineering**  Taylor’s scientific management, Gilbreth’s contributions; productivity – concepts and measurements; method study, micro-motion study, principles of motion economy; work measurement – stop watch time study, work sampling, standard data, pre-determined motion time standards (PMTS), Principles of Plant layout and Types | 11 | 1, 2, 3,4 | CO4 | PSO1  PSO2  PSO4 |

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| **Reference Books** | |
| 1. | [N.V.S.Raju](http://www.flipkart.com/author/n-v-s-raju),” Industrial Engineering and Management”, 1st Edition, Cengage Learning |
| 2. | Hamdy A. Taha “Operations Research: An Introduction”. DORLING KINDERSLEY |
| 3. | [N. D. Vohra](http://www.flipkart.com/author/n-d-vohra),” Quantitative Techniques in Management”, 4th Edition, Tata McGraw-Hill Education |
| 4. | Sarin, R. K & Buffa, E.S, “Modern Production/Operations Management“, 8th Edition, Wiley India Pvt Ltd |
| 5. | [Chary,](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22V.+Chiles%22) S. N, “Production and Operations Management”, 5th Edition, Tata-Mcgraw Hill |
| 6. | [Billington Peter J.](http://www.flipkart.com/author/billington-peter-j), [Narasimhan Setharama L.](http://www.flipkart.com/author/narasimhan-setharama-l), [Mcleavey Dennis W.](http://www.flipkart.com/author/mcleavey-dennis-w),” Production Planning and Inventory Control”, 2nd Edition, Prentice-Hall |
| 7. | [J K Sharma](http://www.flipkart.com/author/j-k-sharma), “Operations Research: Theory and Applications“, 5th Edition, Macmillan |

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| **School: School of Engineering and Technology** | | | | **Program: B.Tech** | | | | | | | |
| **Course Code:** | | | | **Course Name: Advance Manufacturing Technology** | | | | | | | |
| **Year** | |  | **Core Subject(Yes/No):** | **Yes** | | **Lecture:** | | **1** | | | |
| **Semester** | |  | **Elective Subject(Yes/No):** | **No** | | **Tutorial** | | **0** | | | |
| **Typology of Course** | | Lectures | **Foundation Subject(Yes/No):** | **Yes** | | **Practical:** | | **2** | | | |
| **Year of Syllabus Revision:** |  | | **Total Credit:** | | **2** | | | |
| **Year of Introduction** | **2022** | | **Prerequisites**  **(If any)** | | **Manufacturing Technology I** | | | |
| **Course Description:** Discipline “Advance Manufacturing processes” focuses on the learning of Computer numerical control (CNC) machines Constructional features, NC/CNC axis and coordinate system, CNC tooling, Computer assisted part of programming (CAM) applies to computer numerical control (CNC) and familiarity with CAM software. Course also contain the need and importance of non-traditional machining methods and process selection. Study involved to remove material by thermal evaporation, mechanical energy process. Apply the knowledge to remove material by chemical and electro chemical methods and applications of unconventional machining process. Further the course emphasis on different types of Additive Manufacture (AM) processes, their advantages and disadvantages different materials used to produce components by the AM process.  **Course Objectives:** After successful completion of the course, student will be able to-   * To understand computer numerical control (CNC) machine parts, axis and tooling process. * To introduce fundamental knowledge of Numerical control manufacturing systems * To learn and understand processes and operations using a combination of G-codes, milling, drilling and turning equipment and familiarity with CAM software packages. * Understand the need and importance of non-traditional machining methods and process selection. * To Gain the knowledge to remove material by thermal evaporation, mechanical energy process, chemical and electro chemical methods * To understand the different types of Additive Manufacture (AM) processes available as well as their advantages and disadvantages * To understand the different materials, and their properties, used to produce components by the AM process and skills relative to manufacturing/product design.   **Course Outcome (CO):**  CO 1. Understand computer numerical control (CNC) machine parts, axis and tooling process.  CO 2. learn and understand processes and operations using a combination of G and M codes, CAM software packages, operate CNC turning.  CO 3. Understand the principles, processes and applications of various non-traditional machining processes, classification and applications  CO 4. Learn different Additive Manufacture (AM) processes and develop the skill related to skills to manufacturing/3 D Printing. | | | | | | | | | | | |
| **Unit No.** | **Topic/Unit** | | | | **Contact Hours** | | **BT**  **Level** | | **CO** | **PSO** |
| 1 | **UNIT:1 Computer Numerical control machining**  Constructional features of NC/CNC Machines  CAM - concept and definition, Advantages and limitations of CNC, Selection criteria for CNC machines. NC/CNC axis and coordinate system, CNC control system design, Mechanical system design), CNC drive system, Re-circulating ball screw, transducers, Method of improving accuracy and productivity in CNC.  CNC tooling: Tool presetting-concept and importance, Work holding devices -types, working and applications, Tool holding and changing devices - types, working and applications, cutting tools for CNC machine, Automatic tool changer (ATC), Automatic pallet changer (APC).  **CNC Part Programming**  programming format and structure of part programme, types of dimensioning, axis designation, ISO G and M codes, Tape programming format, part Programming for drilling, lathe and milling machine operations, Canned cycle, Need and importance of various compensations: Tool length compensation, Pitch error compensation, Tool radius compensation, Tool offset.  **CAD/CAM integration**- Activity involved in CAD/CAM integration process, used software packages and their use in area of CAD/CAM | | | | 15 | | 1, 2,3,4 | | CO1,2 | PSO1  PSO2  PSO4 |
| 2 | **UNIT:2 Unconventional Machining Processes**  Mechanical Energy Based Processes: Abrasive Water Jet Machining (AWJM), Ultrasonic Machining (USM). Working Principles – equipment used – Process parameters – MRR- Applications. Electrical Energy Based Processes: Electric Discharge Machining (EDM): Working Principle- equipment used -Process Parameters - Surface Finish and MRR - electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications. Chemical and Electro-Chemical Energy Based Processes: Chemical machining and Electro-Chemical machining (CHM and ECM) - Etchants – Maskant - techniques of applying maskants - Process Parameters – Surface finish and MRR - Applications. Thermal Energy Based Processes: Laser Beam machining and drilling (LBM), Plasma Arc machining (PAM) and Electron Beam Machining (EBM). | | | | 15 | | 1, 2,3, 4 | | CO3 | PSO1  PSO2  PSO4 |
| 3 | **UNIT: 3 Additive Manufacturing**  Introduction to additive manufacturing, Benefits and History of additive Manufacturing / 3D printing. Various techniques of additive manufacturing: Stereolithography (SLA), Digital Light Processing (DLP), Fused deposition Modeling (FDM), Selective Laser Sintering (SLS), Selective Laser Melting (SLM), Electronic Beam Melting (EBM), Laminated Object Manufacturing (LOM), Binder Jetting (BJ), Material Jetting (MJ)  Fusion Deposition Modelling: Principle, Process parameter, Applications.  Introduction to principle of Design for additive manufacturing (DFAM), Materials for additive manufacturing. | | | | 15 | | 1, 2,3, 4 | | CO4 | PSO1  PSO2  PSO4 |
| **Reference Books** | | | | | | | | | | | |
| 1. | CAD/CAM: Computer-Aided Design and Manufacturing by Mikell P. Groover and Emory W. Zimmers, [Pearson Education Asia Pte. Ltd.](javascript:OpenSearch(0,%20'Pearson%20Education%20Asia%20Pte.%20Ltd.',%209)) | | | | | | | | | | |
| 2. | James  A.  Regh  and  Henry W.  Kreabber, “Computer  Integrated  Manufacturing”, Pearson Education second edition, 2005. | | | | | | | | | | |
| 3. | Binit Kumar Jha , CNC Programming Made Easy, Vikas Publishing House HMT, Mechatronics, Tata McGraw Hill Education | | | | | | | | | | |
| 4. | [Amitabha Ghosh](https://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=Amitabha+Ghosh&search-alias=stripbooks) and Ashok kumar mallik Manufacturing science , published in 2010 | | | | | | | | | | |
| 5. | J Benedict G. F. – ‘Non-Traditional Manufacturing Processes’ – Marcell Dekker Inc., NY – 1987. | | | | | | | | | | |

**SEMESTER VII**

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| **School: School of Engineering and Technology** | | | **Program: B. Tech Mechanical** | | |
| **Course Code:** | | | **Course Name: Machine Design III** | | |
| **Year** | **III** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **3** |
| **Semester** | **VI** | **Elective Subject(Yes/No):** | **No** | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **3** |
| **Year of Introduction** | **2013** | **Prerequisites**  **(If any)** | **ME 217**  **ME 308** |
| **Course Description:** Machine Design-III’s syllabus consists the method to design several machine components such as different types of gears, the gear box, material handling equipment, lifting equipment and components of internal combustion engine. The intent of course is to learn to use the design data book and standards, to design the above-mentioned machine components. In a system, many standard components are used such as nuts, bolts etc., the selection of such standard components according to the type of stresses coming on it is also to be taught in this course.  **Course Objectives:** After successful completion of the course, student will be able to-   1. Develop the fundamental concepts of mechanical design process, 2. Design simple machine components like Gear, Gear Box, Material handling Equipment.   **Course Outcome (CO):**  CO1 Understand the fundamental of machine design and various components of machines  CO2 Design a system, component or process to meet desired needs within realistic constraints  CO3 Understand the various type of design considerations, design morphology, types of stress, concept of stress concentration, and methods of reliving stress concentration  CO4 Design and interpret of shaft, couplings and keys for safety used  CO5 Design and interpret of Power screw and Levers for safety used  CO6 Design and interpret of various welded joints and riveted joints for industrial applications. | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | **Design of Gears and Gear Boxes**  **Spur Gears :**  Gear Terminology, Speed ratios and number of teeth, Force analysis, Tooth stresses, Dynamic effects, Fatigue strength, Factor of safety, Gear materials, Module and Face Width-power rating calculations based on strength and wear considerations.  **Parallel axis Helical Gears:**  Pressure angle in the normal and transverse plane, Equivalent number of teeth-forces and stresses. Estimating the size of the helical gears.  **Bevel and worm Gear:**  Straight and spiral bevel gear: Tooth terminology, tooth forces and stresses, equivalent Number of teeth. Estimating the dimensions of pair of straight and spiral bevel gears. Worm Gear: Terminology, forces and stresses, efficiency, estimating the size of the worm gear pair.  **Design of Gear Boxes:**  Geometric progression - Standard step ratio - Ray diagram, kinematics layout – Design of sliding mesh gear box -Constant mesh gear box, Design of multi speed gear box. | 20 | 1, 2 | CO1  CO2 | PSO1  PSO2  PSO3 |
| 2 | **Design of I.C Engine Components**  Selection of type, general design consideration, design of cylinder, cylinder liner, Cylinder head, pistons, connecting rod, crank shaft, valves gears mechanism, and flywheel | 10 | 1, 2, 4 | CO2  CO3 | PSO1  PSO2  PSO3 |
| 3 | **Introduction:** material handling equipment, classification and their selection. Concept of material handling system design.  **Lifting Equipment:** classification and selection and design of hooks, sheaves, drums and grab buckets. Classification of cranes, construction working of different types of conveyors, feeders and elevators.  **Conveying equipment:** classification construction and working of different types of conveyors, feeders and elevators. Design of belt conveyors, screw conveyors and vibratory conveyors. | 10 | 1, 2, 4, 5 | CO4 | PSO1  PSO2 |

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| **Reference Books** | |
| 1. | S. G. Kulkarni, “Machine Design - Solved Problems", Tata McGraw Hill Publishing Company Ltd., New Delhi. |
| 2. | Joseph Edward Shigley and Charles R. Mischke, "Mechanical Engineering Design", McGraw Hill International Edition. |
| 3. | Mechanical System Design by Farazdakhaideri Nirali Prakashan |
| 4. | Machine Design by U.C. Jindal Pearson Education |
| 5. | Machine Design by Shigley Tata McGraw hill. |
| 6. | P.C Sharma and D. K. Aggarwal “Machine Design”, S.K. Kataria& Sons 2009. |
| 7. | V. B. Bhandari “Design of Machine Elements”, Tata McGraw Hill Publishing Co. |

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| **School: School of Engineering & Technology** | | | | | **Program: B.Tech (Mechanical Engineering)** | | | | | | |
| **Course Code:** | | | | | **Course Name: FLUID MACHINERY** | | | | | | |
| **Year** | | | **IV** | **Core Subject(Yes/No):** | **yes** | | **Lecture:** | | **3** | | |
| **Semester** | | | **VII** | **Elective Subject(Yes/No):** | **no** | | **Tutorial** | | **0** | | |
| **Typology of Course** | | | Lectures | **Foundation Subject(Yes/No):** | **no** | | **Practical:** | | **0** | | |
| **Year of Syllabus Revision:** | **-** | | **Total Credit:** | | **3** | | |
| **Year of Introduction** | **2014** | | **Prerequisites**  **(If any)** | | Thermodynamics, FM. | | |
| **Course Description:** This course covers the applications of fluid mechanics 1 and 2. It deals with design calculations of turbines, pumps and compressors. The velocity triangles to design these machines will be illustrated with numerous examples which allow students to develop their problem-solving skills.  **Course Objectives:**  To develop understanding of various hydraulic systems like turbines, pumps and compressors. To analyse and design the systems associated transfer of the fluids and conversion of energy.  **Course Outcome (CO):**   |  |  | | --- | --- | | CO1: | To introduce the fundamentals of Hydraulic Machinery. | | CO2: | To empower the student with enough analytical tools of Fluid flow to carry out for various analysis and design of various fluid machines. | | CO3: | To expose the student with techniques to carry out Hydraulic Machinery studies. | | CO4: | Strengthening of analytical capability | | CO5: | Strengthening of fluid system design capability | | CO6: | Design and analysis of various hydraulic systems | | | | | | | | | | | | |
| **Unit No.** | | **Topic/Unit** | | | | **Contact Hours** | | **BT**  **Level** | | **CO** | **PSO** |
| 1 | | **Impulse Turbines**  Working principle, impact of jet on vanes, construction details of Pelton wheel, classification, Specific speed, velocity triangles, various losses, performance characteristics curves, governing of impulse turbine, unit quantities and specific quantities.  **Learning Outcome:**  To introduce the concept of impact of jet and impulse turbines and its design. | | | | 10 | | 1,2,3 | | CO1,  CO2,  CO3,  CO6 | PSO1  PSO2 |
| 2 | | **Reaction Turbines**  Working principle, construction details of Francis & Kaplan turbine, draft tube theory, cavitation, and performance characteristic curves, governing of reaction turbine, Unit quantities & Specific quantities.  **Learning Outcome:**  To develop understanding of design of reaction turbine and turbine selection parameters. | | | | 6 | | 1,2,3 | | CO1,  CO2,  CO3,  CO6 | PSO1  PSO2 |
| 3 | | **Fan, Blowers and Compressor**  Construction details, governing equation, losses, performance curves. Centrifugal and Axial Compressors, radial equilibrium, reaction factor, impact of blade angle.  **Learning Outcome:**  To introduce the design of fan blowers and compressors using concept of compressible fluid flow. | | | | 14 | | 1,2,3 | | CO1,  CO2, | PSO1  PSO2 |
| 4 | | **Pumps**  Classification of different type of pump, principle of dynamic action & positive displacement type of pump, various parts of centrifugal pump & their function, theoretical analysis of energy transfer between fluid & rotor, losses, various efficiencies of the pump, performance characteristics, matching of pump & system characteristics, model analysis of centrifugal pump & specific speed, cavitation in pump & maximum suction lift., special purpose pumps.  **Learning Outcome:**  Understanding of design and analysis of pumps and various types of pumps. | | | | 10 | | 1,2, 3,4 | | CO4,  CO5,  CO6 | PSO1  PSO2 |
| 5 | | **Miscellaneous Fluid Systems**  Hydraulic accumulator, hydraulic intensifier, hydraulic crane, hydraulic ram, hydraulic lift, fluid coupling & torque converter.  **Learning Outcome:**  Introduction with various types of hydraulic systems. | | | | 05 | | 1,2 | | CO1,  CO2 | PSO1 |
| **Reference Books** | | | | | | | | | | | |
| 1. | Som S. K., Biswas. G., “Introduction to Fluid Mechanics and Fluid Machines”, McGraw Hill, 2006. | | | | | | | | | | |
| 2. | Lal Jagdish, “Hydraulic Machines”, Metropolitan, 2006. | | | | | | | | | | |
| 3. | Gupta Vijay and Gupta Santosh K., “Fluid Mechanics and its Applications”, New Age International | | | | | | | | | | |
| 4. | Yahya S.M., “Turbines, Compressors and Fans”, Tata McGraw Hill, 2005. | | | | | | | | | | |
| 5. | Pillai Narayana N. and Ramakrishnan C. R. “Principles of Fluid Mechanics and Fluid Machines”, Universities Press (India), 2006. | | | | | | | | | | |

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| **School: School of Engineering and Technology** | | | **Program: B. Tech Mechanical** | | |
| **Course Code:** | | | **Course Name: Quality Management** | | |
| **Year** | **V** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **3** |
| **Semester** | **VII** | **Elective Subject(Yes/No):** | **No** | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **3** |
| **Year of Introduction** | **2015** | **Prerequisites**  **(If any)** | **No** |
| **Course Description:** The field of quality management keeps advancing in both depth and breadth with the scope of application in manufacturing and services. Quality issues are now the concern of all organizations, including public and service sectors. The purpose of this course is to put quality management into perspective, and to highlight its critical importance, as well as to present in-depth ideas on different methodologies, tools and techniques proposed for product and process improvement. This web course will help students understand opportunities for product/service or process improvement based on quality management principals  **Course Objectives:** After successful completion of the course, student will be able to-   * To understand the fundamentals of quality and the importance in any organization. * To empower the student with enough analytical tools to carry out quality analysis of processes and products. * To expose students to the various practices in industry pertaining to quality. * To make students understand the importance of linking theory with practice through case studies and tutorial work.   **Course Outcome (CO):**  CO1 Understanding of fundamentals of quality and its importance in any organization. Understand the different meanings of the quality concept and its influence. Understanding of TQM and its application in improving quality. To Understand Japanese methods like kaizen and 5s principle  CO2 Understanding important role of statistics in analyzing quality of process and product. To learn various statistical methods and tools to analyze process and its control. Understanding six sigma philosophy and its advantages.  CO3 To understand the Quality function deployment, house of quality, failure mode effect analysis and their role in quality improvement. To understand old and new tools of quality management along with POKAYOKE and Bench marking  CO4 To understand quality assurance through ISO 9000. Understanding quality consciousness and rating of vendors. Understand how quality is maintained over the period time by involvement, motivation, empowerment, recognition and reward. | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | **Introduction to Quality Control**  Meaning of quality, Quality Design, Quality conformance, Aims and objective of QC. Quality – vision, mission and policy statements. Customer Focus – customer feedback, value of quality, Cost of quality, Concepts of Quality circle.  **Total Quality Management**  Concept & philosophy of TQM, TQM models, Benefits of TQM, Kaizen, Brain storming, DMAIC cycle, Japanese 5S principles | 10 | 1, 2,3,4 | CO1 | PSO1  PSO2  PSO4 |
| 2 | **Statistical process control and process capability**  Meaning and significance of statistical process control (SPC) – construction  of control charts for variables and attributed. Acceptance sampling, producer’s risk & Consumer’s risk, Process capability – meaning, significance and measurement – Six sigma concepts of process capability. Reliability concepts, product life characteristics curve. Total productive maintenance (TMP). | 15 | 1, 2,3, 4 | CO2 | PSO1  PSO2  PSO4 |
| 3 | **Tools and Techniques for quality management**  Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation. Seven old (statistical) tools. Seven new management tools. Bench marking and POKA  YOKE. | 10 | 1, 2,3, 4 | CO3 | PSO1  PSO2  PSO4 |
| 4 | **Quality Assurance**  Meaning, QA Manual, quality audit, quality mindness or Quality  consciousness, vendor quality rating.  **Quality system organizing and Implementation**  Introduction to ISO 9000 – quality management systems – guidelines for  performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward | 10 | 1, 2,3, 4 | CO4 | PSO1  PSO2  PSO4 |

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| **Reference Books** | |
| 1. | Mitra A., Fundamentals of Quality Control and Improvement,PHI |
| 2. | D. C. Montgomery, Introduction to Statistical Quality Control, John Wiley & Sons, 3rd Edition |
| 3. | J Evans and W Linsay, The Management and Control of Quality, 6'th Edition, Thomson, 2005 |
| 4. | Dale H.Besterfield et al, Total Quality Management, Third edition, Pearson Education |
| 5. | Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002 |

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| **School: School of Engineering and Technology** | | | **Program: B. Tech Mechanical** | | |
| **Course Code:** | | | **Course Name: Research Studio** | | |
| **Year** | **IV** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **0** |
| **Semester** | **VII** | **Elective Subject(Yes/No):** | **No** | **Tutorial** | **0** |
| **Typology of Course** | Project | **Foundation Subject(Yes/No):** | **No** | **Practical:** | **8** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **4** |
| **Year of Introduction** | **2014** | **Prerequisites**  **(If any)** | **No** |
| **Course Description:** Group projects play an important role in demonstrating the learning acquired during the entire course work. These culminate in group presentations, demonstrations and reports. In the final year of the Mechanical Engineering course, students are formed into teams to undertake a major project. Groups are required to work in the same way as professional engineering teams in industry. For example, they hold regular formal meetings and assign roles to each member. The students are supposed to work on innovative ideas and transform the idea into a prototype. A detailed design, analysis and fabrication work should be carried out. The students must work on the aesthetics of the project and ensure proper functioning of the prototype.  **Course Outcome (CO):**   * CO1 To implement the concept of mechanical engineering subjects and execute the project. * CO2 Enhance the capability of working in group. | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | **This course will enable the faculty and students to**   * Conduct need assessment and map the problems in the particular field using appropriate methods * Analysis of the Problem * Develop skills to apply knowledge to field to address real world problem. * Develop skills to interact with individuals with different disciplinary perspective to arrive at real world problems * Develop strategy to address the problem * Implement the Strategy * Present the documented problems faculty members and experts. * Document and the application of knowledge to address real world problem   A report is to be prepared to document the process.  **Mode of Transaction**  Field work in group, group discussions, presentations under the guidance of mentor | 25 | 3,4, 5, 6 | CO1  CO2 | PSO1  PSO2  PSO3  PSO4  PSO5  PSO6  PSO8  PSO9  PSO10  PSO11  PSO12 |

**CORE ELECTIVES**

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| **School: School of Engineering and Technology** | | | **Program: B. Tech Mechanical** | | |
| **Course Code:** | | | **Course Name: Composite as Tribo Material** | | |
| **Year** | **II** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **2** |
| **Semester** | **IV** | **Elective Subject(Yes/No):** | **No** | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **2** |
| **Year of Introduction** | **2016** | **Prerequisites**  **(If any)** | **No** |
| **Course Description:** This course covers general introduction to composite material, Classification of composite materials and basics of Tribology. Explains in details, FRP Composite and terminology used for FRP Composites. Primary & Secondary Composite manufacturing processes, Destructive & Non Destructive testing for FRP composites. Students will not only understand the subject theoretically but also they will make laminates with different manufacturing processes and materials.  **Course Objectives:** After successful completion of the course, student will be able to-   1. Develop the fundamental concepts of composite manufacturing process, 2. Develop the fundamental concept of Triboogy. 3. Development of composite material with different manufacturing process 4. Understand the concept of composite as Tribo Material.   **Course Outcome (CO):**  CO1 Understand the fundamental of Composite materials and Tribology  CO2 Understand the various composite manufacturing processes.  CO3 Understand the various friction and wear behavior of the material  CO4 understand micro mechanics of composite material. | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | Introduction : Composites, What is composites, its classifications, advantages, Applications of composite materials, Sources of natural fibers and its surface treatments, Significance and economics of natural fiber polymer composites, Basic terminology used in composites | 6 | 1, 2 | CO1 | PSO1  PSO2  PSO3 |
| 2 | Introduction: Tribology, Origin of Friction , Definition of wear and its classifications, How friction and wear are measured, Mechanical characterization of polymer composites, Tribology characterization of polymer composites, Significance of composites in tribology | 6 | 1, 2, 4 | CO2  CO3 | PSO1  PSO2  PSO3 |
| 3 | Causes of friction, theories of friction, Mechanism of wear, Types and measurement of wear, friction affecting wear, Theories of wear; Wear of metals and non-metals, Introduction of Pin on disc wear tester, Different types of wear measuring equipment’s | 6 | 1, 2, 4, 5 | CO2  CO3 | PSO1  PSO2 |
| 4 | Composite manufacturing methods: Hand Layup, Spray Lay up, Filament Winding, Pultrusion, Resin transfer moulding, VARTM, Hot pressing | 6 | 1, 2, 4, 5 | CO3 CO4 | PSO1  PSO2 |
| 5 | Measure of voids and defects in composites, Testing of composites, Introduction of ASTM standards for tribo testing | 6 | 1, 2, 4, 5 | CO4 | PSO1  PSO2 |

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| **Reference Books** | |
| 1. | Introduction to Tribology by Bharat Bhushan, Second Edition, Wiley publishers |
| 2. | Fundamentals of Tribology, Basu, SenGupta and Ahuja/PHI |
| 3. | Analysis and Performance of Fiber Composites, Agarwal, B.D. and Broutman, L. J., John Wiley & Sons |

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| **School: School of Engineering and Technology** | | | **Program: B. Tech Mechanical** | | |
| **Course Code:** | | | **Course Name: Operations and Supply Chain Management** | | |
| **Year** | **III and IV** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **2** |
| **Semester** | **VI and VIII** | **Elective Subject(Yes/No):** | **No** | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **2** |
| **Year of Introduction** | **2016** | **Prerequisites**  **(If any)** | **No** |
| **Course Description:** Operations and Supply Chain Management (OSCM) includes a broad area that covers both manufacturing and service industries, involving the functions of sourcing, materials management, operations planning, distribution, logistics, retail, demand forecasting, order fulfillment, and more. A supply chain is involved in processing or using these materials or even providing services to customers using these materials. Professionals in these fields also work with processes and increasing efficiencies with processes.  **Course Objectives:** After successful completion of the course, student will be able to-   * To gain an understanding and appreciation of the principles and applications relevant to the planning, design, and operations of manufacturing/service firms. * To gain some ability to recognize situations in a production system environment that suggests the use of certain quantitative methods to assist in decision making on operations management * To increase the knowledge, and broaden the perspective of the world in which you will contribute your talents and leadership in business operations   **Course Outcome (CO):**  CO1 Understand the core features of the operations management function at the operational and strategic levels, specifically the relationships between people, process, technology, productivity and quality and how it contributes to the competitiveness of firms.  CO2 Understanding fundamentals of supply chain management and to apply them in various real time situations  CO3 To understand the importance of transportation and IT in the infrastructure of Supply chain and their role and impact on business. | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | **operations management:**  Facility layout and location, Qualitative aspects, Quantitative models for layout Decisions, Product, process fixed position, group layout, Location decisions-quantitative models. Capacity and aggregate planning, Capacity measurement, Long-term and short term strategies, Aggregate planning. | 10 | 1, 2,3,4 | CO1 | PSO1  PSO2  PSO4 |
| 2 | **Supply Chain Management:**  Definition, complexity, key issues, centralized vs. decentralized systems, Value of information and supply chain integration, Bullwhip effect, push-based, pull based systems. Outsourcing: Make or buy decisions. | 10 | 1, 2,3, 4 | CO2 | PSO1  PSO2  PSO4 |
| 3 | **Transportation decision and IT in Supply Chain**  Drivers of the decision, Network design decisions, Cross-docking, transshipment. Distribution and logistics in supply chains, direct shipment/intermediate storage policies. Vehicle routing models, Third-party logistics. Enabling supply chain through IT, ERP vendor platforms, Service oriented architecture (SOA). | 10 | 1, 2, 3, 4 | CO3 | PSO1  PSO2 |

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| Reference Books | |
| 1. | Chopra & Meindl “Supply Chain Management: Strategy, Planning, and Operation”, 5th edition, Pearson publication. |
| 2. | Sarin, R. K & Buffa, E.S, “Modern Production/Operations Management“, 8th Edition, Wiley India Pvt Ltd |
| 3. | [Chary,](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22V.+Chiles%22) S. N, “Production and Operations Management”, 5th Edition, Tata-Mcgraw Hill |
| 4. | [Billington Peter J.](http://www.flipkart.com/author/billington-peter-j), [Narasimhan Setharama L.](http://www.flipkart.com/author/narasimhan-setharama-l), [Mcleavey Dennis W.](http://www.flipkart.com/author/mcleavey-dennis-w),” Production Planning and Inventory Control”, 2nd Edition, Prentice-Hall |
| 5. | [Mertand. T Telsang](http://www.flipkart.com/author/mertand-t-telsang), “Industrial Engineering And Production Management”, 2nd Edition, S. Chand |

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| **School: School of Engineering & Technology** | | | | **Program: B.Tech (Mechanical Engineering)** | | |
| **Course Code:** | | | | **Course Name: Cryogenic Engineering** | | |
| **Year** | **I** | **Core Subject(Yes/No):** | **no** | | **Lecture:** | **2** |
| **Semester** | **II** | **Elective Subject(Yes/No):** | **yes** | | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **no** | | **Practical:** | **0** |
| **Year of Syllabus Revision:** | **-** | | **Total Credit:** | **2** |
| **Year of Introduction** | **2015** | | **Prerequisites**  **(If any)** | Thermodynamics, HMT, FM. |
| **Course Description:** This course is designed to introduce the fundamentals of Cryogenic Engineering**.** To empower the student with enough analytical tools of Fluid flow to carry out various analysis and design of various Cryogenic systems. To understand the importance of linking theory with practice, through engineering case studies.  **Course Objectives:**  This course is designed to introduce the concept of cryogenics engineering to the undergraduate students. The students will be familiarized with various cryogenic systems, materials, insulations and applications of cryogenics in various fields.  **Course Outcome (CO):**   |  |  | | --- | --- | | CO1: | Understanding the changes in properties of material at cryogenic temperature and selection of material as per design requirements. | | CO2: | Knowing methods of producing low temperature and liquefying gases and comparing various types of systems with their merit and demerits. | | CO3: | Get familiar with various types of cryogenic insulations. | | CO4: | Basic understanding of cryogenics and its applications | | CO5: | Strengthening of analytical capability to design cryogenics systems | | CO6: | Strengthening of cryogenics system design capability. | | | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | **Properties of Cryogenic Fluid & Materials**  Cryogenic Engineering application, Cryogenics Fluids: Properties of Air, Oxygen, Nitrogen, Hydrogen, Helium and its isotopes, Material properties.  **Learning Outcome:**  Understanding the changes in properties of material at cryogenic temperature and selection of material as per design requirements. | 8 | 1,2 | CO1,  CO4,  CO5,  CO6 | PSO1  PSO2 |
| 2 | **Cryogenic Refrigeration & Liquefaction System**  Recuperative & Regenerative Cycles, Joule Thomson cycle; Gifford - Mach Mohan cycle, Stirling cycle, Pulse Tube refrigeration. Liquefaction systems: Ideal systems, Linde, Linde Dual Pressure System, claude Heylandt, Kapitza system.  **Learning Outcome:**  Knowing methods of producing low temperature and liquefying gases and comparing various types of systems with their merit and demerits. | 8 | 1,2,,3,4 | CO2,  CO4,  CO5,  CO6 | PSO1  PSO2 |
| 3 | **Cryogenic Insulations and Instrumentation**  Vacuum insulation, Multilayer insulation (MLI), liquid & vapor shield, evacuated porous insulation, Gas filled powders and fibrous materials, Solid foams. Pressure, temperature, flow, density and liquid level measurement for cryogenic application.  **Learning Outcome:**  Get familiar with various types of cryogenic insulations. | 7 | 1,2,,3,4 | CO3,  CO4,  CO5,  CO6 | PSO1  PSO2 |
| 4 | **Separation of Gases**  Purification and separation of Gases, Liquefied Natural Gas: Principles of gas separation: separation by condensation & flashing, separation by Distillation. Air separation system: Linde single column system. Linde double-column systems, Liquefaction of Natural Gas.  **Learning Outcome:**  Basic understanding of separation of various gases from air and various system design and developed for the same. | 7 | 1,2, 3,4 | CO4,  CO5,  CO6 | PSO1  PSO2  PSO3 |

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| **Reference Books** | |
| 1. | Baron, R. F., “Cryogenics Systems”, Oxford Press, USA, 1985. |
| 2. | Thomas M Flyenn “Cryogenic Engineering” 2nd edition CRC Press 2004. |
| 3. | Klaus D. Timmerhaus Thomas M. Flynn, “Cryogenic Process Engineering” Springer Science & Business Media – Publisher, 2013 |

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| **School: School of Engineering and Technology** | | | **Program: B. Tech Mechanical** | | |
| **Course Code:** | | | **Course Name: Pressure Vessel Design** | | |
| **Year** | **III & IV** | **Core Subject(Yes/No):** | **No** | **Lecture:** | **2** |
| **Semester** | **VII & VIII** | **Elective Subject(Yes/No):** | **Yes** | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **2** |
| **Year of Introduction** | **2015** | **Prerequisites**  **(If any)** | **No** |
| **Course Description:** Structures such as tank capable of holding internal pressure have been very important in the history of science and technology. In order to make a better flow of gas and fluid, an aqueduct or tank must be constructed so they can run all the way from the reservoir to the destination. However, temperature & pressure differential is dangerous and many fatal accidents have occurred in the history of their development and operation. These temperature & pressure difference have created stresses toward the shell. ASME sec VIII is accepted worldwide and fulfilling the requirements. This course includes theories of Pressure vessel and design of different component as per ASME Code.  **Course Objectives:** After successful completion of the course, student will be able to design various component of pressure vessel as per ASEM Section VII  **Course Outcome (CO):**  CO1 Understand the fundamental of Pressure vessel design, terminology involved in pressure vessel design, classification of pressure vessel, loading and stresses induced in pressure vessel  CO2 Design of thin and thick shell pressure vessel subjected to internal and external pressure.  CO3 Understand the various codes involve in pressure vessel design. Design pressure vessel components as per ASME Section VIII Div I and DIv II.  CO4 Understand modes of failure and various testing procedure involved in pressure vessel design. | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | * Pressure vessel design Terminology * Application of pressure vessel in detail * Pressure Vessel selection on the basis of its application * Different loading conditions * Fundamental stresses | 08 | 1,2,3,4,5 | CO1 | PSO 1  PSO 2  PSO 3  PSO 4  PSO 5  PSO 12 |
| 2 | * Stresses involved in PVD * Theories of stresses in thin cylinder * Different theories of stresses for thick vessel * Design calculation for thickness and change in dimensions under loading | 08 | 1,2,3,4,5 | CO1  CO2 | PSO 1  PSO 2  PSO 3  PSO 4  PSO 5  PSO 12 |
| 3 | * Worldwide pressure vessel codes * Scope of ASME Section VIII, DIV-1 * Factors affecting to material selection , * Design of different components of vessel as per ASME code, Sec VIII div-1, * Design for wind and seismic loading | 07 | 1,2,3,4,5 | CO2  CO3 | PSO 1  PSO 2  PSO 3  PSO 4  PSO 5  PSO 12 |
| 4 | * Basic idea about manufacturing processes involved in fabrication of vessel * PVD drawing interpretation * Documentation as per industrial requirements. * Weld joint category used in Fabrication of vessel * Hydro test procedure * Radiography Testing | 07 | 1,2,3,4,5 | CO3  CO4 | PSO 1  PSO 2  PSO 3  PSO 4  PSO 5  PSO 12 |

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| **Reference Books** | |
| 1. | ASME Section VIII Div I and Div II |

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| **School: School of Engineering and Technology** | | | **Program: B. Tech Mechanical** | | |
| **Course Code: ME427** | | | **Course Name: Computer Aided Manufacturing** | | |
| **Year** | **IV** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **2** |
| **Semester** | **VII** | **Elective Subject(Yes/No):** | **Yes** | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **2** |
| **Year of Introduction** | **2015** | **Prerequisites**  **(If any)** | **Manufacturing Technology I** |
| **Course Description:** Today the design of almost all products and components is accomplished with the computer-aided manufacturing (CAM) programs. This course emphasizes the integration of manufacturing enterprise using computer-integrated manufacturing (CIM) technologies including computers, database and data collection, networks, and machine control. Computer numerical control (CNC) machining is at the heart of advanced manufacturing and the production of complex components accurately and efficiently. Course cover Constructional features of NC/CNC Machines, NC/CNC axis and coordinate system, CNC tooling, Computer assisted part of programming (CAM)applies to computer numerical control (CNC) and familiarity with CAM softwares.  **Course Objectives:** After successful completion of the course, student will be able to-   1. To understand computer numerical control (CNC) machine parts, axis and tooling process. 2. To introduce fundamental knowledge of Numerical control manufacturing systems 3. To learn and understand processes and operations using a combination of G-codes, milling , drilling and turning equipment. 4. To get familiarity with CAM software packages.   **Course Outcome (CO):**  CO1 To Develop an understanding of computer-integrated manufacturing and computer technologies  CO2 To understand computer numerical control (CNC) machine  CO3 To demonstrate a basic understanding of machining fundamentals  CO4 To learn and understand processes and operations using a combination of G and M codes,  Co5 Generate NC codes using commercial CAM package | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | Introduction - Introduction to CIM Concepts & scope of CIM, Functions in CIM, ,Elements of CIM, CIM Wheel, Role of management in CIM, Computer networking in CIM – the seven layer OSI mode, MAP model, CIM development, Benefits of CIM, CIM hardware and software, impotence of CAM for implementation of CIM. | 10 | 1, 2 | CO1 | PSO1  PSO2 |
| 2 | Constructional features of NC/CNC Machines  CAM - concept and definition, NC (Numerical Control), CNC (Computerized Numerical Control) and DNC (Direct Numerical Control) - concept, features and differences, Advantages and limitations of CNC, Selection criteria for CNC machines. NC/CNC axis and coordinate system, Classification of NC system,CNC control system design, Mechanical system design),CNC drive system, Re-circulating ball screw, transducers, Method of improving accuracy and productivity in CNC. CNC tooling :Tool presetting-concept and importance, Work holding devices -types, working and applications, Tool holding and changing devices - types, working and applications, cutting tools for CNC machine, Automatic tool changer (ATC),Automatic pallet changer (APC). | 10 | 1, 2, 4 | CO2  CO3 | PSO1  PSO2  PSO3 |
| 3 | CNC Part Programming Programming format and structure of part programme,types of dimensioning, axis designation, ISO G and M codes, Tape programming format, part Programming for drilling, lathe and milling machine operations, Canned cycle , Do loops and Subroutine, Need and importance of various compensations: Tool length compensation, Pitch error compensation, Tool radius compensation, Tool offset. Automatically programmed tools (APT) Introduction, APT programming languages, sequence, geometric definition in APT, programming in APT. CAD/CAM integration- Activity involved in CAD/CAM integration process, used software packages and their use in area of CAD/CAM Recent trends in CAM: Rapid prototyping concept and application, 3D printing/additive manufacturing, molding, Reverse engineering concept, M to M communication | 10 | 1, 2, 4, 6 | CO4  CO5 | PSO1  PSO2  PSO3  PSO4 |

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| **Reference Books** | |
| 1. | CAD/CAM: Computer-Aided Design and Manufacturing by Mikell P. Groover and Emory W. Zimmers, Pearson Education Asia Pte. Ltd. |
| 2. | T.K. Kundra, P.N.Rao, N.K. Tewari, Numerical Control and Computer Aided Manufacturing, Tata McGraw Hill Publishing Company Ltd. |
| 3. | James A. Regh and Henry W. Kreabber, “Computer Integrated Manufacturing”, Pearson Education second edition, 2005. |
| 4. | J. S. Narang Computer Aided Manufacturing (CNC and Robotics) for U P Technical university. |
| 5. | Binit Kumar Jha , CNC Programming Made Easy, Vikas Publishing House HMT, Mechatronics, Tata McGraw Hill Education |

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| **School: School of Engineering and Technology** | | | | | | | | | | **Program:** | | | | | | | | | | | | | | |
| **Course Code:** | | | | | | | | | | **Course Name: Introduction to I. C. Engines** | | | | | | | | | | | | | | |
| **Year** | | | | | |  | | **Core Subject(Yes/No):** | | **No** | | | | | **Lecture:** | | | | | | **2** | | | |
| **Semester** | | | | | |  | | **Elective Subject(Yes/No):** | | **Yes** | | | | | **Tutorial** | | | | | | **0** | | | |
| **Typology of Course** | | | | | | Lectures | | **Foundation Subject(Yes/No):** | | **No** | | | | | **Practical:** | | | | | | **0** | | | |
| **Year of Syllabus Revision:** | |  | | | | | **Total Credit:** | | | | | | **2** | | | |
| **Year of Introduction** | | **2023** | | | | | **Prerequisites**  **(If any)** | | | | | | **No** | | | |
| Course Description: Introduction to I.C. Engine is a course that aims to provide students a comprehensive understanding of internal combustion engines, their principles of operations and their applications. The course is designed for providing clear understanding of the various principles of the engine operation. Throughout the course, students will learn about various topics such as engines types, components of engines, fuel systems, ignition systems, combustion processes, engine cooling and lubrication systems and much more.  Course Objectives: The objective of this course is to provide fundamental understanding of the principles of internal combustion engines, their components and application in various field. The students enrolled for this course will be introduced to various types of engines, including their operation principle, advantages and limitations. The course will provide basic understanding about various fuels and fuels systems used in I. C. Engines.  Course Outcome (CO):  CO1 Students will have a solid understanding of the fundamental principles of the internal combustion engines.  CO2 Understand the design of I.C. Engines and its applications  CO3 To get familiarized with various components of I.C. Engines | | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit No.** | | **Topic/Unit** | | | | | | | | | | | **Contact Hours** | | | | **BT**  **Level** | | | **CO** | | | | **PSO** | |
| 1 | | Introduction to Internal Combustion Engines  Basic components of I. C. Engines  Engine Nomenclature and terminology  Application of I. C. Engines  Various Thermodynamic Cycles  Efficiency of I. C. Engines Cycles  Engine performance metrics and calculation  Introduction to fuel system  Components of Fuel injection systems  Ignition System  Ignition system components and operation  Combustion Process  Engine cooling and lubrication system  Alternative Engines and Future Trend | | | | | | | | | | | 26 | | | |  | | | CO 1  CO 2  CO 3 | | | |  | |
| 2 | | Discussion on various case study and demonstration of various parts of I.C. Engine | | | | | | | | | | | 04 | | | |  | | | CO 1  CO 2  CO 3  CO 4 | | | |  | |
| **School: School of Engineering & Technology** | | | | | | | | **Program: B.Tech Mechanical** | | | | | | | | | | | | |
| **Course Code: CMP104** | | | | | | | | **Course Name: Robotics & Automation** | | | | | | | | | | | | |
| **Year** | | | |  | | **Core Subject(Yes/No):** | | **No** | | | **Lecture:** | | | | | | **2** | | | |
| **Semester** | | | |  | | **Elective Subject(Yes/No):** | | **Yes** | | | **Tutorial** | | | | | | **0** | | | |
| **Typology of Course** | | | | Lectures | | **Foundation Subject(Yes/No):** | | **Yes** | | | **Practical:** | | | | | | **0** | | | |
| **Year of Syllabus Revision:** | | **2022** | | | **Total Credit:** | | | | | | **2** | | | |
| **Year of Introduction** | | **2022** | | | **Prerequisites**  **(If any)** | | | | | | **NA** | | | |
| **Course Description:**  From banking ATM’s to Fast Tags, to surgery to production to food industry and many such areas; automation and robots occupy a very significant place and play a critical role. In this course, Robotics is taught through an industrial grade 4 joint articulating arm robot. Students study its design, its mechanisms, and learn to program & control it through its proprietary software. In Automation, students learn about industry automation, IR 4.0, sensors, controls, data acquisition & communication. Students get introduced to LabVIEW – a graphical programming language for developing automated systems, data acquisition & analysis  **Course Objectives:**  Create awareness among students about Automation & Robotics  Demystify the complexities surrounding the robot and certain automated systems  Understand & appreciate the design complexities of automated systems  **Course Outcome (CO):**  CO1 Understand the concepts of Automation & Robotics  CO2 Ability to program & operate a robot  CO3 Gain basic understanding of a programming language for automation control  CO4 Hands-on experience in automation & robotics | | | | | | | | | | | | | | | | | | | | |
| **Unit No.** | | | **Topic/Unit** | | | | | | | **Contact Hours** | | | **BT**  **Level** | | **CO** | | | **PSO** | | | |
| 1 | | | Robotics:  Introduction  Hands-on activities on a robot  Programming of robot  Understanding the geometry & the linear algebra behind robot movements | | | | | | | 10 | | |  | | CO1  CO2  CO4 | | |  | | | |
| 2 | | | Industry & Home Automation:  Introduction to IR4.0 & Smart Homes  Basic components used in automation like relays, proximity sensors  Build a simple automation system | | | | | | | 10 | | |  | | CO1  CO4 | | |  | | | |
| 3 | | | Introduction to LabVIEW  Introduction and hands-on practice with automatic  Industrial machines  CO2 Laser Cutting machine  CNC Lathe  3D Printer | | | | | | | 10 | | |  | | CO1  CO3  CO4 | | |  | | | |
| 1. | | Class notes | | | | | | | | | | | | | | | | | | | |
| 2. | | Machine manuals | | | | | | | | | | | | | | | | | | | |

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| **School: School of Engineering and Technology** | | | **Program: B. Tech Mechanical** | | |
| **Course Code:** | | | **Course Name: Advance Welding Technology** | | |
| **Year** | **III** | **Core Subject(Yes/No):** | **Yes** | **Lecture:** | **2** |
| **Semester** | **VI** | **Elective Subject(Yes/No):** | **Yes** | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **Yes** | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **2** |
| **Year of Introduction** | **2017** | **Prerequisites**  **(If any)** | Manufacturing Technology II |
| **Course Description:** Course cover welding metallurgy, effect of welding parameters and their control , modes of Molten metal transfer in consumable electrode in Arc welding, weld pool convection force study, residual stresses and distortion identification and control Corse also cover recent advances in welding and joining technologies . Module involve the weld design and weld cost calculation of different welding processes. Module involve welding inspection methods, symbols and safety rules.  **Course Objectives:** After successful completion of the course, student will be able to-   1. To understand describe the basic metallurgy of the melted and heat-affected zone of a metal or alloy 2. To understand the advanced welding practices in Industries and their comparative merits and demerits 3. To choose the right kind of welding techniques for joining raw materials of various thicknesses. 4. To Calculate welding time and cost of different welding processes 5. To learn to design joint in different types of welding techniques   **Course Outcome (CO):**  CO1 To Understand mechanisum of molten metal transfer to the weld pool  CO2 To Identify the effect of forces act in weld pool during the arc welding process.  CO3 To Learn to choose the right kind of welding techniques for joining raw materials of various thicknesses.  CO4 To Understand and learn to Calculate welding time and cost  CO5 Understand the inspection techniques and also able to choose the right techniques for testing of weldmelt. | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | **Physics of welding and weld design** – Analysis of heat sources for material joining, welding metallurgy, Epitaxial solidification, homogeneous and heterogeneous nucleation, parameters in welding and their control, Molten metal transfer in arc welding: forces and modes of metal transfer, Weld pool convection: forces and its effect, general concepts of weld joint design, analysis of stresses in welded structures, residual stresses and distortion measurement methods and their control, corrosion study in weld metal | 8 | 1, 2 | CO1  CO2 | PSO1  PSO2 |
| 2 | **Modern welding processes**: Activated TIG welding , Hot wire TIG welding, Flux bounded TIG welding, effect of process parameters, Friction stir processing, solid phase and high energy density welding processes- EBW, LBW, PAW and their process parameters. Welding of plastics, composites. underwater welding, welding in space, Welding in vacuum, | 10 | 1, 2, 4 | CO2  CO3 | PSO1  PSO2  PSO3 |
| 3 | **Welding symbols & Estimation of welding cost** – Welding symbols-American welding symbols, Economics of welding: Standard time and cost calculations – consumable cost – Labor cost- gas cost- overhead cost | 8 | 1, 2, 4, 5 | CO4 | PSO1  PSO2  PSO3 |
| 4 | **Inspection & Testing of Welding** – Inspection during & after welding – visual inspection, NDT of Welds-Magnetic, Xray, Gamma ray, ultra-sonic, destruction tests.  **Protection & Safety in welding** – Protection of body, physical hazards- radiation, heat, toxic hazards, noise, fire. | 4 |  | CO5 | PSO1  PSO2  PSO3 |

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| **Reference Books** | |
| 1. | Welding Technology and design by V.M. Radhakrishnan, New age international (p) ltd. publisher |
| 2. | Welding Engineering and Technology by R.S. Parmar, Khanna Publishers |
| 3. | Welding Processes and Technology by R. S. Parmar, Khanna Publishers. |

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| **Course Code: THE001** | | | | **Course Name: Air-Conditioning** | | |
| **Year** | **NA** | **Core Subject(Yes/No):** | **No** | | **Lecture:** | **2** |
| **Semester** | **NA** | **Elective Subject(Yes/No):** | **Elective** | | **Tutorial** | **0** |
| **Typology of Course** | Lecture, discussion and Laboratory | **Foundation Subject(Yes/No):** | **no** | | **Practical:** | **0** |
| **Year of Syllabus Revision:** | **-** | | **Total Credit:** | **2** |
| **Year of Introduction** | **2024** | | **Prerequisites**  **(If any)** | - |
| **Course Description:** This course provides an introduction to the fundamentals of air conditioning systems. Students will learn about the basic principles of air conditioning, types of systems, components, and their applications in various settings. Emphasis will be placed on understanding the thermodynamic processes involved in air conditioning and the essential concepts needed to design, install, operate, and maintain air conditioning systems.  **Course Objectives:**  To provide a comprehensive understanding of the principles, applications, and practices related to air conditioning systems.  **Course Outcome (CO):**   |  |  | | --- | --- | | CO1: | Understand the principles of Thermodynamics and heat transfer. | | CO2: | Demonstrate Understanding of Air Conditioning Principles | | CO3: | Learn concept of vapor compression refrigeration system. | | CO4: | Apply the knowledge for Heat load calculations. | | CO5: | Execute Installation and Maintenance Procedures. | | | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | Introduction to Air Conditioning: Definition and importance of air conditioning  Historical development of air conditioning technology  Basic principles of thermodynamics and heat transfer as they relate to air conditioning  Psychometric: Introduction to psychrometric charts and their applications, Understanding the psychrometric processes involved in air conditioning  Types of Air Conditioning Systems: Overview of different types of air conditioning systems (e.g., window units, split systems, central systems) Comparison of residential, commercial, and industrial air conditioning systems  Selection criteria for different types of systems based on application requirements  Components of Air Conditioning Systems: Overview of key components (e.g., compressor, condenser, evaporator, expansion valve) Function and role of each component in the refrigeration cycle, Understanding the basic operation of air conditioning systems through component interactions  Refrigeration Cycle: Introduction to the basic refrigeration cycle, Understanding the four primary processes (compression, condensation, expansion, evaporation)  Application of the refrigeration cycle to air conditioning systems  HVAC Load Calculation: Introduction to heat load calculation methods, Factors affecting heat load (occupancy, lighting, equipment, etc.), Importance of proper load calculation for system sizing and efficiency  Installation and Maintenance: Overview of installation procedures for air conditioning systems, Importance of regular maintenance for system efficiency and longevity  Basic troubleshooting techniques for common issues  Energy Efficiency and Environmental Considerations: Introduction to energy-efficient practices in air conditioning  Overview of environmental regulations and refrigerant considerations, Trends in sustainable air conditioning technology | 12 | 1,2, 3, 4 | CO1,  CO2,  CO3,  CO4,  CO5 | PSO1  PSO2 |

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| **Reference Books** | |
| 1. | Stoecker, W., Refrigeration & Airconditioning, Tata Mc Graw Hill, 2004 |
| 2. | Dossat, R.J., Principles of refrigeration, John Wiley & Sons, 2000 |
| 3. | Arora, C.P., Refrigeration & Airconditioning, Tat Mc Graw Hill Pub., 2004 |
| 4. | Threlkeld, J.L., Thermal Environmental Engineering, Prentice Hall , 2002 |
| 5. | Ananthanarayanan, P.N, Basic refrigeration & Airconditioning, Tata Mc Graw Hill, 2005 |

**Minor in Mechatronics**

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| **School: School of Engineering and Technology** | | | **Program: B. Tech. Electrical and Electronics Engineering** | | |
| **Course Code: TEC102** | | | **Course Name: Sensor Technology** | | |
| **Year** |  | **Core Subject(Yes/No):** |  | **Lecture:** | **2** |
| **Semester** |  | **Elective Subject(Yes/No):** |  | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** |  | **Practical:** | **0** |
| **Year of Syllabus Revision:** |  | **Total Credit:** | **2** |
| **Year of Introduction** |  | **Prerequisites**  **(If any)** | **NIL** |
| **Course Description**:  To provide basic knowledge in transduction principles, sensors and transducer technology and measurement systems.  To provide better familiarity with the Theoretical and Practical concepts of Transducers.  To provide familiarity with different sensors and their application in real life.  To provide the knowledge of various measurement methods of physical and electrical parameters    Course Outcome (CO):  **CO1:** Identify suitable sensors and transducers for real time applications  **CO2**: Translate theoretical concepts into working models  **CO3**: Design the experimental applications to engineering modules and practices  **CO4**: Design engineering solution to the Industry/Society needs and develop products. | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | Unit-1  **Thermoelectric Sensors:**  Thermocouples, Thermo electric effects, Common thermocouples, Practical thermocouple laws, Cold junction compensation in thermocouples circuits. Resistence temperature detector, thermistor.  **Piezoelectric Sensors:**  **Piezoelectric effect, piezoelectric materials, applications.** | 08 | 1,2, 4 | CO1 |  |
| 2 | **Unit-2**  **Optical Sources and Detectors:**  Electronic and Optical properties of semiconductor as sensors, LED, Semiconductor lasers, Fiber optic sensors, Thermal detectors, Photo multipliers, photoconductive detectors, Photo diodes, Avalanche photodiodes, CCDs. | 07 | 1,2, 4 | CO2 |  |
| 3 | **Unit-3**  **Pressure and Acoustic sensors**  Strain gages, strain gauge beam force sensor, piezoelectric force sensor, load cell, torque sensor, Piezo-resistive and capacitive pressure sensor, optoelectronic pressure sensors, vacuum sensors. Acoustic sensors- microphones-resistive, capacitive, piezoelectric, fiber optic, solid state - electrect microphone. | 06 | 1,2, 4 | CO3 |  |
| 4 | **Unit-4**  **Velocity and Acceleration sensors**  Electromagnetic velocity sensor, Doppler with sound, light, Accelerometer characteristics, capacitive, piezo-resistive, piezoelectric accelerometer, thermal accelerometer, rotor, monolithic and optical gyroscopes. MEMS and NEMS sensors. | 07 | 1,2, 4 | CO4 |  |

**Text Books:**

1. Principles of Industrial Instrumentation – Patranabis D. TMH. End edition 1997
2. 2. D. Patranabis, Sensors and Transducers, PHI Publication, New Delhi

**Reference Books**

1. Measurement Systems – Applications and Design – by Doeblin E.O., 4/e, McGraw Hill International, 1990.
2. J. Fraden, Handbook of Modern Sensors:Physical, Designs, and Applications, AIP Press, Springer

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| **School: School of Engineering and Technology** | | | | **Program: B. Tech. Electrical and Electronics Engineering** | | | | | | |
| **Course Code: EE433** | | | | **Course Name: Analog Circuits and Sensors** | | | | | | |
| **Year** | | **III** | **Core Subject(Yes/No):** | **Yes** | | **Lecture:** | | | **3** | |
| **Semester** | | **VI** | **Elective Subject(Yes/No):** | **No** | | **Tutorial** | | | **0** | |
| **Typology of Course** | | Lectures | **Foundation Subject(Yes/No):** | **No** | | **Practical:** | | | **0** | |
| **Year of Syllabus Revision:** | **NA** | | **Total Credit:** | | | **3** | |
| **Year of Introduction** | **2020** | | **Prerequisites**  **(If any)** | | | **NIL** | |
| **Course Description**:  Study of linear integraterd circuits as Op Amp and 555 timer and application along with the study of CRO , Transducers and Sensors and Different types of Digital Voltmeters.  **Course Objectives:**   1. To make students to know the basic characteristic, construction, mathematical models, open loop & close loop operations of Op-Amp. 2. To enable students to analyze AC, DC circuits and find frequency response of Op-Amp. 3. To develop understanding of different sensors and Transducers. 4. To Understand the working of different instruments like Funtion Generator , DVM and CRO.   **Course Outcome (CO):**  **CO1:** To be able to understand the working and operation of different DVMs and other instruments used frequently in Electronic Laboratories.  **CO2:** Be able to implement the various applications of CRO , besides only using it to observe the output waveforms.  **CO3:** To be able to design circuits using operational amplifiers, 555 Timers and their applications.  **CO4:** To enable students to implement with the desired sensor according to the required application. | | | | | | | | | | |
| **Unit No.** | **Topic/Unit** | | | | **Contact Hours** | | **BT**  **Level** | **CO** | | **PSO** |
| 1 | **Unit-1**  **OSCILLOSCOPES**  Block Diagram of C.R.O (in details). Requirements of Time base, Delayed Time Base, Post deflection acceleration, triggering .Description of Panel Layout and working of controls. Specifications of CRO. Measurement of phase and frequency by Lissajous Patterns, Types: Dual trace, Dual beam, Digital Storage oscilloscope – Block diagram, working, applications and comparison. | | | | 07 | | 1,2, 4 | CO1 | | PSO1, PSO2 |
| 2 | **Unit-2**  **ADC AND DAC**  Flash A/D converter, Half Flash A/D converter, Counter type A/D converter, Single slope A/D converter, Dual Slope A/D converter, Successive Approximation A/D converter, Resistive divider network for D/A conversion, Binary ladder network for D/A conversion, R2R Ladder D/A converter, Inverted R2R Ladder D/A converter | | | | 08 | | 1,2, 4 | CO2 | | PSO1, PSO2, PSO4 |
| 3 | **Unit-3**  **TRANSDUCERS**  Characteristics of Transducers; Requirement of Transducers; Classification of transducers; Selection Criteria of Transducers. Displacement Transducers, Linear Variable Differential Transformer, Capacitance Sensors.Temperature transducers RTD, Thermisters, Thermocouples- Their Ranges, and Applications. Transducers for Pressure, Level and Flow Measurement, Strain Gauge. | | | | 08 | | 1,2, 4 | CO3 | | PSO1, PSO2, PSO4 |
| 4 | **Unit-4**  **OPERATIONAL AMPLIFIERS AND ITS APPLICATIONS**  Operational Amplifiers: Differential amplifier ,block diagram of a typical op amp , characteristics of an ideal op-amp , definitions of CMRR ,slew rate ,input offset voltage, differential input resistance, input voltage range, SVRR ,large signal voltage gain, output voltage swing ,output resistance ,open-loop configurations, closed-loop configurations . Inverting amplifier, Non Inverting Amplifier ,Adder, subtractor, Adder/ SUbtractor, Integrator, Differentiator, Comparators, Schmitt trigger, voltage follower Using Op Amp.  **IC 555**  Introduction to 555 TIMER , Multivibrators: Monostable using IC 555 and Astable using IC 555 | | | | 12 | | 1,2, 4 | CO4 | | PSO1, PSO2, PSO4 |
| 5 | **Unit-5**  Principle Principle of Sensors, Classification and Terminology of Sensors. Active and Passive Sensors.  **Optical Sensors**  Spectral Characteristics of sensors, Autocollimators ,Optical encoders, Fiber optic sensors, Interferometric sensors, Radiationsensors  **Acoustic Sensors**  Fabrication of Acoustic Wave Devices, Acoustic Wave Propagation Modes, bulk acoustic wave (BAW) sensor, surface acoustic wave sensor, Thickness Shear Mode Resonator, Shear-Horizontal Surface Acoustic Wave Sensors, Sensor Applications.  **Mechanical and Electromechanical sensors**  Introduction to NEMS and MEMS sensors, Design of NEMS and MEMS sensors, Principles used for MEMS sensors | | | | 10 | | 1,2, 4 | CO4 | | PSO1, PSO2, PSO4 |

**Text Books:**

1. Sergio Franco, Design with operational amplifiers and analog integrated circuits, 3rdEdition, Tata

McGraw-Hill, 2007.

2. A. K .Sawhney, “Electrical and electronic Measurements and Instrumentation”, Dhanpat Rai & co.,17th

Edition.

3. D. Patranabis ,Sensors and Transducers, 2 edition ,PHI.

**Reference Books:**

1. B.S.Sonde, System design using Integrated Circuits , New Age Pub, 4nd Edition, 2006Gray and

Meyer, Analysis and Design of Analog Integrated Circuits, Wiley International.

2. RamakantA.Gayakwad, OP-AMP and Linear ICs, Prentice Hall / Pearson Education, 6thEdition,

2009.

3. RamakantA.Gayakwad, OP-AMP and Linear ICs, Prentice Hall / Pearson Education, 4th Edition.

4. Modern Electronic and Measurement Techniques : A.D. Helfrick and W.D. Cooper, Pearson Education.

5. William D.Stanley, Operational Amplifiers with Linear Integrated Circuits, Pearson Education, 2008.

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| **School: School of Engineering and Technology** | | | | | **Program: B. Tech. Electrical and Electronics Engineering** | | | | | |
| **Course Code:** | | | | | **Course Name: Analog Circuits and Sensors Laboratory** | | | | | |
| **Year** | | **III** | **Core Subject(Yes/No):** | | **Yes** | | **Lecture:** | | | **0** |
| **Semester** | | **VI** | **Elective Subject(Yes/No):** | | **No** | | **Tutorial** | | | **0** |
| **Mode of Transaction** | | Laboratory | **Foundation Subject(Yes/No):** | | **No** | | **Practical:** | | | **2** |
| **Year of Syllabus Revision:** | | **NA** | | **Total Credit:** | | | **1** |
| **Year of Introduction** | | **2020** | | **Prerequisites**  **(If any)** | | | **NIL** |
| **Course Description:**  Study of circuits using Opamp and 555 timer and application of CRO.  **Course Outcome (CO):**  **CO1**: Students will be able to design circuits using operational amplifiers for various applications  **CO2:** To understand 555 timer Circuits, also will be able to implement the various applications of CRO | | | | | | | | | | |
| **No.** | **Experiment** | | | **Contact Hours** | | **BT**  **Level** | | **CO** | **PSO** | |
| 1 | Design a Digital Phase Meter. | | | 3 | | 3,5,6 | | CO1, CO2 | PSO1, PSO2,PSO4 | |
| 2 | Measurement of frequency by Lissajous Pattern. | | | 3 | | 3,5,6 | | CO1, CO2 | PSO1, PSO2,PSO4 | |
| 3 | To study and verify the adder applications using IC741 operational amplifier. | | | 3 | | 3,5,6 | | CO1, CO2 | PSO1, PSO2,PSO4 | |
| 4 | To study and verify the subtractor applications using IC741 operational amplifier. | | | 3 | | 3,5,6 | | CO1, CO2 | PSO1, PSO2,PSO4 | |
| 5 | To study and verify comparator applications using IC741 operational amplifier. | | | 3 | | 3,5,6 | | CO1, CO2 | PSO1, PSO2,PSO4 | |
| 6 | To study and verify the Integrator applications using IC741 operational amplifier. | | | 3 | | 3,5,6 | | CO1, CO2 | PSO1, PSO2,PSO4 | |
| 7 | To study and verify the Differentiator applications using IC741 operational amplifier. | | | 3 | | 3,5,6 | | CO1, CO2 | PSO1, PSO2,PSO4 | |
| 8 | Design an Inverting and Non Inverting Amplifier using Op Amp. | | | 3 | | 3,5,6 | | CO1, CO2 | PSO1, PSO2,PSO4 | |
| 9 | Design of Astable MUltivibrator using 555 timer. | | | 3 | | 3,5,6 | | CO1, CO2 | PSO1, PSO2,PSO4 | |
| 10 | To Design a Digital Frequency Meter. | | | 3 | | 3,5,6 | | CO1, CO2 | PSO1, PSO2,PSO4 | |
| 11 | Measurement of frequency by Lissajous Pattern. | | | 3 | | 3,5,6 | | CO1, CO2 | PSO1, PSO2,PSO4 | |
| 12 | Measurement of phase by Lissajous Pattern. | | | 3 | | 3,5,6 | | CO1, CO2 | PSO1, PSO2,PSO4 | |

**Reference Books:**

1. B.S.Sonde, System design using Integrated Circuits , New Age Pub, 4nd Edition, 2006Gray and

Meyer, Analysis and Design of Analog Integrated Circuits, Wiley International.

2. RamakantA.Gayakwad, OP-AMP and Linear ICs, Prentice Hall / Pearson Education, 6thEdition,

2009.

3. Modern Electronic and Measurement Techniques : A.D. Helfrick and W.D. Cooper, Pearson Education

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| **School: School of Engineering & Technology** | | | | | | **Program: B.Tech Mechanical** | | | | | | | | | | |
| **Course Code: MEC301** | | | | | | **Course Name: Basic Mechatronics** | | | | | | | | | | |
| **Year** | | | **II** | **Core Subject(Yes/No):** | **Yes** | | | | | **Lecture:** | | | | **2** | | |
| **Semester** | | | **III** | **Elective Subject(Yes/No):** | **No** | | | | | **Tutorial** | | | | **0** | | |
| **Typology of Course** | | | Lectures | **Foundation Subject(Yes/No):** | **Yes** | | | | | **Practical:** | | | | **2** | | |
| **Year of Syllabus Revision:** | **2020** | | | | | **Total Credit:** | | | | **3** | | |
| **Year of Introduction** | **2020** | | | | | **Prerequisites**  **(If any)** | | | | **NA** | | |
| **Course Description:**  To understand and learn about automation and control of systems. The course will introduce basics of Mechatronics and Automation. The course gives understanding of various components of systems Automated using Mechatronics    **Course Objectives:**  The objective of the course is to that at the end of the course students should be able to identify, design and troubleshoot various components of Automated systems.    **Course Outcome (CO):**  CO1To understand concept of Mechatronics and Automation  CO2To understand various components of Mechatronics system  CO3To understand various sensors and its working and principles  CO4 To understand use of Programmable Logic Designs | | | | | | | | | | | | | | | | |
| **Unit No.** | **Topic/Unit** | | | | | | | **Contact Hours** | | | **BT**  **Level** | | **CO** | | | **PSO** |
| 1 | Introduction to Mechatronics: Definition, Mechatronics in manufacturing, products and design. Comparison between Traditional and Mechatronics approach. Design and fabrication of Mechatronics systems, Ball screws, linear motion bearings, transfer systems.  Components of Automation system: Actuators, controllers, sensors | | | | | | | 10 | | | 1,2 | | CO1  CO2 | | | PSO1 |
| 2 | Working, Specification and selection of Transducers. Phototransistor, Potentiometer, Temperature Sensor. Displacement Transducers, Linear Variable Differential Transformer, Capacitance Sensors. Temperature transducers RTD, Thermistors, Thermocouples- Their Ranges, and Applications. Transducers for Pressure, Level and Flow Measurement, Strain Measurement | | | | | | | 10 | | | 2,3 | | CO3 | | | PSO1 |
| 3 | Introduction to PLC, Microprocessor and Microcontroller, microcontrollers, hardware architecture, input/output pins, I/O ports and circuits, on chip ram, general purpose registers, arithmetic and logical instructions, loop and call instructions, concepts of subroutines. Timers-counters, introduction to data communication, ADC/DAC interfacing, speed control of DC motor.  Introduction to various controllers used on field: eg. FAGOR, FANUC, Arduino, etc. | | | | | | | 10 | | | 2, 3, 6 | | CO4 | | | PSO1  PSO2 |
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| **No.** | | **Experiment** | | | | | **Contact Hours** | | **BT**  **Level** | | | **CO** | | | **PSO** | |
| 1 | | Study of Microprocessor and microcontroller | | | | |  | | 1 | | | CO1 | | | PSO1 | |
| 2 | | Prepare a basic electronics circuit | | | | |  | | 2, 3, 6 | | | CO2 | | | PSO2 | |
| 3 | | Programming of any microcontroller such as Arduino/ raspberry Pi, etc | | | | |  | | 2, 3, 6 | | | CO3 | | | PSO3  PSO4 | |

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| **Reference Books** | |
| 1. | Jacob Millman and Christos C. Halkias, Integrated Electronics, Tata McGraw Hill Publication |
| 2. | Floyd, Electronics Devices, Pearson Publication, Seventh edition |
| 3. | Robert Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Ninth Edition |
| 4 | Electronic Devices and Circuit Theory by Robert Boylestad and Louis Nashelsky [Ninth Edition] |
| 5 | A. K. Sawhney, “Electrical and electronic Measurements and Instrumentation”, Dhanpat Rai & co., 17th Edition. |
| 6 | M. Mazidi and others, “The 8051 Microcontroller and Embedded Systems”, PRENTICE Hall Of India, 3rd edition. |

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| **School: School of Engineering & Technology** | | | | | | **Program: B.Tech Mechanical** | | | | | | |
| **Course Code: ME323** | | | | | | **Course Name: Automation and control systems** | | | | | | |
| **Year** | | | **II** | **Core Subject(Yes/No):** | **Yes** | | **Lecture:** | | | **3** | | |
| **Semester** | | | **IV** | **Elective Subject(Yes/No):** | **No** | | **Tutorial** | | | **0** | | |
| **Typology of Course** | | | Lectures | **Foundation Subject(Yes/No):** | **Yes** | | **Practical:** | | | **0** | | |
| **Year of Syllabus Revision:** | **2020** | | **Total Credit:** | | | **3** | | |
| **Year of Introduction** | **2016** | | **Prerequisites**  **(If any)** | | | **ME 223 Basic Mechatronics** | | |
| **Course Description:**  To understand and learn about automation and control of systems. The course will introduce basics of Mechatronics and Automation. The course gives understanding of various components of systems Automated using Mechatronics. Various components include Actuators and control. The course will introduce students to fundamental concepts of Control systems.    **Course Objectives:**  The objective of the course is to that at the end of the course students should be able to identify, design and troubleshoot various Control system components of Automated systems.    **Course Outcome (CO):**  CO1Students will be aware of role, importance and contribution of Mechatronics/Automation in present day manufacturing system  CO2Students will be able to read, and design hydraulic, pneumatic and electrical circuit design used in mechatronic systems  CO3Students will be able to carry out motor sizing/selection for given application  CO4 The student will understand systems and system modelling.  CO5 Students will be able to prepare, simulate and evaluate mathematical model of second order systems using various inputs  CO6 The student will be made aware of current trends of automation in industry.  CO7 The student will be aware of general information regarding present day automated machines | | | | | | | | | | | | |
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| **Unit No.** | **Topic/Unit** | | | | | | | **Contact Hours** | **BT**  **Level** | | **CO** | **PSO** |
| 1 | Introduction to Mechatronics: Definition, Mechatronics in manufacturing, products and design. Comparison between Traditional and Mechatronics approach. Design and fabrication of Mechatronics systems, Ball screws, linear motion bearings, transfer systems.  Components of Automation system: Actuators, controllers, sensors | | | | | | | 4 | 1,2 | | CO1 | PSO1 |
| 2 | **Hydraulic and Pneumatic Actuation Systems:** Overview: pumps, fluids, control valves application and limitations, Pressure Control Valves, Direction Control Valves, Rotary Actuators, Accumulators, Amplifiers, and Pneumatic Sequencing Problems. maintenance of hydraulic systems, Pneumatic systems constructional details, filter, lubricator, regulator, constructional features, types of cylinders, control valves for direction, pressure and flow – air hydraulic equipment, general approach to control system design, symbols and drawings, schematic layout, electro-pneumatic logic circuit, pneumatic counters, relays, application and limitations.  **Electrical Actuation Systems:** Switching Devices, Mechanical Switches **–** SPST,SPDT, DPDT; Relays, Solid State Switches, Diodes, Thyristors, Transistors, Solenoid, Types Devices: Solenoid Operated Hydraulic and Pneumatic Valves, Electro-Pneumatic Sequencing Problems. Control of DC Motors, Permanent Magnet DC Motors, Control of DC Motors, Brushless Permanent Magnet DC Motors, AC Motors, Stepper Motors, Stepper Motor Controls, Servo Motors | | | | | | | 19 | 2,3, 6 | | CO2  CO3 | PSO1 |
| 3 | Introduction to Control Engineering: Definition of control systems, open loop and closed loop systems. Essence of feedback control systems, servomechanism. Brief overview of system representation: impulse response model and transfer function model and block diagram representation.  Mathematical modeling of electrical and physical systems: transfer function and state variable model in particular, overall gain determination using block diagram algebra and signals flow graphs. Concept of stability and the Routh stability criteria. Applications of the Routh Criteria. Concepts of stability, Routh-Hurwitz stability criterion, relative stability. Time and Frequency response analysis,  Proportional control, integral control, derivative control, hydraulic control systems, control valves application and limitations. | | | | | | | 19 | 2, 3, 6 | | CO4  CO5 | PSO1  PSO2 |
|  | History of automation and industrial revolutions (industry 4.0). Introduction to program controlled machine tools. Numerical control and its basics. Axis designation. NC motion control systems: point-to-point, straight-cut and continuous path control systems. Applications of NC in metal-cutting and non-metal cutting areas | | | | | | | 3 | 1, 2,3 | | CO6  CO7 | PSO1  PSO2 |
| **Reference Books** | | | | | | | | | | | | |
|  | | I. J. Nagrath & M.Gopal, “Control Systems Engineering”, New Age International Publishers. | | | | | | | | | | |
|  | | K. Ogata, “Modern Control Engineering” Prentice Hall of India. | | | | | | | | | | |
|  | | W. Bolton, “Mechatronics”, Pearson Education Ltd | | | | | | | | | | |
|  | | Mikell P. Groover, “Automation, Production Systems and Computer-Integrated Manufacturing”, 2nd Edition, Pentice Hall, | | | | | | | | | | |
|  | | Mikell P. Groover, Emory W.Zimmers, “CAD/CAM”, Pearson Education, | | | | | | | | | | |
|  | | P.N. Rao, “CAD/CAM Principles and Applications”, Tata McGraw Hill, | | | | | | | | | | |
|  | | Irvin L. Kosow, “Electric Machinery and Transformers” Prentice Hall of India. | | | | | | | | | | |
|  | | D. Roy Choudhary, “Modern Control Engineering” Prentice Hall of India. | | | | | | | | | | |
|  | | M. Gopal, Control Systems: Principles and Design” Tata McGraw Hill. | | | | | | | | | | |
|  | | Mohammad Ali Mazidi Janice Gillispier Mazidi, “The 8051 Microcontroller”, Pearson Education Inc.,2004. | | | | | | | | | | |
|  | | Gary Dunning, “Introduction to Programmable Logic Controllers”, Thomson Asia P. Ltd., Singapore, 1998. | | | | | | | | | | |
|  | | Gopal K. Dubey, “Fundamentals of Electrical Drives”, Narosa Publishing House, 2001. | | | | | | | | | | |
|  | | Charles H. Roth, “Jr. Fundamentals of Logic Design”, Jaico Publishing House, 2001. | | | | | | | | | | |
|  | | "HMT Mechatronics”, Tata McGraw Hill Publishing Co. Ltd., 2001. | | | | | | | | | | |
|  | | Devdas Shetty, Richard A. Kolk “Mechatronics System Design”, Thomson Asia Pvt. Ltd., Singapore, 2001. | | | | | | | | | | |
|  | | A.K. Tayal, “Instrumentation & Mechanical Measurements”, Galgotia Publication Pvt.Ltd., 2003. | | | | | | | | | | |
|  | | D. Rana Durgaiah, “Fluid Mechanics & Machinery”, New Age Int. Publishers, 2004. | | | | | | | | | | |
|  | | Nitaigour Premchand Mahalik, “Mechatronics Principles, Concepts & Application”, Tata McGraw Hill Publishing Co.Ltd., 2003. | | | | | | | | | | |
|  | | S.K. Sinha, “CNC Programming”, Galgotia Publications 2003. | | | | | | | | | | |
|  | | “HMT Mechatronics”, Tata McGraw Hill, 2001. | | | | | | | | | | |
|  | | B.C. Kuo, “Automatic Control systems.” Wiley India Ltd. | | | | | | | | | | |
|  | | Shetty Devdas and Richard A Kolk, *“Mechatronics System Design”,* Thomson Learning, Vikas Publishing House, New Delhi. | | | | | | | | | | |

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| **School: School of Engineering & Technology** | | | | **Program: B.Tech Mechanical** | | | | | | | |
| **Course Code: MEC403** | | | | **Course Name: Automation and control systems Laboratory** | | | | | | | |
| **Year** | | **II** | **Core Subject(Yes/No):** | | | **Yes** | | **Lecture:** | | | **0** |
| **Semester** | | **IV** | **Elective Subject(Yes/No):** | | | **No** | | **Tutorial** | | | **0** |
| **Typology of Course** | | Laboratory | **Foundation Subject(Yes/No):** | | | **Yes** | | **Practical:** | | | **2** |
| **Year of Syllabus Revision:** | | | **2020** | | **Total Credit:** | | | **1** |
| **Year of Introduction** | | | **2016** | | **Prerequisites**  **(If any)** | | | **ME 223 Basic Mechatronics** |
| **Course Description:** To understand and learn about automation and control of systems. The course will introduce basics of control engineering. The course gives understanding and use of NC/CNC system and do a case study of existing CNC machines    **Course Outcome (CO):**  CO1 To understand modelling of systems  CO2 To understand various actuation systems in control engineering  CO3 Understand and program using LabView  CO4 To program using Ardiuno IDE  CO5 To study and program CNCs | | | | | | | | | | | |
| **No.** | **Experiment** | | | | **Contact Hours** | | **BT**  **Level** | | **CO** | **PSO** | |
| 1 | Fundamentals of control engineering. Servomechanism, basic actuator and transducer used in servomechanism. This can include modeling of a servomotor, both ac and dc. | | | | 3 | | 1 | | CO1 | PSO1 | |
| 2 | Study of various components of Hydraulic control system | | | | 3 | | 2, 3, 4 | | CO2 | PSO1 | |
| 3 | Study of various components of Pneumatic control system | | | | 3 | | 2, 3, 4 | | CO2 | PSO1  PSO2 | |
| 4 | Basics of LabView | | | | 12 | | 1, 2, 3 | | CO3 | PSO1  PSO3 | |
| 5 | Modeling of electromechanical device… may be a dc shunt motor (in machine lab) with speed characteristics of the motor. Transfer function and implementation in LabView. | | | | 6 | | 1,3 | | CO2, CO3 | PSO1  PSO5 | |
| 6 | Study of different types of controllers and introduction of Arduino as controller | | | | 12 | | 1,2,3,6 | | CO4 | PSO1  PSO7 | |
| 7 | Study of CNC machine tool as an Automatic system. | | | | 3 | | 2,3 | | CO5 | PSO1 | |
| 8 | Programming in CNC for job on CNC | | | | 3 | | 2,3,6 | | CO5 | PSO1 | |
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| **Reference Books** | |
|  | J. Nagrath& D. P. Kothari, “Electrical machines” Tata McGraw Hill. |
|  | B.R. Gupta & Vandana Singhal, “Fundamentals of Electrical Machines”, New Age International. |
|  | K. Ogata, “Modern Control Engineering” Prentice Hall of India. |
|  | B.C. Kuo, “Automatic Control systems.” Wiley India Ltd. |
|  | Irvin L. Kosow, “Electric Machinery and Transformers” Prentice Hall of India. |
|  | D. Roy Choudhary, “Modern Control Engineering” Prentice Hall of India. |
|  | M. Gopal, Control Systems: Principles and Design” Tata McGraw Hill. |

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| **School: School of Engineering & Technology** | | | | | **Program: B.Tech Mechanical** | | | | | | |
| **Course Code: CMP104** | | | | | **Course Name: Robotics & Automation** | | | | | | |
| **Year** | | |  | **Core Subject(Yes/No):** | **No** | | **Lecture:** | | | **2** | |
| **Semester** | | |  | **Elective Subject(Yes/No):** | **Yes** | | **Tutorial** | | | **0** | |
| **Typology of Course** | | | Lectures | **Foundation Subject(Yes/No):** | **Yes** | | **Practical:** | | | **0** | |
| **Year of Syllabus Revision:** | **2022** | | **Total Credit:** | | | **2** | |
| **Year of Introduction** | **2022** | | **Prerequisites**  **(If any)** | | | **NA** | |
| **Course Description:**  From banking ATM’s to Fast Tags, to surgery to production to food industry and many such areas; automation and robots occupy a very significant place and play a critical role.  In this course, Robotics is taught through an industrial grade 4 joint articulating arm robot.  Students study its design, its mechanisms, and learn to program & control it through its proprietary software. In Automation, students learn about industry automation, IR 4.0, sensors, controls, data acquisition & communication.  Students get introduced to LabVIEW – a graphical programming language for developing automated systems, data acquisition & analysis  **Course Objectives:**  Create awareness among students about Automation & Robotics  Demystify the complexities surrounding the robot and certain automated systems  Understand & appreciate the design complexities of automated systems  **Course Outcome (CO):**  CO1 Understand the concepts of Automation & Robotics  CO2 Ability to program & operate a robot  CO3 Gain basic understanding of a programming language for automation control  CO4 Hands-on experience in automation & robotics | | | | | | | | | | | |
| **Unit No.** | | **Topic/Unit** | | | | **Contact Hours** | | **BT**  **Level** | **CO** | | **PSO** |
| 1 | | Robotics:  Introduction  Hands-on activities on a robot  Programming of robot  Understanding the geometry & the linear algebra behind robot movements | | | | 10 | |  | CO1  CO2  CO4 | |  |
| 2 | | Industry & Home Automation:  Introduction to IR4.0 & Smart Homes  Basic components used in automation like relays, proximity sensors  Build a simple automation system | | | | 10 | |  | CO1  CO4 | |  |
| 3 | | Introduction to LabVIEW  Introduction and hands-on practice with automatic  Industrial machines  CO2 Laser Cutting machine  CNC Lathe  3D Printer | | | | 10 | |  | CO1  CO3  CO4 | |  |
| **Reference Books** | | | | | | | | | | | |
| 1. | Class notes | | | | | | | | | | |
| 2. | Machine manuals | | | | | | | | | | |

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| **School: School of Engineering and Technology** | | | **Program: B. Tech ME** | | |
| **Course Code: ME 443** | | | **Course Name: Engineering System Design - I** | | |
| **Year** | **IV** | **Core Subject(Yes/No):** | **No** | **Lecture:** | **3** |
| **Semester** | **VII** | **Elective Subject(Yes/No):** | **Yes** | **Tutorial** | **0** |
| **Typology of Course** | Lectures | **Foundation Subject(Yes/No):** | **?** | **Practical:** | **0** |
| **Year of Syllabus Revision:** | **2022** | **Total Credit:** | **3** |
| **Year of Introduction** | **2020** | **Prerequisites**  **(If any)** | **No** |
| **Course Description:** Engineering System Design is the first part of a two-course series. The course is designed around an industrial engineering system. Modern day engineering system is a complex machinery encompassing mechanical parts, automation, electronics & instrumentation, software and hardware. This course breaks down such a complex system to its component level. Each major component is examined & understood in terms of its specification, function, about the manufacturers and vendors and other design related aspects. The engineering system used includes an articulating arm robot and a CNC lathe.    **Course Objectives:**  To showcase the interdisciplinary nature of modern-day machines, and the need for engineers to be aware and resourceful about other areas of engineering. The course also focuses on design principles like design optimization & design for manufacturing. The course also highlights the process of component selection, manufacturers, availability and maintenance.    **Course Outcome (CO):**  CO1 Students become more aware and resourceful about other engineering fields like electronics, electrical,  instrumentation & communication.  CO2 Students learn to read industrial product specification sheets and engineering drawings  CO3 Students get familiar with the formal process of documentation, design & assembly  CO4 Students learn about industrial grade machine components, their availability, about their manufacturers and  vendors | | | | | |

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| **Unit No.** | **Topic/Unit** | **Contact Hours** | **BT**  **Level** | **CO** | **PSO** |
| 1 | **Core**  A contemporary engineering system like the articulating arm robot and CNC lathe is used for the purpose of study at the component level.  Study includes:  Components like motors, drives, power supplies, actuators, sensors, controllers, industrial communication systems. Mechanical components like bearings, joints, couplings, materials & its manufacturing.  Review of engineering drawings and specification sheets of the system and its components.  Discussion on reasons for use of the components, about its manufacturers & vendors | 26 |  | CO 1  CO 2  CO 3  CO 4 | PSO 3  PSO 4 |
| 2 | **Case Studies**  Three different engineering systems are taken up for discussion.  The engineering systems belong to production, test & measurement and material handling & storage respectively | 9 |  | CO 1  CO 2  CO 3  CO 4 | PSO 3  PSO 4 |
| 3 | **Experiential**  Observe, use and experience the working of the robot and the cnc machine. | 6 |  | CO 1  CO 2  CO 3  CO 4 | PSO 3  PSO 4 |
| 4 | In-class discussions and debates  Documentaries | 4 |  | CO 1  CO 4 | PSO 3 |

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| **Reference Material** | |
|  | IGUS robolink DSi Technical Data Sheet  DC Robot User Guide  Pinacho CNC Lathe  Fagor User Manual & Communication Guide  In-class notes |

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| **School: School of Engineering & Technology** | | | | | | **Program: Electrical & Electronics Engineering** | | | | | | | |
| **Course Code: EE328** | | | | | | **Course Name: Internet of Things** | | | | | | | |
| **Year** | | | **III** | **Core Subject(Yes/No):** | **Yes** | | | **Lecture:** | | | **3** | | |
| **Semester** | | | **VI** | **Elective Subject(Yes/No):** | **No** | | | **Tutorial** | | | **0** | | |
| **Typology of Course** | | | Lectures | **Foundation Subject(Yes/No):** | **No** | | | **Practical:** | | | **0** | | |
| **Year of Syllabus Revision:** | **NA** | | | **Total Credit:** | | | **3** | | |
| **Year of Introduction** | **2018** | | | **Prerequisites**  **(If any)** | | | **Introduction to Programming** | | |
| **Course Description:**  Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain verticals ranging from civilian to defence sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IoT. Today it is possible to envision pervasive connectivity, storage, and computation, which, in turn, gives rise to building different IoT solutions. IoT-based applications such as innovative shopping system, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems, are gradually relying on IoT based systems. Therefore, it is very important to learn the fundamentals of this emerging technology.  **Course Objectives:**   1. **Understand the definition and significance of the Internet of Things** 2. **Discuss the architecture, operation, and business benefits of an IoT solution** 3. **Examine the potential business opportunities that IoT can uncover** 4. **Explore the relationship between IoT, cloud computing, and big data** 5. **Identify how IoT differs from traditional data collection systems**   **Course Outcome (CO):**  Student will be able to:  CO1. To understand the Architectural Overview of IoT  CO2. To understand the IoT reference architecture and weal-world Design Constraints  CO3. To design and develop basic IoT based Applications using various IoT Protocols | | | | | | | | | | | | | |
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| **Unit No.** | | **Topic/Unit** | | | | | | | **Contact Hours** | **BT**  **Level** | | **CO** | **PSO** | |
| 1 | | Unit 1 Introduction  IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business  processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management | | | | | | | 9 | 1, 2, 3 | | CO1 | PSO1 | |
| 2 | | Unit 2 IoT Architecture  IoT Architecture-State of the Art – introduction, reference Model and architecture, IoT design Constraints- Introduction, Technical Design constraints-software and hardware constraints, Data representation and visualization, Interaction and remote control. | | | | | | | 9 | 1, 2, 3, 6 | | CO1,  CO2 | PSO1  PSO2 | |
| 3 | | Unit 3 IoT Data link layer and Network Layer Protocols  PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), WirelessHART,Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP | | | | | | | 9 | 1, 2, 3, 6 | | CO2,  CO3 | PSO1  PSO2  PSO4 | |
| 4 | | Unit 4 Transport Layer and Session Layer protocols  Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT | | | | | | | 9 | 1, 2, 3, 6 | | CO3, | PSO3  PSO5 | |
| 5 | | Unit 5 Application Layer protocols and Security in IoT  Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4 , 6LoWPAN architecture, RPL, Application Layer, Security in IoT | | | | | | | 9 | 2, 3, 6 | | CO2,  CO3 | PSO1  PSO5 | |
| **Reference Books** | | | | | | | | | | | | | | |
| 1. | Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1 st Edition, Academic Press, 2014. | | | | | | | | | | | | | |
| 2. | Peter Waher, “Learning Internet of Things”, PACKT publishing, BIRMINGHAM – MUMBAI | | | | | | | | | | | | | |
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