## Department of

## Mechanical Engineering

# CURRICULUM

# Second Year B.Tech. Engineering Program
# With effect from 2025-26

# Institute

## Vision

To be a reputed Technological and Management Institute imparting Quality Education and developing Core Human Values (H3).

(H3): Honest - Humble - Human Being

## Mission

We are committed for Enrichment of the Institute by disseminating the knowledge to achieve academic excellence and develop industry ready technical manpower

# Department

## Vision

To provide quality education in Mechanical Engineering by Lifelong learning and strive to be the best in all respect.

## Mission

To impart total quality education through effective advanced teaching-learning techniques in mechanical engineering along with the development of core human values.

## Program Outcomes (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4).
3. **Design/development of solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5).
4. **Conduct investigations of complex problems:** Conduct investigations of complex engineering problems using research- based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
5. **Modern tool usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6).
6. **The engineer and The world:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
7. **Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9).
8. **Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

9. **Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.
10. **Project management and finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
11. **Life-long learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8).

Department of Mechanical Engineering

## Program Specific Outcomes (PSOs)

Upon successful completion of UG course, the students will attain following Program Specific Outcomes:

1. To solve real life engineering problems related to production, design, thermal and allied industries using engineering tools.
2. To develop the ability for higher education and research in various streams of mechanical engineering.
3. To promote start-up activities and create entrepreneurs.

## B.Tech. Program with one Major and one Minor (175 Credits)
## Semester wise Indicative Credit Distribution

| Semester | | I | II | III | IV | V | VI | VII | VIII | Total Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| Basic Science Course (BSC) | BSC/ESC | 08 | 08 | -- | -- | -- | -- | -- | -- | 16 |
| Engineering Science Course (ESC) | | 06 | 09 | -- | -- | -- | -- | -- | -- | 15 |
| Programme Core Course (PCC) | Programme Courses | 03 | | 15 | 15 | 12 | 11 | 10 | 06 | 72 |
| Programme Elective Course (PEC) | | -- | -- | -- | -- | 03 | 07 | 08 | 03 | 21 |
| Multidisciplinary Minor (MDM) | Multi-disciplinary Courses | -- | -- | 02 | 02 | 03 | 03 | 04 | -- | 14 |
| Open Elective (OE) | | -- | -- | -- | -- | 03 | -- | -- | -- | 03 |
| Vocational and Skill Enhancement Course (VSEC) | Skill Courses | 01 | 02 | -- | -- | -- | -- | -- | -- | 03 |
| Ability Enhancement Course (AEC -01), Modern Indian Language (AEC-02) | Humanities Social Science and Management (HSSM) | 03 | -- | -- | 02 | -- | -- | -- | -- | 05 |
| Entrepreneurship/Economics/ Management Courses (EEM) | | -- | -- | 04 | 03 | -- | -- | -- | -- | 07 |
| Indian Knowledge System (IKS) | | -- | 02 | -- | -- | -- | -- | -- | -- | 02 |
| Value Education Course (VEC) | | -- | -- | -- | -- | -- | 01 | -- | -- | 01 |
| Internship / OJT (Int/OJT) | Experiential Learning Courses (ELC) | -- | -- | -- | -- | -- | -- | -- | 05 | 05 |
| Project (Proj) | | -- | -- | -- | -- | -- | -- | 02 | 06 | 08 |
| Community Engagement Activity (CEA) / Field Project (FP) | | -- | -- | 01 | -- | -- | -- | -- | -- | 01 |
| Co-curricular & Extracurricular Activities (CCA) | Liberal Learning Course (LLC) | 01 | 01 | -- | -- | -- | -- | -- | -- | 02 |
| Total Credits (Major) | | 22 | 22 | 22 | 22 | 21 | 22 | 24 | 20 | 175 |

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# Teaching and Evaluation Scheme

# Program: B. Tech. Mechanical Engineering

Class.: **Second Year, B. Tech.** Semester: **SEM - III** W.E.F.: **2025-2026**

| Sr. No. | Course Code | Course Title | Course Category | Teaching Scheme | | | | Course Credits | Evaluation scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Contact Hrs/wk | | Theory | | | | Practical | | Total |
| | | | | | | | | | CIE | | | ESE | CIE | ESE | |
| | | | | | | | | | CA-I | MSE | CA-II | | | | |
| **01** | 24ME301T | Applied Mathematics | PCC | 03 | -- | -- | 03 | 03 | 15 | 20 | 15 | 50 | -- | -- | 100 |
| **02** | 24ME302T | Applied Thermodynamics | PCC | 03 | -- | -- | 03 | 03 | 15 | 20 | 15 | 50 | -- | -- | 100 |
| **03** | 24ME303T | Strength of Materials | PCC | 03 | -- | -- | 03 | 03 | 15 | 20 | 15 | 50 | -- | -- | 100 |
| **04** | 24ME304T | Material Science and Metallurgy | PCC | 02 | 01 | -- | 03 | 03 | 15 | 20 | 15 | 50 | -- | -- | 100 |
| **05** | 24ME305T | Multidisciplinary Minor-1 | MDM | 02 | -- | -- | 02 | 02 | 15 | 20 | 15 | 50 | -- | -- | 100 |
| **06** | 24UHV306T | Universal Human Values | HSSM | 02 | -- | -- | 02 | 02 | 15 | 20 | 15 | 50 | -- | -- | 100 |
| **07** | 24ME307T | Engineering Economics | EEM | 02 | -- | -- | 02 | 02 | 15 | 20 | 15 | -- | -- | -- | 50 |
| **08** | 24ME308L | Community Connected Project | ELC | -- | -- | 02 | 02 | 01 | -- | -- | -- | -- | 50 | -- | 50 |
| **09** | 24ME302L | Applied Thermodynamics Lab | PCC | -- | -- | 02 | 02 | 01 | -- | -- | -- | -- | 30 | 20* | 50 |
| **10** | 24ME303L | Strength of Materials Lab | PCC | -- | -- | 02 | 02 | 01 | -- | -- | -- | -- | 50 | -- | 50 |
| **11** | 24ME309L | Machine Drawing Lab | PCC | -- | -- | 02 | 02 | 01 | -- | -- | -- | -- | 50 | 50* | 100 |
| **Total** | | | | **17** | **01** | **08** | **26** | **22** | **105** | **140** | **105** | **300** | **180** | **70** | **900** |

**L:** Lecture, **T:**Tutorial, **P:**Practical, **CA-I:** Continuous Assessment-I, **CA-II:** Continuous Assessment-II, **CIE**: Continuous in Semester Evaluation, **ESE**: End Semester Examination

| | BSC/ESC | | Program Courses | | Multidisciplinary Courses | | Skill Courses | Humanities Social Science and Management (HSSM) | | | | Experiential Learning Courses (ELC) | | | Liberal Learning Courses (LLC) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Category** | BSC | ESC | PCC | PEC | MDM | OE | VSEC | AEC-01, AEC-02 | EEM | IKS | VEC | Int/OJT | Proj. | CEA/FP | CCA |
| **Credits** | -- | -- | 15 | -- | 02 | -- | -- | -- | 04 | -- | -- | -- | -- | 01 | -- |
| **Cum. Sum** | **16** | **15** | **18** | **00** | **02** | **00** | **03** | **03** | **04** | **02** | **00** | **00** | **00** | **01** | **02** |

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# Teaching and Evaluation Scheme

## Program: B. Tech. Mechanical Engineering

Class.: **Second Year, B. Tech.** Semester: **SEM - IV** W.E.F.: **2025-2026**

| Sr. No. | Course Code | Course Title | Course Category | Teaching Scheme | | | | Course Credits | Evaluation scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Theory | | | | Practical | | Total |
| | | | | | | | | | CIE | | | ESE | CIE | ESE | |
| | | | | L | T | P | Contact Hrs/wk | | CA-I | MSE | CA-II | | | | |
| **01** | 24ME401T | Fluid Mechanics | PCC | 03 | -- | -- | 03 | 03 | 15 | 20 | 15 | 50 | -- | -- | 100 |
| **02** | 24ME402T | Theory of Machines-I | PCC | 03 | -- | -- | 03 | 03 | 15 | 20 | 15 | 50 | -- | -- | 100 |
| **03** | 24ME403T | Manufacturing Processes-I | PCC | 03 | -- | -- | 03 | 03 | 15 | 20 | 15 | 50 | -- | -- | 100 |
| **04** | 24ME404T | Metrology and Quality Control | PCC | 03 | -- | -- | 03 | 03 | 15 | 20 | 15 | 50 | -- | -- | 100 |
| **05** | 24ME405T | Multidisciplinary Minor-2 | MDM | 02 | -- | -- | 02 | 02 | 15 | 20 | 15 | 50 | -- | -- | 100 |
| **06** | 24COI406T | Constitution of India | HSSM | 02 | -- | -- | 02 | 01 | 25 | -- | 25 | -- | -- | -- | 50 |
| **07** | 24ME407T | Industrial Management and Operation Research | EEM | 02 | -- | -- | 02 | 02 | 15 | 20 | 15 | 50 | -- | -- | 100 |
| **08** | 24ME408T | Sustainable Engineering in Mechanical System | AEC | 02 | -- | -- | 02 | 02 | 15 | 20 | 15 | -- | -- | -- | 50 |
| **09** | 24ME401L | Fluid Mechanics Lab | PCC | -- | -- | 02 | 02 | 01 | -- | -- | -- | -- | 30 | 20** | 50 |
| **10** | 24ME402L | Theory of Machines -I Lab | PCC | -- | -- | 02 | 02 | 01 | -- | -- | -- | -- | 50 | -- | 50 |
| **11** | 24ME403L | Manufacturing Processes- I Lab | PCC | -- | -- | 02 | 02 | 01 | -- | -- | -- | -- | 30 | 70** | 100 |
| **Total** | | | | **20** | | **06** | **26** | **22** | **130** | **140** | **130** | **300** | **110** | **90** | **900** |

**L:**Lecture, **T:**Tutorial, **P:**Practical, **CA-I:** Continuous Assessment-I, **CA-II:** Continuous Assessment-II, **CIE**: Continuous in Semester Evaluation, **ESE**: End Semester Examination

| | BSC/ESC | | Program Courses | | Multidisciplinary Courses | | Skill Courses | Humanities Social Science and Management (HSSM) | | | | Experiential Learning Courses (ELC) | | | Liberal Learning Courses (LLC) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Category** | BSC | ESC | PCC | PEC | MDM | OE | VSEC | AEC-01, AEC-02 | EEM | IKS | VEC | Int/OJT | Proj. | CEA/FP | CCA |
| **Credits** | -- | -- | 15 | -- | 02 | -- | -- | 02 | 03 | -- | -- | -- | -- | -- | -- |
| **Cum. Sum** | **16** | **15** | **33** | **00** | **04** | **00** | **03** | **05** | **07** | **02** | **00** | **00** | **00** | **01** | **02** |

## Multidisciplinary Minor (MDM)

- Students should select any one minor, excluding those offered by their parent department, from the diverse range of minors available.
- Students should complete all courses within their selected minor in order to earn credits.

| MDM Name | Sr. No | Course Code | Course Name | Sem | Offered by Department |
|---|---|---|---|---|---|
| Leadership and Management | 1 | 24CV305T | Management in Engineering | III | Civil Engineering |
| | 2 | 24CV406T | Lean Concept and Management Approach | IV | |
| | 3 | 24CV506T | Disaster Management and Mitigation Techniques | V | |
| | 4 | 24CV506L | Disaster Management and Mitigation Techniques Laboratory | V | |
| | 5 | 24CV606T | Operation Research | VI | |
| | 6 | 24CV606L | Operation Research Laboratory | VI | |
| | 7 | 24CV706T | Sustainable Engineering and Trends | VII | |
| | 8 | 24CV706L | Capstone Project | VII | |
| Artificial Intelligence and Machine Learning | 1 | 24AI305T | Introduction to AIML | III | Computer Science (AIML) Engineering |
| | 2 | 24AI405T | Prompt Engineering | IV | |
| | 3 | 24AI505T | Applied Machine Learning | V | |
| | 4 | 24AI505L | Applied Machine Learning Lab | V | |
| | 5 | 24AI605T | Deep Learning | VI | |
| | 6 | 24AI605L | Deep Learning Lab | VI | |
| | 7 | 24AI705T | Applications of AI | VII | |
| | 8 | 24AI711L | Capstone Project on AI-ML | VII | |
| Data Science | 1 | 24CE305T | Principles of Data Science | III | Computer Science Engineering |
| | 2 | 24CE405T | Mathematics for Data Science | IV | |
| | 3 | 24CE505T | Programming in Data Science | V | |
| | 4 | 24CE505L | Programming in Data Science Lab | V | |
| | 5 | 24CE605T | R Programming for Data Analysis | VI | |
| | 6 | 24CE605L | R Programming for Data Analysis Lab | VI | |
| | 7 | 24CE704T | AI & IOT Data Science applications | VII | |
| | 8 | 24CE711L | Capstone Project on Data Science Application | VII | |
| Industrial Electrical System | 1 | 24EE305T | Renewable Energy and Cogeneration in Industry | III | Electrical Engineering |
| | 2 | 24EE403T | Electrical Vehicle Technology | IV | |
| | 3 | 24EE505T | Electrical Installation System | V | |
| | 4 | 24EE505L | Electrical Installation System Lab | V | |
| | 5 | 24EE605T | Electrical Switchgears and Safety | VI | |
| | 6 | 24EE605L | Electrical Switchgears and Safety Lab | VI | |
| | 7 | 24EE303T | Creative, Innovative and New product Development | VII | |
| | 8 | 24EE303L | Capstone/Mini Project | VII | |
| Communication System | 1 | 24ET304T | Fundamentals of Communication Engineering | III | Electronics & Telecommunication Engineering |
| | 2 | 24ET404T | Optical Communication Network | IV | |
| | 3 | 24ET505T | Wireless & 6G Technology | V | |

| | | | | | |
|---|---|---|---|---|---|
| | 4 | 24ET505L | Wireless & 6G Technology Lab | V | |
| | 5 | 24ET605T | Data Communication & Networking | VI | |
| | 6 | 24ET605L | Data Communication & Networking Lab | VI | |
| | 7 | 24ET703T | Network Simulation & Security | VII | |
| | 8 | 24ET703L | Mini/Capstone Project | VII | |
| IoT and Applications | 1 | 24EC305T | Fundamentals of IoT | III | Electronics & Computer Engineering |
| | 2 | 24EC405T | Sensors and Wireless Sensor Network | IV | |
| | 3 | 24EC505T | Communication Protocol & Networking for IoT tools & Platforms | V | |
| | 4 | 24EC505L | Communication Protocol & Networking for IoT tools & platforms Lab. | V | |
| | 5 | 24EC605T | Security Privacy and Data Management | VI | |
| | 6 | 24EC605L | Security Privacy and Data Management Lab. | VI | |
| | 7 | 24EC705T | Robotics | VII | |
| | 8 | 24EC705L | Capstone Project | VII | |
| Product Design and Development | 1 | 24ME305T | Introduction to Product Design | III | Mechanical Engineering |
| | 2 | 24ME405T | Materials and Manufacturing Processes for Product Design | IV | |
| | 3 | 24ME505T | CAD and Digital Prototyping | V | |
| | 4 | 24ME505L | CAD and Digital Prototyping Lab | V | |
| | 5 | 24ME605T | Product Lifecycle Management | VI | |
| | 6 | 24ME605L | Product Lifecycle Management Lab | VI | |
| | 7 | 24ME706T | Creativity, Innovation and New Product Development | VII | |
| | 8 | 24ME708L | Mini Project (MDM) | VII | |

## Second Year B. Tech (Mechanical Engineering) Semester -III

| Course Code | 24ME301T | | Course Name | Applied Mathematics | | | |
|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | | Evaluation Scheme | | | |
| L | T | Credits | | CA-I | MSE | CA-II | ESE |
| 03 | -- | 03 | | 15 | 20 | 15 | 50 |

**Course Prerequisites:**

1. Sound knowledge of calculus, algebra, trigonometry, and coordinate geometry from first-year level.
2. Familiarity with differentiation, integration, vectors, and matrices as fundamentals for advanced topics.

**Course Objective:**

1. To introduce fundamental concepts of Laplace, Transform & Inverse Laplace transform and its applications.
2. To introduce Partial Differential Equations and its Applications
3. To develop Mathematical skills and enhance thinking power of students.
4. To introduce Mathematics and their applications in engineering fields

**Course Outcome:**

| | |
|---|---|
| CO-1 | Comprehend the fundamental knowledge of the Laplace transforms and its properties for elementary functions. |
| CO-2 | Use Laplace Transform and Inverse Laplace Transform to solve linear differential equations with constant coefficients |
| CO-3 | Understand the Fourier transform and its properties |
| CO-4 | Apply PDEs for solving Engineering problems. |
| CO-5 | Apply numerical methods for differentiation and integration to solve engineering problems. |

## Course Contents

| Unit-I | **Laplace Transform** | Hours: 09 |
|---|---|---|
| Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by tn , scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside unit step function, Dirac delta function. | | |
| Unit-II | **Inverse Laplace Transform** | Hours:09 |
| Introductory remarks; Inverse transforms of some elementary functions; General methods of finding inverse transforms; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients | | |
| Unit-III | **Fourier Transform** | Hours:09 |
| Definitions – integral transforms; Fourier integral theorem (without proof); Fourier sine and cosine integrals; Complex form of Fourier integrals; Fourier sine and cosine transforms; Properties of Fourier transforms; Parseval's identity for Fourier Transforms. | | |
| Unit-IV | **Partial Differential Equations and Their Applications** | Hours:09 |
| Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations | | |

| | | |
|---|---|---|
| solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one-dimensional heat flow equation (∂u ∂t = c 2 ∂ 2u ∂x 2), and one-dimensional wave equation (i.e.∂ 2y ∂t 2 = c 2 ∂ 2y ∂x 2). | | |
| Unit-V | **Numerical Differentiation and Integration** | Hours: 09 |
| Numerical differentiation, methods based on interpolation, Error analysis, numerical integration, methods based on interpolation, Newton cotes methods, Error estimates for trapezoidal and Simpson's rule. | | |
| Text Books: | | |
| 1. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.<br>2. A course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.<br>3. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.<br>4. "A Text Book of Applied Mathematics", P. N. and J. N. Wartikar, Vol I and II", Vidyarthi Griha Prakashan, Pune, 2006.<br>5. "Introductory Methods of Numerical Analysis", S.S. Sastry, 3rd edition, Prentice Hall of India, 1999. | | |
| Reference Books: | | |
| 1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.<br>2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pvt. Ltd. Singapor<br>3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.<br>4. "Advanced Engineering Mathematics", Wylie C.R, Tata McGraw Hill Publication, 8th Edition, 1999.<br>5. "Fundamentals of Mathematical Statistics", Gupta and Kapoor, S. Chand & Sons Publishers, 10th Edition, 2000.<br>6. "Numerical methods for scientific and Engineering Computation", M. K. Jain, S. R. K. Iyengar, R. K. Jain, New Age International Limited Publishers. | | |
| MOOCs Course (Course name and Weblink) / Supplementary Readings / Videos: | | |
| 1. https://ocw.mit.edu/courses/2-087-engineering-math-differential-equations-and-linear-algebra-fall-2014/<br>2. https://alison.com/course/diploma-in-mathematics-for-engineering | | |

| Course Code | 24ME302T | Course Name | Applied Thermodynamics | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | | | |
| L | T | Credits | CA-I | MSE | CA-II | ESE |
| 03 | -- | 03 | 15 | 20 | 15 | 50 |

**Course Prerequisites:**

1. Basic knowledge of Engineering Thermodynamics, including laws of thermodynamics, pure substances, and properties of gases/steam.
2. Familiarity with mathematics (calculus, differential equations), physics (heat, work, energy), and fluid mechanics fundamentals

**Course Objective:**

1. To learn about energy interaction in a system and energy balance between system and surrounding.
2. To learn about the application of first law to various energy conversion devices.
3. To understand properties of a pure substance and evaluate the performance of vapour power cycle
4. To understand the working of various Gas Power cycles.

**Course Outcome:**

| | |
|---|---|
| CO-1 | Understand concepts of energy transformation, basic concepts, fundamental laws and principles. |
| CO-2 | Understand the properties of pure substance and evaluate Rankine vapour power cycle by using steam table. |
| CO-3 | Evaluate condenser performance through concepts like vacuum efficiency and condenser efficiency and estimate cooling water requirements. |
| CO-4 | Analyse nozzle performance concepts of maximum discharge and design of throat and exit area. |
| CO-5 | Analyse flow through steam turbine blades using velocity diagrams and calculate work done and efficiencies. |

## Course Contents

| Unit-I | **Basic Concepts of Thermodynamics** | Hours:08 |
|---|---|---|
| Introduction, thermodynamic system, control volume, thermodynamic property, state and process, zeroth law, temperature scales, various thermometers, first law, its limitations, second law of thermodynamics, kelvin- plank and clausius statements, statement of third law of thermodynamics, corollaries of second law, numerical treatment on second law of thermodynamics (Heat engine, Refrigerator and Heat pump). Introduction of Entropy, calculation of entropy changes in gases (Numerical Treatment) | | |
| Unit-II | **Pure Substances and Vapour Power Cycles** | Hours:09 |
| Pure substances, ideal and real gases, formation of steam, properties of steam, use of steam table and mollier chart, p-v, t-s, and Mollier diagram for steam, Carnot cycle, limitations of Carnot cycle, Rankine cycle, p-v, T-s and h-s diagram. Thermal efficiency, specific steam consumption. Work ratio, effect of superheat, boiler and condenser pressure on the performance of Rankine cycle (numerical treatment). | | |
| Unit-III | **Steam Condensers** | Hours:07 |
| Steam condenser, Functions, Elements of condensing plant, types of steam condenser, surface and Jet condenser, comparison, vacuum efficiency, condenser efficiency, source of air leakages, methods of leak detection, estimation of cooling water required (Numerical Treatment). | | |

| Unit-IV | **Steam Nozzles** | Hours:09 |
|---|---|---|
| Functions, shapes, Critical pressure ratio, Maximum discharge condition, Effect of friction, Design of throat and exit areas, Nozzle efficiency, Velocity coefficient, coefficient of discharge, Supersaturated flow, Degree of Under-cooling and Degree of supersaturation, Effects of super saturation (Numerical Treatment without friction). | | |
| Unit-V | **Steam Turbines** | Hours:09 |
| Principles of operation, Classification, Impulse and Reaction steam turbine, Compounding of steam, turbines Comparison between Impulse and Reaction Turbine. Flow through Impulse Turbine blades, Velocity diagrams flow through impulse reaction blades, velocity diagram, degree of reaction and parson's reaction turbine, losses in steam turbines numerical (Treatment on single stage turbine). | | |
| Text Books: | | |
| 1. "Thermal Engineering" Kumar and Vasandani, D. S. Publisher Metrpolitan Book Co. Delhi 3 rd Edition<br>2. "Thermal Engineering" Ballaney P. L Khanna Publishers New Delhi 27th Edition<br>3. "Engineering Thermodynamics", P. K. Nag, Tata Mcgraw Hill, New Delhi, 4th Edition<br>4. "Thermal Engineering" R. K. Rajput, Laxmi Publishers 3rd Edition<br>5. "Steam and Gas Turbines", R. Yadav, CPH Allahabad, 2nd Edition 2005 | | |
| Reference Books: | | |
| 1. Y. A. Cengel & M. A. Boles, Thermodynamics and Engineering approach 8 th Edition McGrawHill Education (India) Pvt. Ltd New Delhi 2016<br>2. R. E. Sonntag, C. Borgnakke & G. J. Van wylen, Fundamentals of Thermodynamics 6th Ed John Wiley2003 3 T. D. Eastop &amp<br>3. McConkey, Applied Thermodynamics, 5th Ed, Pearson Education Ltd, New Delhi, 2014 | | |
| MOOCs Course (Course name and Weblink) / Supplementary Readings / Videos: | | |
| 1. https://www.classcentral.com/course/swayam-applied-thermodynamics<br>2. https://alison.com/course/advanced-diploma-in-engineering-thermodynamics | | |

| Course Code | 24ME303T | Course Name | Strength of Materials | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | | | |
| L | T | Credits | CA-I | MSE | CA-II | ESE |
| 03 | -- | 03 | 15 | 20 | 15 | 50 |

**Course Prerequisites:**

1. Knowledge of Basic Mechanical Engineering
2. Knowledge of applied mechanics

**Course Objective:**

1. To develop understanding of the basic concepts related to tensile, compressive and shear
2. Stresses in engineering components and basic knowledge of principal stresses and strains.
3. To discuss the basic principles of torsion in shafts, shear force and bending moment in beams, deflection in beams, buckling in mechanical elements.
4. To enable the students to calculate distribution of bending stresses and shear stresses in mechanical components of various cross sections.

**Course Outcome:**

| | |
|---|---|
| CO-1 | Define different types of stresses and strains induced in any machine component due to various loading conditions. |
| CO-2 | Interpret the nature of internal stresses that will develop within the mechanical components for different types of loading. |
| CO-3 | Utilize mathematics and basic engineering principle-to evaluate stress, strain torque, buckling load, slope and deflection. |
| CO-4 | Examine the effect of different loading conditions in various machine elements such as simple machine components, beams, shafts, columns. |
| CO-5 | Apply and construct graphical solutions for given loading conditions structure. |

## Course Contents

| Unit-I | **Stresses and Strains** | Hours:07 |
|---|---|---|
| Concept of Stress and Strain, (Linear, Lateral, Shear and Volumetric), Hook's Law, Poisson's ratio, Stress-strain diagram for ductile and brittle material, Factor of safety, Elastic constants and Inter-relationship between elastic constants, Stresses, stains and deformation in composite bars, Thermal Stresses.) | | |
| Unit-II | **Principal Stresses and Strains** | Hours:09 |
| Normal and shear stresses on any oblique planes, Concept of Principal planes, Derivation of expression for Principal stresses and maximum shear stress ,Positions of principal planes and planes of maximum shear, Graphica lsolutions using Mohr'scircle of stresses. | | |
| Unit-III | **Shear Force and Bending Moment Diagram** | Hours:09 |
| Concept and definition of shear force and bending moment in determinate beams (Simply supported, cantilever and overhanging) due to concentrated load, UDL, UVL | | |
| Unit-IV | **Bending Stresses in Beams** | Hours:08 |
| Symmetric pure bending of beams, flexure formula, moment of resistance of cross-sections, Design of rectangular, circular (solid and hollow) sections, I and T sections.<br>**Shear Stresses in Beams**<br>Distribution of shear stresses in beams of various commonly used sections such as rectangular, circular, I and T. (Only numerical) | | |

| Unit-V | **Torsion** | Hours:08 |
|---|---|---|

Introduction to Torsion, Basic assumptions, Torsion equation, Stresses in hollow and solid circular shafts, power transmitted by shaft.

**Columns**

Euler's formula & assumptions; assumptions, Euler's formula for different end connections, Concept of equivalent length, limitations of Euler's formula.

Text Books:

1. Strength of Materials, S. Ramamruthum, Dhanpat Rai and Sons, New Delhi.
2. Strength of Materials R. K. Bansal, Laxmi Publication, 4th Edition.
3. Strength of Materials, Khurmi Gupta, S. Chand Publication.
4. Mechanics of structure, S.B Junnerkar, Charotar Publication House.
5. Strength of Materials S. S. Bhavikatti, Vikas Publication House.

Reference Books:

1. Strength of Materials, Beer and Johnson, CBS Publication.
2. Strength of Materials, G.H. Rider,Mac Millan India Ltd.
3. Strength of Materials, Nag and Chanda, Willey India Publication.
4. Advanced Mechanics of Materials, Boresi, Willey India Publication.
5. Strength of Materials, Den Hartong, McGraw Hill Publication.

MOOCs Course (Course name and Weblink) / Supplementary Readings / Videos:

1. https://nptel.ac.in/courses/112/107/112107146/
2. https://nptel.ac.in/courses/112/106/112106141

| Course Code | 24ME304T | Course Name | Material Science and Metallurgy | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | | | |
| L | T | Credits | CA-I | MSE | CA-II | ESE |
| 02 | 01 | 03 | 15 | 20 | 15 | 50 |

**Course Prerequisites:**

1. Basic Mechanical Engineering
2. Engineering Physics
3. Engineering Chemistry

**Course Objective:**

1. Provide students and understanding of basics structure, crystal arrangement of materials and the phase diagrams.
2. Study the different methods of heat treatment processes and advantages of heat treatment for different steel components.
3. Introduce the fundamental theory of powder metallurgy processes.

**Course Outcome:**

| | |
|---|---|
| CO-1 | Visualize the fundamental structure of materials and understand different material defects. |
| CO-2 | Explain nucleation and grain growth and draw Iron-Iron carbide equilibrium diagram. |
| CO-3 | Explain various destructive and non-destructive testing techniques. |
| CO-4 | Compare the heat treatment processes used in mechanical components. |
| CO-5 | Discuss the various stages of techniques used in manufacturing of powder metallurgy components |

## Course Contents

| Unit-I | **Introduction to Metals and Alloy Systems** | Hours: 08 |
|---|---|---|

Introduction to metallic and non-metallic materials and its classification (metals/alloys, polymers, and composites)

a. Metals, Metallic bonds, Crystal structure (SC, BCC, FCC, HCP)
b. Alloy formation by crystallization, nucleation and growth, cooling curves, Dendritic structure and Coring.
c. Solid solutions and intermediate phases.
d. Phases and Gibbs phase rule.
e. Construction of equilibrium diagrams from cooling curves, isomorphous system (Solid Solution), Eutectic, partial solubility, Peritectic and intermetallic compounds, Lever arm principles.

| Unit-II | **Study of Phase Diagram** | Hours: 09 |
|---|---|---|

With respect to typical compositions, properties and applications for the following alloys, (Fe-Fe3C equilibrium diagram- ferrous alloys) (plane Carbon Steels, cast iron) Alloy Steels – free cutting Steels, HSLA high carbon low alloy Steels, maraging steels, creep resisting steels, stainless steels- different types,Tool steels types, selection of materials and specifications based on-IS, BS,SAE,AISI, Copper basedalloys brasses Cu-Sn, Cu-Be, Cu-Ni, aluminium based alloys Al-Cu (Duralumin) - Al-Si (modification)Pb-Sn(Solders and fusible alloys.

| Unit-III | **Principles of Mechanical Testing** | Hours: 09 |
|---|---|---|

Destructive testing methods; Tensile, Compressive, Impact, fatigue, Creep, hardness(Rockwell, Brinell) Non-Destructive testing; Dye penetrant test, Magnetic particle test, Sonic and Ultrasonic

| | | |
|---|---|---|
| test,Radiography test, Eddy-Current testing. | | |
| Unit-IV | **Heat Treatment Processes** | Hours:08 |
| Transformation of austenite into Pearlite, Bainite and Martensite on cooling. TTT & CCT Diagram<br>A. Heat treatment of Steels.<br>B. Normalizing-purpose<br>C. Hardening- (Hardening Types) purposes, Austempering and Martempering Mechanism of quenching and quenching media, hardenability- concept and methods of determination of hardenability- Grossmans critical diameter method.<br>D. Tempering- Types, structural transformations during tempering, purposes subzero treatment.<br>E. Surface Hardening- flame and Induction Chemical heat treatments for case hardening-Carburising, Nitriding, Cyniding, Carbonitriding. Heat treatment defects and remedies. | | |
| Unit-V | **Powder Metallurgy** | Hours: 07 |
| Advantages, Limitations and Applications of Powder Metallurgy. Powder manufacturing types- Mechanical, Physical, Chemical, and electro-chemical Mixing/ Blending Compaction Types- conventional, powder rolling and extrusion Sintering-Types liquid stage and solid stage sintering | | |
| Text Books: | | |
| 1. S. H. Avner, introduction to physical metallurgy", Mc-Graw Hill book company,2ndEdition1974.<br>2. Vijendra Singh, "physical metallurgy", Standard Publishers New Delhi.<br>3. Material Science-An introduction by William D. Callister Jr. and David G. Rathish Wiley, 10th Edition2010.<br>4. V. D. Kodgire, "Material Science & Metallurgy for Engineers", Everest Publishers Pune, 12thEdition.<br>5. T. V. Rajan/C. P. Sharma, "Heat Treatments Principles and Practices," Prentice Hall of India, NewDelhi<br>6. V. Raghwan, "Material Science & Metallurgy." Prentice Hall of India, New Delhi 3rdEdition 1995 | | |
| Reference Books: | | |
| 1. V. Raghwan, "Material Science & Metallurgy." 5 th Edition Prentice Hall of India<br>2. W. Callister "Material Science & Metallurgy." Jhon Wiley & Sons<br>3. R. A. Higgins "Engineering Metallurgy" Viva Books Pvt. Ltd. New Delhi 1 st Edition<br>4. Foundation of "Material Science & Metallurgy." By William F. Smith, Mc-GrawHill 3rdEdition 2004<br>5. Elements of Material Science & Metallurgy by H. Van Vlack, Addison-Wesley, 5 thEdition 2006 | | |
| MOOCs Course (Course name and Weblink) / Supplementary Readings / Videos: | | |
| 1. https://gate.nptel.ac.in/video.php?branchID=6&cid=1<br>2. https://www.coursera.org/courses?query=material+science<br>3. https://www.iitb.ac.in/mems/en/academics/courses | | |

| Course Code | 24ME305T | Course Name | Introduction to Product Design | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | | | |
| L | T | Credits | CA-I | MSE | CA-II | ESE |
| 02 | -- | 02 | 15 | 20 | 15 | 50 |

**Course Prerequisites:**

1. Basic understanding of engineering graphics, sketching, and technical drawing.
2. Familiarity with materials, manufacturing processes, and their properties

**Course Objective:**

1. To understand the principles of product design and their application in real-world scenarios.
2. To develop proficiency in using various tools and techniques for conceptualizing and prototyping products.
3. To cultivate critical thinking and problem-solving skills essential for successful product design.
4. To explore the relationship between design, technology, and user experience.
5. To gain insights into the ethical, environmental, and social implications of product design.

**Course Outcome:**

| | |
|---|---|
| CO-1 | Demonstrate an understanding of the fundamental principles and processes of product design, including its historical context and interdisciplinary nature. |
| CO-2 | Utilize various ideation techniques to generate creative concepts and ideas, and evaluate and select concepts based on predefined criteria. |
| CO-3 | Demonstrate proficiency in using different prototyping materials and methods, including rapid prototyping technologies, to create physical prototypes of products. |
| CO-4 | Apply design thinking methodology to analyze complex problems, generate innovative solutions, and iterate through multiple design cycles to refine solutions. |
| CO-5 | Recognize and discuss ethical considerations, environmental impact, and social responsibility issues related to product design and development. |

## Course Contents

| Unit-I | **Introduction to Product Design** | Hours:06 |
|---|---|---|
| Characteristics of Successful Product Development, Who Designs and Develops Products? Duration and Cost of Product Development, The Challenges of Product Development.<br>**Development Processes and Organizations**<br>The Product Development Process,basics of design thinking, concept Development: The Front-End Process, Adapting the Generic Product Development Process. | | |
| Unit-II | **Opportunity Identification** | Hours:05 |
| What Is an Opportunity, Tournament Structure of Opportunity Identification, Opportunity Identification Process. | | |
| Unit-III | **Product Planning and Identifying Customer Needs** | Hours:07 |
| The Product Planning Process, Four Types of Product Development Projects and The Process. The Importance of Latent Needs, The Process of Identifying Customer Needs. | | |
| Unit-IV | **Product Specifications and Concept Testing** | Hours:05 |
| What Are Specifications? When Are Specifications Established? Establishing Target, Specifications. Purpose of the Concept Test, Survey Population, Survey Format, Measure Customer Response. | | |
| Unit-V | **Concept Generation and Concept Selection** | Hours:06 |
| The Activity of Concept Generation, What Is Industrial Design? Assessing the Need for Industrial | | |

| |
|---|
| Design, Concept Selection Is an Integral Part of the Product Development Process, All Teams Use Some Method for Choosing a Concept, A Structured Method Offers Several Benefits. |
| Text Books: |
| 1. Introduction to Product Design and Development for Engineers by Dr. Ali Jamnia<br>2. Product Design and Development (7th Edition) by Karl Ulrich, Steven Eppinger, and Maria C. Yang<br>3. The Fundamentals of Product Design by Richard Morris |
| Reference Books: |
| 1. Product Design and Development by Karl T. Ulrich \| Steven D. Eppinger, McGraw-Hill Education<br>2. Materials Science and Engineering by WILLIAM D. CALLISTER, JR and DAVID G. RETHWISCH |
| MOOCs Course (Course name and Weblink) / Supplementary Readings / Videos: |
| 1. https://supercharge.design/products/introduction-to-product-design<br>2. https://www.uxdatabase.io/free-product-design-course |

| Course Code | 24UHV306T | Course Name | Universal Human Values | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | | | |
| L | T | Credits | CA-I | MSE | CA-II | ESE |
| 02 | -- | 02 | 15 | 20 | 15 | 50 |

**Course Prerequisites:**

1. Basic communication skills for discussions, group activities, and sharing perspectives.
2. General awareness of self, family, and community to connect concepts with real-life situations.

**Course Objective:**

1. To help students understand themselves better (their aspirations, happiness, and purpose in life).
2. To enable students to identify and appreciate universal human values that forms the basis for a meaningful life and harmonious society.
3. To develop sensitivity towards family, friends, peers, and society by recognizing the importance of trust, respect, and care.
4. To instill the understanding of living in harmony with nature, society, and the larger world, promoting sustainable development.

**Course Outcome:**

| | |
|---|---|
| CO-1 | Help the students appreciate the essential complementarily between 'VALUES' and' SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings. |
| CO-2 | Facilitate the development of a Holistic perspective among students towards life and profession |
| CO-3 | Highlight the possible implications of Holistic understanding in terms of ethical human conduct, trustful mutually fulfilling human behaviour. |
| CO-4 | Explain and appreciate the harmony in nature by realizing interconnectedness, co-existence, and holistic perception of all levels of existence. |
| CO-5 | Apply holistic understanding of human values to develop ethical conduct, professional competence, and strategies for a value-based life and profession. |

## Course Contents

| Unit-I | **Introduction to Value Education** | Hours: 07 |
|---|---|---|
| -Understanding Value Education<br>- Self-exploration as the Process for Value Education<br>- Continuous Happiness and Prosperity -the Basic Human Aspirations<br>- Right Understanding, Relationship and Physical Facility<br>- Happiness and Prosperity<br>-Current Scenario - Method to Fulfil the Basic Human Aspirations | | |
| Unit-II | **Harmony in the Human Being** | Hours:06 |
| - Understanding Human being as the Co-existence of the Self and the Body<br>- Distinguishing between the Needs of the Self and the Body<br>- The Body as an Instrument of the Self - Understanding Harmony in the Self<br>- Harmony of the Self with the Body<br>- Programme to Ensure self-regulation and Health | | |
| Unit-III | **Harmony in the Family and Society** | Hours: 05 |
| - Harmony in the Family – the Basic Unit of Human Interaction | | |

| | | |
|---|---|---|
| - Values in Human-to-Human Relationship<br>- 'Trust' – the Foundational Value in Relationship<br>- 'Respect' – as the Right Evaluation<br>- Understanding Harmony in the Society<br>- Vision for the Universal Human Order | | |
| Unit-IV | **Harmony in the Nature (Existence)** | Hours: 05 |
| - Understanding Harmony in the Nature<br>- Interconnectedness, self-regulation, and Mutual Fulfilment among the Four Orders of Nature<br>- Realizing Existence as Co-existence at All Levels<br>- The Holistic Perception of Harmony in Existence | | |
| Unit-V | **Implications of the Holistic Understanding – a Look at Professional Ethics** | Hours: 06 |
| - Natural Acceptance of Human Values<br>- Definitiveness of (Ethical) Human Conduct<br>- A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order<br>- Competence in Professional Ethics<br>- Holistic Technologies, Production Systems and Management Models-Typical Case Studies<br>- Strategies for Transition towards Value-based Life and Profession | | |
| Text Books: | | |
| 1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, GPBagaria,2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1<br>2. "Teachers Manual for A Foundation Course in Human Values and Professional Ethics", R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN978-93-87034-53-2 | | |
| Reference Books: | | |
| 1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.<br>2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.<br>3. The Story of Stuff (Book).<br>4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi<br>5. Small is Beautiful - E. F Schumacher.<br>6. Slow is Beautiful - Cecile Andrews<br>7. Economy of Permanence - J C Kumarappa<br>8. Bharat Mein Angreji Raj – Pandit Sunderlal<br>9. Rediscovering India - by Dharampal<br>10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi<br>11. India Wins Freedom - Maulana Abdul Kalam Azad<br>12. Vivekananda - Romain Rolland (English)<br>13. Gandhi - Romain Rolland (English). | | |
| MOOCs Course (Course name and Weblink) / Supplementary Readings / Videos: | | |
| 1. https://nptel.ac.in/courses/109104068<br>2. https://alison.com/course/global-justice-and-human-rights-a-comprehensive-framework | | |

| Course Code | 24ME307T | Course Name | Engineering Economics | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | | | |
| L | T | Credits | CA-I | MSE | CA-II | ESE |
| 02 | -- | 02 | 15 | 20 | 15 | -- |

**Course Prerequisites:**

1. Basic Knowledge of Economics and Mathematics

**Course Objective:**

1. Acquaint with basic concepts of economics.
2. Educate students about various cost elements of manufactured product or service.
3. Understand the concepts of time value of money and equivalence.
4. Explore different methods for evaluating engineering projects.
5. Acquire basic knowledge of replacement study considering inflation

**Course Outcome:**

| | |
|---|---|
| CO-1 | Relate basic concepts of economics to real life |
| CO-2 | Classify different cost elements of manufactured product or service |
| CO-3 | Utilize the concepts of time value of money and equivalence in economic decision making |
| CO-4 | Identify appropriate method to evaluate an engineering project. |
| CO-5 | Make use of replacement study considering inflation to make decisions |

## Course Contents

| Unit-I | **Introduction** | Hours: 06 |
|---|---|---|
| Introduction to Engineering Economy-Flow in an economy, Law of supply and demand, Definition and Role of Engineering Economics Economic decision-making process, Importance of Ethics in Engineering Economy. | | |
| Unit-II | **Elements of Costs** | Hours:06 |
| Fixed, Variable, Marginal, and Average Costs. Sunk costs, Opportunity costs, Recurring and non-recurring costs, Incremental Costs. Cost estimating. Estimating models. Criteria for make or buy,. Approaches for make or buy decision. Concept of depreciation and methods of depreciation. | | |
| Unit-III | **Interest and Equivalence** | Hours: 05 |
| Time value of money- simple and compound interest, repaying a debt. Cash flow diagram, Concept of equivalence. | | |
| Unit-IV | **Evaluation of Engineering Projects** | Hours: 06 |
| Present worth method, Future worth method, Annual worth method, Internal rate of return method | | |
| Unit-V | **Replacement and Break Even Analysis** | Hours: 06 |
| Basics of replacement study, determining economic service life, Performing replacement study. Breakeven Analysis for a Single Project and two alternatives. Payback analysis. | | |

Text Books:

1. R. Paneerselvam, "Engineering Economics", PHI Learning Private Ltd., 2010
2. William G. Sullivan, Elin M.Wicks, & C. Patrick Koelling., "Engineering Economy",Pearson Higher Education Inc., 2015.

Reference Books:

1. Leland Blank, Anthony Tarquin, "Engineering Economy",McGraw Hill,2012.
2. Chan S. Park, "Contemporary Engineering Economics", Pearson Prentice Hall, 2018

3. Donald G. Newman, Ted G. Eschenbach,& Jerome P. Lavelle, "Engineering Economic Analysis", Oxford University Press, Inc.,2012.

MOOCs Course (Course name and Weblink) / Supplementary Readings / Videos:

1. https://engineering.purdue.edu/online/courses/engineering-economic-analysis
2. https://online.stanford.edu/courses/cee146s-engineering-economics-and-sustainability

| Course Code | 24ME308L | Course Name | Community Connected Project | |
|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | |
| P | Credits | | CIE | ESE |
| 02 | 01 | | 50 | -- |

**Course Prerequisites:**

1. Basic communication and interpersonal skills to interact with community members effectively.
2. Fundamental knowledge of social issues and local context to identify community needs.
3. Ability to apply engineering/science concepts for simple problem-solving and project execution.

**Course Objective:**

1. Gain a thorough understanding of community engagement principles and ethics, with a focus on local dynamics and rural culture.
2. Assess the role of NGOs and self-help groups in promoting rural development and their contribution to community improvement.
3. Exhibit the ability to communicate effectively and work collaboratively with community members, local authorities, and other stakeholders to achieve common goals.

**Course Outcome:**

| | |
|---|---|
| CO-1 | Understand community engagement concepts. |
| CO-2 | Identify community issues, needs, problems, strength, resources and recognize the value of rural development. |
| CO-3 | Understand how NGOs and self-help groups contribute to rural development. |
| CO-4 | Demonstrate the ability to communicate effectively and collaborate with others. |

## Course Contents

1. Duration: The internship program spans 02 hours per week of immersive learning and training.
2. Group Size: Students will participate in group of 5 to 6 promoting teamwork and collaborative learning
3. Permission: Prior to beginning the internship, students must obtain permission from the NGO to ensure a structured and organized experience.
4. Report Submission: At the conclusion of the internship, students are required to submit a detailed report in a standard format to their department. This report will reflect their learning experiences, insights and contributions during the internship.
5. Internship Report Structure:
   A. Introduction: Brief overview of the internship Experience. Objectives and purpose of the internship.
   B. Organization Structure: Description of the NGOs structure. Key departments and their functions.
   C. Role of the Students in the Organization: Specific tasks and responsibilities undertaken. Contribution made by the students during the internship.
   D. Suggestions and Recommendations: Insights on how the NGO could improve its operations. Recommendations based on the student's observations and experiences.
   E. Conclusion: Summary of the internship experience. Reflection on the learning outcomes and their applicability to future endeavours.

6. Course Assessment: The assessment of the NGO Internship Program will be based on the following components:

   A. Internship Performance (40%): Evaluation by the faculty supervisor on tasks performed, engagement level and overall contribution. Feedback on teamwork, initiative, and adherence to ethical practices.

   B. Internship Report (40%): Quality and thoroughness of the report, including all required sections (Introduction, Organizational Structure, Role of Students, Suggestions and Recommendations, Conclusion). Clarity, coherence, and reflection on the learning outcomes.

   C. Presentation (20%): Oral presentation of the internship experience and findings to the department. Ability to articulate experiences, insights and recommendations.

| Course Code | 24ME302L | Course Name | Applied Thermodynamics Lab | |
|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | |
| P | Credits | | CIE | ESE |
| 02 | 01 | | 30 | 20* |

**Course Prerequisites:**

1. Knowledge of Basic Mechanical Engineering
2. Knowledge of applied mechanics

**Course Objective:**

1. Learn about the detailed construction working of steam power plant
2. Learn about different types of boilers, mountings, and accessories.
3. Learn about different types of steam condensers and cooling tower.

**Course Outcome:**

| | |
|---|---|
| CO-1 | Understand the construction and working of steam power plant. |
| CO-2 | Understand the construction, working and classification of different types of steam boilers |
| CO-3 | Understand the use and functioning of boiler mountings used in steam power plant |
| CO-4 | Understand the use and functioning of boiler accessories used in steam power plant |
| CO-5 | Analyse and evaluate heat balance sheet of steam power plant. |

## Course Contents

| Exp. No. | Experiment Title | CO |
|---|---|---|
| 1 | Study of steam power plant | 1 |
| 2 | Study and Demonstration of water tube and fire tube boilers | 2 |
| 3 | Study and Demonstration of boiler mountings | 3 |
| 4 | Study and Demonstration of boiler accessories | 4 |
| 5 | Study and demonstration of steam condenser and cooling Towers used in steam power plant | 4 |
| 6 | Heat balance sheet of steam power plant | 4 |
| 7 | Industrial visit to steam generating unit co-generation plant | 1 |

| Course Code | 24ME303L | Course Name | Strength of Materials Lab | |
|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | |
| P | Credits | | CIE | ESE |
| 02 | 01 | | 50 | -- |

**Course Prerequisites:**

1. Knowledge of Basic Mechanical Engineering
2. Knowledge of applied mechanics

**Course Objective:**

1. Apply the basic concepts related to tensile, compressive and shear stresses in engineering components and evaluate the stress- strain
2. Calculate force and bending moment in beams, deflection in beams, buckling in columns using fundamental equations.
3. Estimate distribution of bending stresses and shear stresses

**Course Outcome:**

| | |
|---|---|
| CO-1 | Understand the concept of stresses and strains. |
| CO-2 | Draw shear force and bending moment diagram under different loading conditions. |
| CO-3 | Determine torque, bending stresses, shear stresses and principle stresses in beams. |
| CO-4 | Evaluate deflection in beams and buckling load in column due to application of different loading. |

## Course Contents

| Exp. No. | Experiment Title | CO |
|---|---|---|
| 1 | Tension test on ferrous and non-ferrous alloys(mild steel/cast iron/aluminium,etc) | 1 |
| 2 | Compression test on mild steel/ concrete/wood | 1 |
| 3 | Shear test on mild steel/aluminium(Single and double shear tests) | 1 |
| 4 | Flexure test on timber and cast iron beams. | 3 |
| 5 | Assignment on torsion and column. | 4 |

| Course Code | 24ME309L | Course Name | Machine Drawing Lab | |
|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | |
| P | Credits | | CIE | ESE |
| 02 | 01 | | 50 | 50* |

**Course Prerequisites:**

1. Knowledge of Engineering Graphics: Orthographic projections, isometric views, dimensioning, and conventions.
2. Basic understanding of Machine Components: Fasteners, joints, bearings, shafts, keys, couplings, etc.
3. Familiarity with Drawing Standards: BIS/SP:46 codes, symbols, and sectional views.

**Course Objective:**

1. To study and identify BIS conventions used in machine drawing.
2. To develop an ability to create constrained 2 D Sketches and 3 D modelling.

**Course Outcome:**

| | |
|---|---|
| CO-1 | Prepare standard representations and sketches of components, joints, symbols, surface finish, limits, fits, and tolerances on a full imperial drawing sheet. |
| CO-2 | Develop assembly and detailed drawings of standard machine components (e.g., valves, pumps, machine tool parts, engine parts) using conventional drawing practices. |
| CO-3 | Create orthographic projections in AutoCAD of simple machine components with proper dimensioning and detailing. |
| CO-4 | Generate a 3-D model of a simple machine component using CAD tools to visualize geometry and design features. |

## Course Contents

| Exp. No. | Experiment Title | CO |
|---|---|---|
| 1 | One full imperial drawing sheet consisting the drawing/sketches of representation of standard components, symbols of pipe joints, weld joints, rivet joint etc., surface finish symbols and grades, limit, fit and tolerance sketches. | 1 |
| 2 | Two full imperial drawing sheets, one consisting of assembly and the other consisting of details of any one standard component such as valves, components of various machine tools, pumps, joints, engine parts, etc. | 2 |
| 3 | Two assignments of AutoCAD: Orthographic Projections of any one simple machine component such as bracket, Bearing Housing or Cast component for Engineers such as connecting rod, Piston, etc.; with dimensioning and detailing of three views of components. | 3 |
| 4 | 3-D model at least one simple machine component. | 4 |

## Second Year B. Tech (Mechanical Engineering) Semester -IV

| Course Code | 24ME401T | Course Name | Fluid mechanics | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | | | |
| L | T | Credits | CA-I | MSE | CA-II | ESE |
| 03 | -- | 03 | 15 | 20 | 15 | 50 |

**Course Prerequisites:**

1. Knowledge of differentiation, integration, ordinary differential equations, and basic vector calculus.
2. Ability to solve linear and nonlinear equations used in fluid flow analysis.
3. Basic understanding of mechanics, pressure, forces, and properties of matter.
4. Concept of density, viscosity, elasticity, surface tension, and buoyancy.

**Course Objective:**

1. Introduce fundamental aspects of fluid properties, Fluid flow behaviour and develop energy balance equation for fluid flow system.
2. Apply the fundamental equations on such as continuity equation Bernoulli's equation and Momentum equation analyse its characteristics.
3. Understand the fuel flow in Pipe and determine the different head losses in pipe.
4. Study the concept of boundary layer developed in the fluid flow over the surface.

**Course Outcome:**

| | |
|---|---|
| CO-1 | Understand concepts of energy transformation, basic concepts, fundamental laws and principles. |
| CO-2 | Understand the properties of pure substance and evaluate Rankine vapour power cycle by using steam table. |
| CO-3 | Evaluate condenser performance through concepts like vacuum efficiency and condenser efficiency and estimate cooling water requirements. |
| CO-4 | Analyse nozzle performance concepts of maximum discharge and design of throat and exit area. |
| CO-5 | Analyse flow through steam turbine blades using velocity diagrams and calculate work done and efficiencies. |

## Course Contents

| Unit-I | **Fluid properties and fluid statics** | Hours: 09 |
|---|---|---|

A. Fluid Properties: Definition of fluid, various Properties of fluid, Types of fluids
B. Fluid Statics: Pascal's law, Hydrostatic law of pressure, Total Pressure, Centre of Pressure, Buoyancy, Metacentre, Condition of Equilibrium of floating and submerged bodies (No Numerical Treatment on fluid Statics)

| Unit-II | **Fluid kinematics and dynamics** | Hours: 08 |
|---|---|---|

A. Fluid Kinematics: Eulerian and Langragian approach of fluid flow, Types of flow, Stream line, Streak line, Path line, concept of Velocity potential & stream function, flow net (no numerical treatment), Continuity equation
B. Fluid Dynamics: Euler's equation, Bernoulli's equation along a streamline for incompressible flow, Practical applications of Bernoulli's equation - Pitot tube, Venturi meter, Orifice meter

| Unit-III | **Momentum equation and laminar flow** | Hours: 07 |
|---|---|---|

A. Momentum equation: Applications of momentum equation, Definition of kinetic energy correction

| | | |
|---|---|---|
| factor, definition of momentum correction factor, analysis of fluid flow through pipe bends (no numerical treatments)<br>B. Laminar flow: flow through circular pipes and derivation of Hagen Poiseuille's equation laminar flow through parallel plates | | |
| Unit-IV | **Fluid flow through pipes** | Hours: 09 |
| Losses due to Friction: Darcy's Weisbatch equation and Chezy's equation, minor losses due to expansion, contraction, pipe fitting, at entrance, at exit, Obstruction etc. Flow through Series pipe, Parallel pipes, Branching pipes and equivalent pipes | | |
| Unit-V | **Boundary layer theory and forces on immersed body** | Hours: 08 |
| A. Boundary Layer Theory: Boundary thickness, Layer thickness, its characteristics, Laminar and turbulent boundary layers, displacement thickness, Momentum thickness, Energy thickness, boundary layer separation and control (No numerical treatment)<br>B. Forces on immersed bodies: Lift and Drag, Drag on a Flat plate and on aerofoil, Types of drags, Condition of aerofoil. | | |
| Text Books: | | |
| 1. Fluid mechanics, R. K. Bansal, lakshmi Publications, New Delhi, 1998.<br>2. Fluid mechanics and Hydraulics machinery, R. K. Bansal, Lakshmi Publishers.<br>3. Introduction to fluid mechanics and fluid machines, S K Som, Gautam Biswas, Suman Chakraborty. Tata Mc-Graw Hill publication, 3rd Edition 2012.<br>4. Hydraulics and fluid mechanics including Hydraulic Machines, Dr. P. N. Modi and Dr. S.M. Seth, standard book house. | | |
| Reference Books: | | |
| 1.Fluid Mechanics - fundamentals and application, Y A Cengal, J. M. Cimbala, TMI<br>2.Fluid Mechanics - K. L. Kumar, S. Chand publication, New Delhi, 2nd Edition 2000.<br>3.Fluid mechanics - V. L. Streeter and E. B. Wylie, Tata Mc-Graw Hill Pvt. Ltd. New Delhi, 2nd Edition 1997 | | |
| MOOCs Course (Course name and Weblink) / Supplementary Readings / Videos: | | |
| 1. https://alison.com/course/introduction-to-physics-fluid-statics-and-dynamics<br>2. https://ocw.mit.edu/search/?t=Fluid+Mechanics | | |

| Course Code | 24ME402T | Course Name | Theory of machines-I | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | | | |
| L | T | Credits | CA-I | MSE | CA-II | ESE |
| 03 | -- | 03 | 15 | 20 | 15 | 50 |

**Course Prerequisites:**

1. Basic knowledge of Engineering Mechanics (force, moment, equilibrium, friction).
2. Understanding of Engineering Graphics and simple mechanical sketches.
3. Fundamentals of Mathematics (differentiation, integration, trigonometry) and simple machines.

**Course Objective:**

1. Provide the students with basic knowledge of mechanism and its application in mechanical engineering including power transmitting devices.
2. Explain types of Cams with Followers and select according to their applications.
3. Introduce working principle and construction of governors as well as comparing different types of governing mechanisms.
4. Study the fundamental theory of friction and its analysis in different Mechanisms and machines.

**Course Outcome:**

| | |
|---|---|
| CO-1 | List different types of mechanisms and their applications in mechanical engineering. |
| CO-2 | Describe and apply kinematic theories of mechanism to plot velocity and acceleration diagrams of links used in machines. |
| CO-3 | Select and design an appropriate mechanism for given proposed machine by considering various parameters like friction. |
| CO-4 | Apply knowledge of cam to draw the cam profile with follower for different applications. |
| CO-5 | Evaluate suitability of given governing mechanisms based on speed control parameter analysis |

## Course Contents

| Unit-I | **Basic concept of mechanisms** | Hours: 08 |
|---|---|---|
| Links, kinematic pair (lower and higher), Kinematic chain, Mechanism, inversion, Types of constraints, Grubbler's criterion, Inversions of slider crank chain, Double slider crank chain, four bar, Steering gear mechanisms, Hooke's joint (only theoretical treatment). | | |
| Unit-II | **Velocity and acceleration in mechanisms** | Hours: 09 |
| Graphical analysis of Velocity and acceleration for different mechanisms using relative velocity and acceleration method, Klein's construction for slider crank mechanism, Velocity analysis by Instantaneous center method. | | |
| Unit-III | **Friction** | Hours: 08 |
| Introduction to friction, Friction in pivot bearings, Inclined plane theory, Friction in screws | | |
| Unit-IV | **Cams** | Hours: 07 |
| Cams Types of cams and followers, Profiles of cams for specified motion of different followers, Spring load on the follower, Jumping of follower. | | |
| Unit-V | **Governors** | Hours: 09 |
| Types of governors, Porter and Hartnell governor, Controlling force and stability of governor, Hunting, Sensitivity, Isochronism's, Governor effort and power, Insensitiveness of governors | | |
| Text Books: | | |
| 1. Theory of Machines, Ratan S.S, Tatu McGraw Hill New Delhi, 2nd Edition. | | |

| |
|---|
| 2. Theory of Machines, P.L.Ballany, Khanna Publication, New Delhi, 2nd Edition<br>3. Theory of Machines, V.P. Singh, Dhanpat Rai and Sons |
| Reference Books: |
| 1. Theory of Machines and Mechanism, Shigley, McGraw Hill, New York<br>2. Theory of Machines, Abdullah Shariff, McGraw Hill, New Delhi.<br>3. Theory of Machines, Thomas Bevan, CBS Publisher |
| MOOCs Course (Course name and Weblink) / Supplementary Readings / Videos: |
| 1. https://www.magicmarks.in/product/theory-of-machines-i/<br>2. https://www.classcentral.com/course/swayam-theory-of-machines-ii-10053 |

| Course Code | 24ME403T | Course Name | Manufacturing Processes-I | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | | | |
| L | T | Credits | CA-I | MSE | CA-II | ESE |
| 03 | -- | 03 | 15 | 20 | 15 | 50 |

**Course Prerequisites:**

1. Basic knowledge of materials, their structure, and properties.
2. Types of engineering materials: metals, polymers, ceramics, and composites.
3. Mechanical properties like hardness, toughness, ductility, brittleness.
4. Understanding of physical changes (melting, solidification, heat treatment).

**Course Objective:**

1. To understand different methods of Moulding and Casting.
2. To study different types of forming processes
3. To learn various plastic shaping processes and welding processes.
4. To understand theories of lathe, drilling and boring machine, shaping, milling and gear manufacturing process & Non-conventional Machining.

**Course Outcome:**

| | |
|---|---|
| CO-1 | Explain the construction & working of various machine tools used in Manufacturing processes. |
| CO-2 | Describe various metal casting, metal cutting, metal forming & metal joining processes |
| CO-3 | Apply the fundamental theory of machining processes to calculate Machining time and Metal removal rate. |
| CO-4 | Summarize various Gear manufacturing processes and select the appropriate process as per the requirement. |
| CO-5 | Illustrate the principles and applications of Non-traditional machining (NTM) processes |

## Course Contents

| unit-i | **Casting Processes** | Hours: 09 |
|---|---|---|

Importance of casting as manufacturing process, advantages and limitations of casting processes, introduction and types of patterns and core boxes, materials used and selection criteria for patterns, pattern allowances, Types of sands used in moulding and core making, their properties. Sand moulding types such as green sand Moulding, shell Moulding, CO Moulding, Investment casting. Components of gating system, functions and importance of runners and risers, solidification control devices: chills, ceramics. Introduction to permanent mould casting processes such as Continuous casting, Gravity die casting, pressure die-casting, Centrifugal casting, Cupola furnace, Induction and Arc Furnace, casting defects.

| Unit-II | **Forming Processes** | Hours: 08 |
|---|---|---|

Introduction - Hot, cold and worm working, Classification of various metal Forming processes.
a) Rolling: Introduction, Hot and cold rolling, Rolling Mill Classification, Defects in rolling.
b) Forging: Introduction, Forging Machines (board Hammer, Air and Steam, Hydraulic Hammer), Open and Closed die Forging, Defects in forging.
c) Extrusion: Introduction, Direct, Indirect, Tube, Impact and Hydraulic Extrusion, Defects in extrusion.

| Unit-III | **Machine Tools for Metal Cutting-I** | Hours: 07 |
|---|---|---|

a) Lathe: Introduction, Working principle, types, specifications, principle parts, accessories, attachments, and various lathe operations.

| | | |
|---|---|---|
| b) Drilling Machines: Classification of drilling machines, Construction and working of radial drilling machine, various accessories, and various operations.<br>c) Boring Machines: Introduction to boring machines, Types of boring machine, different operations. | | |
| Unit-IV | **Machine Tools For Metal Cutting -II** | Hours: 07 |
| a) Milling Machine: Types- Horizontal, Vertical milling machines, Milling cutters, construction and working of column and knee type, milling operations, simple and compound indexing.<br>b) Shaping & Planning Machine: Construction & working of shaper and Planer machine, Comparison between planer and shaper machine<br>c) Gear Manufacturing processes: Study of various processes like gear shaping gear hobbing, Gear finishing processes-Gear shaving, Gear burnishing and gear rolling. | | |
| Unit-V | **Non-Conventional Machining** | Hours: 08 |
| Fundamental principle, machining unit, tool material, advantages, limitations and applications of Abrasive Jet Machining, Electrical Discharge machining. Electro Chemical machining, Laser beam machining. Ultrasonic machining, Water jet machining. | | |
| Text Books: | | |
| 1. Manufacturing Technology- Foundry, Forming and Welding, Vol. I P. N. Rao, Tata McGraw-Hill, New Delhi,3rd edition, 2009.<br>2. A Textbook of Production Technology (Manufacturing Processes) , P.C. Sharma, S. Chand and Company Pvt. Ltd, New Delhi.7Edition,2010.<br>3. Workshop Technology vol. II, B.S. Raghuvanshi, Dhanapat Rai Publications Pvt. Ltd, New Delhi.10 Edition, 2000.<br>4. Workshop Technology vol. II, B.S. Raghuvanshi, Dhanapat Rai Publications Pvt. Ltd Viva Books Pvt. Ltd, NewDelhi, l Edition,2001.<br>5. Elements of Workshop Technology vol. II, S.K.Hajra Choudhury and A.K. Hajra Choudhury. Media promoters and Publishers Pvt.Ltd, NewDelhi,13Edition,2012.<br>6. Production technology, R. K. Jain, Khanna Publishers, Delhi, 15th Edition,2000. | | |
| Reference Books: | | |
| 1. Principles of metal casting, Haineand Rosenthal, Tata McGraw-Hill Book, Company. New Delhi.<br>2. Workshop Technology; W.A.J.Chapman, CBS Publishing and Distributors, N.DelhiVol.I [ISBN]13: 9788123904016]2001, Vol.II [9788123904115] 2007 and Vol.III [9788123904122] 1995.<br>3. Machine Tools and Manufacturing Technology, Steve F. Krar, Mario Rapisarda,Albert F. | | |
| MOOCs Course (Course name and Weblink) / Supplementary Readings / Videos: | | |
| 1. https://onlinecourses.nptel.ac.in/noc22_me28/preview?utm<br>2. https://msvs-dei.vlabs.ac.in/mem103/memHome.html | | |

| Course Code | 24ME404T | Course Name | Metrology and Quality Control | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | | | |
| L | T | Credits | CA-I | MSE | CA-II | ESE |
| 03 | -- | 03 | 15 | 20 | 15 | 50 |

**Course Prerequisites:**

1. Fundamentals of measurements, units, and accuracy.
2. Concepts of light, optics, and material properties relevant to instruments.
3. Understanding of error analysis, averages, and tolerances.
4. Importance of dimensional accuracy in components.
5. Ability to read and interpret dimensions, tolerances, and geometric features.
6. Understanding of limits, fits, and surface finish symbols.

**Course Objective:**

1. To understand the fundamentals of measurement standards, traceability, and types of errors in engineering metrology.
2. To develop knowledge of linear, angular, and surface measurement techniques using traditional and advanced instruments.
3. To apply principles of limits, fits, tolerances, and gauge design in mechanical inspection and manufacturing processes.
4. To explore metrology techniques for threads, gears, and recent advancements such as CMMs and laser-based systems.

**Course Outcome:**

| | |
|---|---|
| CO-1 | Identify techniques to minimize the errors in measurement |
| CO-2 | Identify methods and devices for measurement of length, angle, and gear and thread parameters, surface roughness and geometric features of parts. |
| CO-3 | Choose limits for plug and ring gauges. |
| CO-4 | Explain methods of measurement in modern machineries |
| CO-5 | Select quality control techniques and its applications |

## Course Contents

| Unit-I | **Measurement Standard and Comparators** | Hours: 07 |
|---|---|---|
| Measurement Standard, Principles of Engineering Metrology, Line end, wavelength, Traceability of Standards. Types and Sources of error, Alignment, slip gauges and gauge block, Linear and Angular Measurement (Sine bar, Sine center, Autocollimator, Angle Décor and Dividing head), Calibration. Comparator: Mechanical, Pneumatic, Optical, Electronic (Inductive), Electrical LVDT). | | |
| Unit-II | **Interferometry and Limits, Fits, Tolerances** | Hours: 07 |
| Principle, NPL Interferometer, Flatness measuring of slip gauges, Parallelism, Laser Interferometer, Surface Finish Measurement: Surface Texture, Measuring Surface Finish by Stylus probe, Tomlinson and Talysurf, Analysis of Surface Traces: Methods. Design of Gauges: Types of Gauges, Limits, Fits, Tolerance; Terminology for limits and Fits. Indian Standard (IS 919-1963) Taylor‟s Principle. | | |
| Unit-III | **Metrology of Screw Thread** | Hours: 07 |
| Gear Metrology: Gear Error, Gear Measurement, Gear Tooth Vernier; Profile Projector, Tool Marker's Microscope. Advancements In Metrology: Co-Ordinate Measuring Machine, Universal Measuring Machine, Laser In Metrology. | | |
| Unit-IV | **Introduction to Quality and Quality Tools** | Hours: 07 |

| | | |
|---|---|---|
| Quality Statements, Cost of Quality and Value of Quality, Quality of Design, Quality of Conformance, Quality of Performance, Seven Quality Tools: Check sheet, Flow chart, Pareto analysis, cause and effect diagram, scatter diagram, Brain storming, Quality circles. | | |
| Unit-V | **Total Quality Management and Statistical Quality Control** | Hours: 08 |
| Quality Function Deployment, 5S, Kaizan, Kanban, JIT, Poka yoke, TPM, FMECA, FTA, Zero defects. Statistical Quality Control: statistical concept, Frequency diagram, Concept of Variance analysis, Control chart for variable & attribute, Process Capability. Acceptance Sampling: Sampling Inspection, sampling methods. Introduction to ISO 9000: Definition and aims of standardizations, Techniques of standardization, Codification system | | |
| Text Books: | | |
| 1. C. Gupta, "Engineering Metrology", Dhanpat and Rai Publications, New Delhi, India.<br>2. M. S. Mahajan."Statistical Quality Control", Dhanpat and Rai Publications.) , P.C. Sharma, S. Chand and Company Pvt. Ltd, New Delhi.7Edition,2010. | | |
| Reference Books: | | |
| 1. R. K. Jain, "Engineering Metrology", Khanna Publications, 17th edition, 1975.<br>2. K. J. Hume, "Engineering Metrology", McDonald Publications, 1st edition, 1950.<br>3. A. W. Judge, "Engineering Precision Measurements", Chapman and Hall, London, 1957.<br>4. K. L. Narayana, "Engineering Metrology", Scitech Publications, 2nd edition.<br>5. J. F. Galyer, C. R. Shotbolt, "Metrology for Engineers", Little-hampton Book Services Ltd., 5th edition, 1969.<br>6. V. A. Kulkarni, A. K. Bewoor, "Metrology & Measurements", Tata McGraw Hill Co. Ltd., 1st edition, 2009.<br>7. AmitavaMitra, "Fundamental of Quality Control and Improvement", Wiley Publication.<br>8. V. A. Kulkarni, A. K. Bewoor, "Quality Control", Wiley India Publication, 01st August, 2009. | | |
| MOOCs Course (Course name and Weblink) / Supplementary Readings / Videos: | | |
| 1. https://alison.com/course/introduction-to-quality-control<br>2. https://alison.com/course/basics-of-meteorology | | |

| Course Code | 24ME405T | Course Name | Materials and Manufacturing Processes for Product Design | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | | | |
| L | T | Credits | CA-I | MSE | CA-II | ESE |
| 02 | -- | 02 | 15 | 20 | 15 | 50 |

**Course Prerequisites:**

1. Knowledge of thermal, electrical, and mechanical properties of materials.
2. Ability to read and create technical drawings.

**Course Objective:**

1. To familiarize students with the properties and behaviour of engineering materials used in product design.
2. To provide an overview of various manufacturing processes and their applications in producing functional components.
3. To understand the relationship between material properties, manufacturing processes, and product performance.
4. To develop skills in material selection based on design requirements and performance criteria.

**Course Outcome:**

| | |
|---|---|
| CO-1 | Demonstrate a comprehensive understanding of the properties, characteristics, and behaviour of engineering materials commonly used in product design, including metals, polymers, ceramics, and composites. |
| CO-2 | Analyze mechanical properties such as stress, strain, hardness, and impact resistance, and correlate them with material selection and performance in product design applications. |
| CO-3 | Explain the principles, capabilities, and limitations of various manufacturing processes. |
| CO-4 | Apply material selection methodologies and criteria to choose suitable materials for specific design applications. |
| CO-5 | To understand various types of joining process |

## Course Contents

| | | |
|---|---|---|
| Unit-I | **Introduction to Materials for Product Design** | Hours: 06 |
| Overview of engineering materials: metals, polymers, ceramics, composites,smart materials, material properties and their significance in product design Material selection criteria and methodologies. | | |
| Unit-II | **Mechanical Properties of Materials** | Hours: 05 |
| Stress, strain, and mechanical behaviour of materials Tensile testing, hardness testing, and impact testing Factors influencing mechanical properties: microstructure, temperature, and processing | | |
| Unit-III | **Manufacturing Processes Overview** | Hours: 07 |
| Classification of manufacturing processes: casting, forming, machining, joining, additive, manufacturing, Introduction to process parameters, capabilities, and limitations. Selection of manufacturing processes based on design requirements. | | |
| Unit-IV | **Forming Process and Machining Process** | Hours: 05 |
| Sheet metal forming, forging, extrusion, stamping Process fundamentals and applications, Material flow, deformation characteristics, and tooling design. Turning, milling, drilling, grinding, Cutting tool geometry, machining parameters, and surface finish, Computer Numerical Control (CNC) machining and programming. | | |
| Unit-V | **Joining Processes and Additive Manufacturing and Rapid Prototyping** | Hours: 06 |

Welding, brazing, soldering, adhesive bonding, Process principles, joint design considerations, and applications, on-destructive testing techniques for weld quality assessment. Principles of additive manufacturing (3D printing) Various additive manufacturing techniques: FDM, SLA, SLS, etc. Rapid prototyping applications and case studies.

Text Books:

1. Manufacturing Technology- Foundry, Forming and Welding, Vol. I P. N. Rao, Tata McGraw-Hill, New Delhi,3rd edition, 2009.
2. A Textbook of Production Technology (Manufacturing Processes) , P.C. Sharma, S. Chand and Company Pvt. Ltd, New Delhi.7Edition,2010.
3. Elements of Workshop Technology vol. II, S.K.Hajra Choudhury and A.K. Hajra Choudhury. Media promoters and Publishers Pvt.Ltd, NewDelhi,13Edition,2012.
4. Production technology, R. K. Jain, Khanna Publishers, Delhi, 15th Edition,2000.

Reference Books:

1. Manufacturing Engineering and Technology" by Serope Kalpakjian and Steven Schmid.
2. Manufacturing Processes for Engineering Materials by by Serope Kalpakjian Steven R. Schmid Publisher Pearson Education.
3. Manufacturing Engineering and Technology by by Serope Kalpakjian (Author), Steven R. Schmid, Publisher Pearson Education
4. "Engineering Materials 1: An Introduction to Properties, Applications, and Design" by Michael F. Ashby and David R. H. Jones

MOOCs Course (Course name and Weblink) / Supplementary Readings / Videos:

1. https://www.classcentral.com/course/swayam-product-design-and-manufacturing-10068
2. https://www.udemy.com/course/introduction-to-manufacturing-processes/

| Course Code | 24COI406T | Course Name | Constitution of India | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | | | |
| L | T | Credits | CA-I | MSE | CA-II | ESE |
| 02 | -- | 01 | 25 | 00 | 25 | 00 |

**Course Prerequisites:**

1. Basic understanding of Indian history, independence movement, and social structure.
2. Familiarity with concepts of government, democracy, rights, and duties.
3. Ability to read, understands, and interprets official/legal language in simple form.

**Course Objective:**

1. A basic understanding of Constitution of India.
2. Builds the ability to apply the knowledge gained from the course to current social legal issues.
3. Ability to understand and solve the contemporary challenges.
4. Understanding constitutional remedies.

**Course Outcome:**

| | |
|---|---|
| CO-1 | Explain the significance of Indian Constitution as the fundamental law of the land |
| CO-2 | Exercise his fundamental rights in proper sense at the same time Identifies his responsibilities in national building. |
| CO-3 | Analyse the Indian political system, the powers and functions of the Union, State and Local Governments in detail |
| CO-4 | Understand Electoral Process, Emergency provisions and Amendment procedure. |

## Course Contents

| | | |
|---|---|---|
| Unit-I | **Constitution – Structure and Principles** | Hours: 03 |
| 1.1: Meaning and importance of Constitution<br>1.2: Making of Indian Constitution – Sources<br>1.3: Salient features of Indian Constitution | | |
| Unit-II | **Fundamental Rights and Directive Principles** | Hours: 10 |
| 2.1: Fundamental Rights & Fundamental Duties<br>2.2: Directive Principles of State Policy | | |
| Unit-III | **Union Government and Executive** | Hours: 03 |
| 3.1: President of India – Qualification, Powers and Impeachment<br>3.2: Lok Sabha & Rajya Sabha Sabha- Composition, Powers & Functions, Scope to | | |
| Unit-IV | **State Government and Executive** | Hours: 03 |
| 4.1: Governor – Qualification, Appointment, Powers & Functions<br>4.2: Legislative Assembly & Legislative Council – Composition, Powers & Functions | | |
| Unit-V | **The Judiciary** | Hours: 04 |
| 5.1: Features of Judicial System in India<br>5.2: Hierarchy of Courts, Composition and Jurisdiction<br>5.3 73rd and 74th Constitutional Amendments<br>5.4 Public Service Commission, Election Commission, CAG, National Commissions for SC, ST etc. | | |
| Text Books: | | |
| 1. M.P. Jain, Indian Constitutional Law<br>2. M.P. Singh (ed.), V.N. Shukla, Constitutional Law of India<br>3. D.D. Basu, Commentary on the Constitution of India | | |

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|---|
| 4. S.S. Desai, Constitutional Law--I & II |
| Reference Books: |
| 1. Durga Das Basu, Introduction to the Constitution of India, Gurgaon; LexisNexis, 2018 (23rd edn.)<br>2. J.N. Pandey, The Constitutional Law of India, Allahabad; Central Law Agency, 2018 (55th edn.)<br>3. Shripad Shridhar Desai, Constitutional Law--I, S.S. Law Publication, 2021<br>4. Shripad Shridhar Desai, Constitutional Law --II, S.S. Law Publication, 2021<br>6. Durga Das Basu, Bharatada Samvidhana Parichaya, Gurgaon; LexisNexis Butterworths Wadhwa, 2015 |
| MOOCs Course (Course name and Weblink) / Supplementary Readings / Videos: |
| 1. https://legalaffairs.gov.in/samvidhan-diwas<br>2. https://english.mathrubhumi.com/education/news/know-your-constitution-course |

| Course Code | 24ME407T | Course Name | Industrial Management and Operation Research | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | | | |
| L | T | Credits | CA-I | MSE | CA-II | ESE |
| 02 | -- | 02 | 15 | 20 | 15 | 50 |

**Course Prerequisites:**

1. Useful for productivity, cost, and financial calculations.
2. Understanding of demand, supply, cost, and value.
3. Probability distributions and basic statistical decision-making
4. Useful for solving OR problems computationally.

**Course Objective:**

1. State various functions of management
2. Know Production and marketing functional area of management.

**Course Outcome:**

| | |
|---|---|
| CO-1 | Apply the concepts of Industrial management and operations research approaches. Know various functional areas of management. |
| CO-2 | They will analyse issues in Managing operations and projects and various approaches to resolve those issues. |
| CO-3 | They will Study MIS, Entrepreneurship Development |
| CO-4 | Formulate and solve a wide variety of applications and problems that can be addressed using Operations Research techniques as Linear programming problems. |
| CO-5 | Formulate and solve a wide variety of applications and problems that can be addressed using Operations Research techniques as, Transportation, Assignment problems and network model |

# Course Contents

| Unit-I | **Functions of Management** | Hours: 06 |
|---|---|---|
| Definition of Management, Planning-Objectives, Steps in Planning, elements of planning, Organizing - Process of Organizing importance and principle of organizing. departmentation, Span of control. areas of Management Staffing- Nature, Purpose, Scope, Human resource management, Policies, Recruitment procedure, training and development, appraisal methods. Leading -Leadership style, Communication process, Barriers, remedies, Motivation, importance Herzberg's theory, Maslow's theory, McGregor's theory. | | |
| Unit-II | **Functional Areas of Management** | Hours: 06 |
| Production Management-Product mix, line balancing, break even analysis, Material Handling Equipment's, TPM, Problem solving Techniques. Marketing Management -Principles & Functions, Types of Market, Market Research, Market Segmentation, Marketing Mix, Advertisement, Channel of Distribution | | |
| Unit-III | **Entrepreneurship Development** | Hours: 05 |
| Types of small-scale industries (SSI), stages in starting SSI, Qualities required to be Entrepreneur, Government policies for SSI, Problems of SSI, Feasibility Report writing. Industrial Safety, Management Information System. | | |
| Unit-IV | **Introduction to Operations Research and Linear Programming Problems** | Hours: 06 |
| History and development of OR, Applications, OR models and their applications. Formulation of LPP | | |

problem, Graphical solution of LPP, Simplex procedure for maximization, Simplex procedure for minimization, Duality concept.

| Unit-V | **Assignment Model and Transportation Model** | Hours: 06 |
|---|---|---|

Assignment Model-
Mathematical statement, Methods to solve balanced assignment problems, Unbalanced assignment problems, Maximization problems.
Transportation model-
Mathematical formulation, methods to obtain initial basic feasible solution (IBFS)- NWCR, LCM and VAM, Conditions for testing optimality. MODI method for testing optimality of solution of balanced problems and unbalanced problems.
Network model
CPM-Construction of network, Critical path, forward and backward Path, Floats, and their significance.
PERT- construction of networks, Time estimates, Probability of completing project by given date.

Text Books:

1. Industrial Engineering and Management, Vishwanath , Scitech Publication, 1st Edition.
2. Industrial Management and Operation Research, Nandkumar Hukeri, Electrotech Publication.
3.Operations Research, J. K. Sharma, McMillan India Publication New Delhi,Sth Edition
4 Operations Research, Hira and Gupta, S.Chand and Co. New Delhi.
5 Operation Research an Introduction, Hamdy A. Taha, Pearson,10 th Edition

Reference Books:

1.Management, Today - Principles and Practice, Gene Burton and Manab Thakur, Tata McGraw Hill Publishing Company, New Delhi.
2. Essentials of Management, Koontz, and H.Weinrich, Tata McGraw Hill Publication, 12th Edition.
3. Business Management, J.P.Bose, S. Talukdar, New Central Agencies (P) Ltd.
4. Production and Operation Management, Tripathy, Scitech Publication, 2nd Edition.
5. Management, James A.F. Stoner, R. Edward Freeman, Prentice Hall of India New Delhi.
6. Introduction to Operation Research, Paneer-Selvam, Prentice Hall of India publication,2nd Edition.
7. Operation Research, Pradeep J. Jha, Tata McGraw Hill Publication.
8. Operation Research, Mariappan, Pearson Education.
9. Operation Research - Principle and Applications, G. Srinivasan, Prentice Hall of India Publication, 3rd Edition.

MOOCs Course (Course name and Weblink) / Supplementary Readings / Videos:

1. https://nptel.ac.in/courses/112/106/112106134/
2. https://onlinecourses.nptel.ac.in/noc20_ma31/preview

| Course Code | 24ME408T | Course Name | Sustainable Engineering In Mechanical Systems | | | |
|---|---|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | | | |
| L | T | Credits | CA-I | MSE | CA-II | ESE |
| 02 | -- | 02 | 15 | 20 | 15 | -- |

**Course Prerequisites:**

1. Awareness of how subsystems interact in larger engineering systems.
2. Understanding of optimization and resource management.
3. Awareness of life-cycle thinking and eco-friendly design principles.
4. Concepts of pollution, natural resources, and ecological balance.

**Course Objective:**

1.To understand the basics of sustainability and its importance in engineering
2. To learn sustainable manufacturing and renewable energy practices in mechanical systems
3. Explore energy-efficient and environmentally friendly practices in mechanical Engineering

**Course Outcome:**

| | |
|---|---|
| CO-1 | Define sustainability and its environmental, social, and economic aspects, and identify key global environmental challenges such as climate change, resource depletion, and pollution. |
| CO-2 | Explain the principles of sustainable manufacturing processes, such as additive manufacturing, lean manufacturing, and green machining, and summarize their benefits in reducing energy consumption and material waste. |
| CO-3 | Apply the methodology of Life Cycle Assessment (LCA) to demonstrate how to evaluate the environmental impact of mechanical engineering products. |
| CO-4 | Explain the significance of renewable energy sources, such as solar, wind, and hydro, in mechanical systems, and discuss their importance in promoting sustainable energy solutions in mechanical engineering. |
| CO-5 | Discuss the principles of sustainable design in mechanical systems and outline the strategies for integrating renewable materials and energy-efficient tools. |

## Course Contents

| | | |
|---|---|---|
| I | **Introduction to Sustainability** | Hours: 06 |
| Definition of sustainability: Environmental, Social, and Economic aspects. Global environmental challenges: Climate change, resource depletion, pollution, Importance of sustainability in engineering, Role of sustainability in modern technologies and industrial practices | | |
| Unit-II | **Sustainability In Mechanical Engineering** | Hours: 06 |
| Sustainable manufacturing processes Explore various sustainable manufacturing processes, such as: Additive manufacturing (3D printing). Lean manufacturing & Green machining, discuss their benefits in reducing energy consumption, material waste, and environmental impact | | |
| Unit-III | **Life Cycle Assessment (LCA) Overview** | Hours: 05 |
| Study the Life Cycle Assessment (LCA) methodology, its stages (from raw material extraction to disposal), and its application in evaluating the environmental impact of products. | | |
| Unit-IV | **Energy-Efficient Systems** | Hours: 06 |
| Importance of sustainable energy solutions in mechanical engineering. Renewable energy applications in mechanical engineering. Design and implementation of energy-efficient systems | | |

| Unit-V | **Sustainable Design** | Hours: 05 |
|---|---|---|
| Key principles of sustainable design in mechanical systems, Energy-efficient design strategies, Use of renewable materials in mechanical design. Introduction of tools for sustainable design. | | |
| Text Books: | | |
| 1. Environmental Studies K. R. Nambiar<br>2. Renewable Energy Engineering by G. D. Rai<br>3. Toyota Production System Ravi Phadke, Nilesh Kate<br>4. Product design and Manufacturing A. K. Chitale | | |
| Reference Books: | | |
| 1. Sustainable Energy by Jeffersons W. Tester, Elisabeth M. Drake<br>2. Sustainable Design and Manufacturing by A. J. A. Barron and B. D. Sheppard<br>3. Mechanical Engineering Design by J. E. Shigley | | |
| MOOCs Course (Course name and Weblink) / Supplementary Readings / Videos: | | |
| 1. https://greatermanchester.ac.uk/blogs/sustainable-design-principles-in-mechanical-engineering<br>2. https://www.motiondrivesandcontrols.co.uk/blog/engineering-ethics-and-sustainability-building-a-responsible-future | | |

| Course Code | 24ME401L | Course Name | Fluid Mechanics Lab | |
|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | |
| P | Credits | | CIE | ESE |
| 02 | 01 | | 30 | 20** |

**Course Prerequisites:**

1. Basic knowledge of Fluid Mechanics theory (properties of fluids, hydrostatics, Bernoulli's equation, continuity equation, flow regimes).
2. Understanding of Engineering Mathematics (algebra, calculus, differential equations for flow analysis).
3. Ability to read & interpret engineering graphs and experimental data (pressure, velocity, discharge, head loss, etc.).

**Course Objective:**

1. To familiarize the students with the use equipment to determine mechanical properties of materials to acquire the knowledge in Destructive Material Testing.
2. To familiarize the students with various heat treatment processes.

**Course Outcome:**

| | |
|---|---|
| CO-1 | Identify and use different pressure measuring devices used fluid system. system. |
| CO-2 | Understand different types of fluid flow and determine laminar or turbulent fluid flow. |
| CO-3 | Verify Bernoulli's theorem. |
| CO-4 | Calibrate the different discharge measuring devices to determine coefficient of discharge |
| CO-5 | Determine the major and minor losses in pipe |

**Course Contents**

| Exp. No. | Experiment Title | CO |
|---|---|---|
| 1 | Assignment on study and demonstration of pressure measuring devices. | 1 |
| 2 | Flow visualization by plotting of streamlines (Heleshaw's Apparatus) | 2 |
| 3 | Reynold's experiment | 2 |
| 4 | Verification of Bernoulli's equation | 3 |
| 5 | Calibration of Venturi meter | 4 |
| 6 | Calibration of Orifice meter | 4 |
| 7 | Calibration of Orifice under steady flow condition | 4 |
| 8 | Determination of minor losses in pipe fittings | 5 |
| 9 | Determination of coefficient of friction in pipe of different materials. | 5 |

| Course Code | 24ME402L | Course Name | Theory of Machines- I Lab | |
|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | |
| P | Credits | | CIE | ESE |
| 02 | 01 | | 50 | 00 |

**Course Prerequisites:**

1. Basic knowledge of Engineering Mechanics (statics, dynamics, kinematics of particles and rigid bodies).
2. Understanding of Engineering Graphics (to interpret mechanism diagrams and sketches of cams, gears, linkages, etc.).
3. Mathematical skills (differentiation, integration, vector analysis, solving equations for velocity/acceleration of links).

**Course Objective:**

1. Provide the students with basic knowledge of mechanism and its application in mechanica engineering through the experiments and table top working models.
2. Know the significance of velocity and acceleration diagram in application of mechanism.
3. Introduce the role of power transmission device (belt drive) in mechanism.
4. Study the fundamental theory of friction and its analysis in different mechanisms and machines

**Course Outcome:**

| | |
|---|---|
| CO-1 | Understand and study the basic mechanisms and their motions (demonstration and observation of models). |
| CO-2 | Verify performance of Hooke's joint, Porter governor, and dynamometer experimentally. |
| CO-3 | Prepare and solve A3-size problem sheets on velocity, acceleration, Klein's construction, and cam profiles to reinforce theoretical concepts. |

**Course Contents**

| Exp. No. | Experiment Title | CO |
|---|---|---|
| 1 | Study of basic mechanisms. (Demonstration of models, actual mechanism etc.) | 1 |
| 2 | One A3 size sheet of velocity problems by relative velocity method. (Minimum 4 problems) | 3 |
| 3 | One A3 size sheet of acceleration problems (including Coriolis's Component) by relative acceleration method. | 3 |
| 4 | One A3 size sheet of velocity problems by Klien's construction and Instantaneous center method. (Minimum 4 problems) | 3 |
| 5 | Verification of ratio of angular velocities of shafts connected by Hook's Joint | 2 |
| 6 | One A3 size sheet of problems on cam profile. (Minimum 4 problems) | 3 |
| 7 | Experiment on Governor characteristics for Porter governor. | 2 |
| 8 | Experiment on Dynamometer. | 2 |

| Course Code | 24ME403L | Course Name | Manufacturing Processes -I Lab | |
|---|---|---|---|---|
| Teaching Scheme | | | Evaluation Scheme | |
| P | Credits | | CIE | ESE |
| 02 | 01 | | 30 | 70** |

**Course Prerequisites:**

1. Basic knowledge of Engineering Materials – properties, classifications, and applications.
2. Understanding of Engineering Drawing – to read and interpret part drawings and tolerances.
3. Familiarity with Workshop Safety – use of machines, tools, and protective equipment.

**Course Objective:**

1. Acquire skills in the basic sand-casting process.
2. Understand the pattern making process.
3. Perform sand testing.
4. Study lathe machine, drilling machine, milling machine.
5. Study and perform the various machining operations.

**Course Outcome:**

| | |
|---|---|
| CO-1 | Design and develop the pattern. |
| CO-2 | Describe the importance of casting processes in manufacturing |
| CO-3 | Evaluate the properties of molding sand. |
| CO-4 | Demonstrate the components and accessories of various machine tools. |
| CO-5 | Perform various machining operation to prepare job using plain turning, facing taper turning, threading, knurling, grooving and center drilling. |

**Course Contents**

| Exp. No. | Experiment Title | CO |
|---|---|---|
| 1 | Study of pattern-types, materials used, pattern allowances and preparation of pattern for solid casting. | 1,2 |
| 2 | To find size and grain fineness number of molding sand. To calculate hardness and green compressive strength of molding sand to find permeability, moisture percentage and clay content of given sand. | 3 |
| 3 | Demonstration of lathe machine to understand constructional details, various mechanisms, accessories, and attachments. | 4 |
| 4 | Reading the component drawing, selecting, and preparing operation sequence. Manufacturing of component on lathe machine. This job consists of operations such as turning, facing, grooving, taper turning, threading, knurling, centre drilling. | 5 |
| 5 | Visit to a foundry to study patterns and different types of machine tools. | 4 |