# SCHOOL OF STUDIES OF ENGINEERING AND TECHNOLOGY

## DEPARTMENT OF MECHANICAL ENGINEERING

### Scheme of Teaching and Evaluation 2024-25 (As per NEP-2020)

### Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

### (Effective from the Academic year 2024-25)

**V-SEMESTER SCHEME OF TEACHING & EVALUATION 2024-25**

| S. N. | Course Type | Course Code | Course Title | Teaching Hours/week | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory lectures | Tutorial | Practical/Drawi | Examination in Hours | CIA Marks | SEA Marks | Total Marks | |
| | | | | L | T | P | | | | | |
| 1 | Department Core | MEUETT1 | Machine Design – I | 3 | 1 | - | | 40 | 60 | 100 | 4 |
| 2 | Department Core | MEUETT2 | Dynamics of Machines | 3 | - | - | | 40 | 60 | 100 | 3 |
| 3 | Department Core | MEUETT3 | Heat and Mass Transfer | 3 | - | - | | 40 | 60 | 100 | 3 |
| 4 | Industry Course | MEUETI1 | Innovation and Design Thinking | 1 | - | - | | 100 | - | 100 | 1 |
| | | MEUETI2 | Maintenance Engineering and Management | | | | | | | | |
| 5 | Department Core | MEUETT4 | Automobile Engineering | 3 | - | - | | 40 | 60 | 100 | 3 |
| 6 | Practical | MEUELT1 | Heat and Mass Transfer Lab | - | - | 2 | | 20 | 30 | 50 | 1 |
| 7 | Practical | MEUEPV1 | Mini Project - II | - | - | 3 | | 20 | 30 | 50 | 2 |
| 8 | Practical | MEUELT2 | Theory of Machines Lab | - | - | 2 | | 20 | 30 | 50 | 1 |
| 9 | Practical | MEUELT3 | Modeling and Simulation – I Lab | 1 | - | 2 | | 20 | 30 | 50 | 2 |
| **Total** | | | | **14** | **1** | **09** | | **340** | **360** | **700** | **20** |
| *** Not for ME students** | | | | | | | | | | | |

**Credit Definition:**

➢1-hour lecture **(L)** per week per semester = **1 Credit**

➢1-hour tutorial **(T)** per week per semester = **1 Credit**

➢2-hour Practical/Drawing**(P)** per week per semester = **1 Credit**

- **Four credit** courses are to be designed for **50** hours of Teaching-Learning process.
- **Three credit** courses are to be designed for **40** hours of Teaching-Learning process.
- **Two credit** courses are to be designed for **30** hours of Teaching-Learning process.
- **One credit** courses are to be designed for **15** hours of Teaching-Learning process

**Note: The above is applicable only to THEORY courses**

**CIA: Two internal Class Tests, each of 15 Marks.**

**Assignment: 10 Marks**

**SEA: Semester End Assessment – 60 marks**

**Guru Ghasidas Vishwavidyalaya**
**Central University**
Department of Mechanical Engineering

| CODE | COURSE NAME | HOURS PER WEEK | | | CIA | SEA | CREDIT |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| | MACHINE DESIGN - I | 3 | 1 | - | 40 | 60 | 4 |

Course objectives:

1. Impart knowledge on various types of stress components and theories of failure.
2. Emphasis on the significance of loading nature on the design of machine elements.
3. Make the students understand the design of temporary and permanent joints.
4. To enable students to design IC engine components.

| | |
|---|---|
| UNIT – I | Steady and Variable stress on machine elements |
| | Selection of Materials, Design Stress – Tension, Bending and Torsion, Factor of Safety, Stress concentration factor, Theories of failures, Calculation of principle stresses for various load combinations, Notch sensitivity, Design for variable and repeated loadings, Fatigue stress concentration factor and Endurance diagrams. |
| UNIT -II | Design of shafts and Couplings |
| | Transmission shaft, Design against static load, Design for strength, Rigidity and stiffness.<br>Types of keys and Splines, Design of Cotter joint, Sleeve and Cotter joint and Design of Knuckle joint.<br>Couplings: Types of couplings, Design of flange and flexible couplings, Compression coupling, Muff coupling. |
| UNIT -III | Threaded Fasteners |
| | The geometry of thread forms, Terminology of screw threads and thread standards, Initial tension, Relation between bolt tension and torque, and Design of statically loaded tension joints.<br>Design of bolted joints due to eccentric loading. Power Screws: Power screws, Force analysis, Stresses in screw, Coefficient of friction, Efficiency of thread. |
| UNIT IV | Welded and Riveted joints |
| | Welded joint: Types of welded joints, Stresses in butt and fillet welds, eccentrically loaded joint, welded joint subjected to bending moment, Design procedure, Fillet welds under varying loads.<br>Riveted Joints: Types of rivet heads, joints, Failure of riveted joint, Strength of rivet joint, Efficiency of riveted joint, Design of riveted joint, eccentrically loaded riveted joint. |
| UNIT V | Design of IC Engine Parts |
| | Flywheels considering stresses in rims and arms for engines and punching machines<br>Connecting Rods - Forces Acting on the Connecting Rod - Design of Connecting Rod.<br>Crankshafts - Design Procedure for Crankshaft - Design for Centre Crankshaft - Side or Overhung Crankshaft. |

TEXT BOOKS:

1. Machine Design- J. E. Shigley -McGraw Hill Publications.
2. Design of Machine Elements - V. B. Bhandari, TMH Publications.
3. Machine Design, Spott, TMH Publications.
4. PSG - Design Data Book – PSG College, Coimbatore.
5. Principles of Mechanical Design, R. Phelan, McGraw Hill Pub

REFERENCE BOOKS:

1. Machine Design – R. S. Khurmi, Chand Publications.

WEB RESOURCES:

https://iitg.ac.in/mech/academics/masters/machine-design/
https://archive.nptel.ac.in/courses/112/106/112106137/
https://www.me.iitb.ac.in/~ramesh/courses/ME423/Introduction1.pdf
https://www.purdue.edu/freeform/me354/wpcontent/uploads/sites/28/2022/06/220607_ME354_LectureNotes_BHess.pdf

**Course Outcome and their mapping with Program Outcomes:**

| After completion of the course, the students will be able to | | |
|---|---|---|
| COs | Statement | Highest BTL |
| CO1 | Apply the concept of stress and the associated failure theories in the design of machine elements | K3 |
| CO2 | Design the shaft and temporary joins for varied application | K3 |
| CO3 | Calculate design parameters for threaded fasteners as per the standards | K3 |
| CO4 | Determine the strength and efficiency of the rivet and welded joints. | K3 |
| CO5 | Design and explain some IC engine parts like the Connecting rod, crankshaft etc. | K3 |

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO5 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 2 | | | | | | 2 | | 2 | 2 | | |
| CO2 | 3 | 2 | 3 | 2 | | | | | | 2 | | 2 | 2 | | |
| CO3 | 3 | 2 | 3 | 2 | | | | | | 2 | | 2 | 2 | | |
| CO4 | 3 | 2 | 3 | 2 | | | | | | 2 | | 2 | 2 | | |
| CO5 | 3 | 2 | 3 | 2 | | | | | | 2 | | 2 | 2 | | |

**Guru Ghasidas Vishwavidyalaya**
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| CODE | COURSE NAME | HOURS PER WEEK | | | CIA | SEA | CREDIT |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| MEUETT2 | Dynamics Of Machinery | 2 | 1 | - | 40 | 60 | 3 |

Course objectives:

1. Make students understand the fundamental knowledge of dynamics and the concept of a gyroscope.
2. Impart the knowledge of inertia forces and flywheels.
3. Enabling students to balance rotating and reciprocating masses in a mechanism.
4. To impart knowledge on various types of governors.
5. To Understand the fundamental concept of vibrations

| | |
|---|---|
| UNIT – I | Gyroscope |
| | Gyroscope: Gyroscopic forces and couple (Torque), Angular velocity and acceleration of gyroscope, gyroscopic effect on naval ships, gyroscopic effect on aeroplane and vehicle moving on a curved path. |
| UNIT – II | Inertia force analysis |
| | Inertia force analysis: Effective force and inertia force of a link, D-Alembert's principle and dynamic equilibrium, equivalent offset inertia force, dynamically equivalent system, velocity and acceleration of piston, inertia forces in reciprocating engine, engine force analysis, inertia of connecting rod, Flywheels, turning moment diagram for single and multi-cylinder I.C. Engine, Co-efficient of fluctuation of speed, Co-efficient of fluctuation of energy. |
| UNIT – III | Balancing |
| | Balancing: Static and dynamic balancing, balancing of rotating masses and balancing of reciprocating masses, balancing of locomotives, the effect of partial balancing in the locomotive balancing of I.C. Engine, balancing of IN-line engine, balancing of V-engine, balancing of a radial engine, forward and reverse crank method |
| UNIT – IV | Governors |
| | Governors: Types of governors, centrifugal governor, spring-controlled governor, Watt, Porter and Proell, Hartnell, Hartung governor, governor effect, Power stability, Inertia effects. Governor Performance parameters. |
| UNIT -V | Vibration |
| | Vibration: One dimensional longitudinal, transverse, and torsional vibrations, natural frequency, effect of damping on vibrations, types of damping, different types of damping. Forced vibration, forces and displacement, transmissibility, vibration isolation, vibration sensors: seismometer and accelerometers Whirling of shafts with a single rotor. |

TEXTBOOKS:

1. Theory of Machines - S. S. Ratan, McGraw Hill Education India
2. Theory of Machines -Thomas Beven, Pearson Publications
3. Theory of Mechanisms and Machines -Amitabh Ghosh and Ashok Kumar Mallik, East West Press
4. Theory of Machines and Mechanisms- John J. Uicker Jr., Gordon R. Pennock, and Joseph E. Shigley, McGraw Hill Education India
5. Mechanisms and Machines Theory-J.S. Rao & R.V. Dukkipati, Wiley Eastern Limited

REFERENCE BOOKS:

Theory of Machines– R. S. Khurmi, J. K. Gupta, S. Chand Publications.

WEB RESOURCES:
https://archive.nptel.ac.in/courses/112/104/112104114/
https://archive.nptel.ac.in/courses/112/101/112101096/

https://www.physics.wisc.edu/ingersollmuseum/exhibits/mechanics/gyroscope/

https://www.jntua.ac.in/gate-online-classes/registration/downloads/material/a159033048922.pdf

https://ramadossegsp.weebly.com/uploads/9/3/7/8/93786092/unit5-vvb.pdf

https://www.jntua.ac.in/gate-online-classes/registration/downloads/material/a159033051429.pdf

https://www.unife.it/ing/lm.meccanica/insegnamenti/meccanica-delle-vibrazioni/materiale-didattico/copy_of_a-a-2016-17-dispense-e-programma/03-rao_cap1-fundamentals-of-vibration.pdf

**Course Outcomes and their Mapping with Program Outcomes:**

| After completion of the course, the students will be able to | | |
|---|---|---|
| COs | Statement | Highest BTL |
| CO1 | Determine the gyroscopic effects | K3 |
| CO2 | Evaluate a mechanism's inertia forces, the flywheel's dimension, and energy fluctuations. | K3 |
| CO3 | Check the balancing of rotating & reciprocating masses of mechanisms | K3 |
| CO4 | Calculate the speed, height, power, and effort of various types of governors. | K3 |
| CO5 | Determine the type of vibration and calculate transmissibility, isolation, etc. | K3 |

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 1 | | | | | | | | | 1 | 1 | | |
| CO2 | 2 | 1 | 1 | | | | | | | | | 1 | 1 | | |
| CO3 | 2 | 1 | 1 | | | | | | | | | 1 | 1 | | |
| CO4 | 3 | 2 | 1 | | | | | | | | | 1 | 1 | | |
| CO5 | 3 | 2 | 1 | | | | | | | | | 1 | 1 | | |

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| CODE | COURSE NAME | HOURS PER WEEK | | | CIA | SEA | CREDIT |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| MEUETT3 | HEAT & MASS TRANSFER | 3 | - | - | 40 | 60 | 3 |

Course objectives:

1. To understand the basic modes of heat and mass transfer.
2. To understand and solve conduction, convection and radiation problems
3. To understand the concepts of heat transfer through extended surfaces.
4. To learn the thermal analysis and area requirement of heat exchangers.
5. To understand the basic concepts of phase change heat transfer (boiling/condensation).

| | |
|---|---|
| UNIT – I | Conduction Heat Transfer |
| | Introduction to modes and mechanisms of heat transfer, Fourier's law, Electrical analogy, Overall heat transfer coefficient, Conduction heat transfer in rectangular, cylindrical and spherical solids, 1-D steady state heat transfer with & without heat generation, critical radius of insulation, Unified view of momentum. |
| UNIT – II | Conduction in Extended Surface |
| | 1-D steady state heat conduction in Extended surfaces, Lumped Capacitance and 1-D transient models, Semi-infinite wall, Error in Temperature measurement. |
| UNIT – III | Convection Heat Transfer |
| | Convection: Forced and free convection - mass, momentum and energy conservation equations, scaling analysis and significance of non-dimensional numbers, velocity & thermal boundary layers, heat transfer in external and internal laminar and turbulent flows, and use of correlations. |
| UNIT– IV | Heat Exchanger and Phase Change Heat Transfer |
| | Heat Exchanger types and analysis: LMTD and Effectiveness-NTU method.<br>Boiling and Condensation: physical phenomena and correlations. |
| UNIT -V | Radiation Heat Transfer and Mass Transfer |
| | Radiation heat transfer: Properties, laws, configuration factors, radiation shields, three-surface network of diffuse gray surfaces.<br>Mass Transfer: Diffusion Mass Transfer, Fick's Law of Diffusion, Steady state Molecular Diffusion, Convective Mass Transfer. |

TEXTBOOKS:

1. Heat and Mass Transfer, Cengel, McGraw Hill
2. Heat & Mass Transfer, DS Kumar, Katsons
3. Heat Transfer, JP Holman, McGraw Hill
4. Heat Transfer, SP Sukhatme, Tata McGraw Hill
5. Heat & Mass Transfer, SC Sachadeva, EEE

REFERENCE BOOKS:

1. Fundamentals of heat and mass transfer.– Frank P. Incropera, David P. Dewitt, Wiley India Edition
2. Heat Transfer: A Basic Approach- M. Necati Ozisik

WEB RESOURCES:

https://archive.nptel.ac.in/courses/112/108/112108149/
https://nptel.ac.in/courses/112101097

**Course Outcomes and their Mapping with Program Outcomes:**

| After completion of the course, the students will be able to | | |
|---|---|---|
| COs | Statement | Highest BTL |
| CO1 | Able to understand and solve steady state and transient heat conduction problems in simple geometries. | K3 |
| CO2 | Able to analyze the performance of heat exchangers. | K3 |
| CO3 | Able to analyze the performance of extended surfaces. | K3 |
| CO4 | Evaluate heat transfer coefficients for simple natural convection and forced convection situations. | K3 |
| CO5 | Calculate the radiation heat exchange between surfaces (black and gray). | K3 |

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 | 1 |
| CO2 | 3 | 2 | 2 | | | | | | | | | | 3 | 1 | 1 |
| CO3 | 3 | 2 | 2 | | | | | | | | | | 3 | 1 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 | 1 |

| Sub Code | L | T | P | Duration | IA | ESE | Total | Credits |
|---|---|---|---|---|---|---|---|---|
| MEUETI1 | 1 | 0 | 0 | -- | 100 | -- | 100 | 1 |

**Innovation and Design Thinking (One Credit Course)**

**Course Objectives:**

- To understand the concept of innovation and its importance in today's business world
- To identify the different categories of innovation and their applications in various industries
- To develop the skills required for creative problem-solving and idea generation
- To apply design thinking techniques and tools to identify, define, and solve complex problems in various contexts

**Course Content:**

**CONCEPT OF INNOVATION** - Why Innovation is important for businesses, What is Innovation, Difference between Innovation and Invention, Types of Innovation, Product Innovation, Process Innovation, and Business Model Innovation (2)

**SKILL & PERSONALITY TRAITS FOR INNOVATION** -Personality traits for innovation, Organisational Structure for Innovation. (1)

**SPECIAL CATEGORIES OF INNOVATIONS** - Disruptive Innovation, Reverse Innovation. (2)

**TOOLS FOR FOSTERING INNOVATION** - Value Chain Analysis, The 3 Box Approach to Innovation, Focus Groups and other tools, Software tools for Innovation. (3)

**DESIGN THINKING** - Design Thinking Mindset, Process of Design Thinking, Idea generation, Understanding the current situation, What if - alternatives, Prototyping, Testing, Cases of application of Design Thinking. (4)

Design Thinking & Innovation Projects in Groups. (4)

Total - 15

**References:**


1. Govindarajan, Vijay. The Three-Box Solution, Harvard Business Review Press, 2016.
2. Brown, Tim. "Design Thinking." Harvard Business Review, vol. 86, no. 6, 2008,
3. Larson, Chris. "Disruptive Innovation Theory: What It Is & 4 Key Concepts." Harvard Business School Online, January 26, 2021, https://online.hbs.edu/blog/post/disruptive-innovation-theory.
4. Christensen, Clayton M. The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail. Harvard Business Review Press, 1997
5. Soni, Pavan. Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving. Notion Press, 2018

**Course outcomes**

CO1 Students will be able to define and explain the concept of innovation, its importance and role in modern businesses

CO2 Students will be able to identify and differentiate between various types of innovation and their applications in different industries

CO3 Students will be able to explain the principles and concepts of design thinking and apply them to real-world problems

CO4 Students will be able to develop creative and innovative solutions to complex problems, and evaluate the feasibility and potential impact of these solutions

**Course Outcomes and their mapping with Programme Outcomes:**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 1 | | 3 | | 2 | | | | | | 2 | 1 | 2 | 1 | 3 |
| CO2 | 1 | | 3 | | 2 | | | | | | 1 | 1 | 1 | 1 | 2 |
| CO3 | 1 | | 3 | | 1 | | | | | | 2 | 1 | 1 | 1 | 2 |
| CO4 | 1 | | 2 | | 2 | | | | | | 2 | 1 | 1 | 1 | 3 |

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

**Proposed Evaluation system**

Industry Integrated course / one credit courses will be evaluated by the course instructor / department faculty concerned and will carry a total of 100 marks for internal assessment such as assignments, seminars, quiz, projects, etc.

Course developed by

**Alok K Tripathi, BE, MBA, PhD**

**General Manager, NTPC (Regional Learning Institute)**

**Maintenance Engineering and Management**
**(ONE CREDIT COURSE)**

| Sub Code | L | T | P | Duration | IA | ESE | Total | Credits |
|---|---|---|---|---|---|---|---|---|
| MEUETI2 | 1 | 0 | 0 | -- | 100 | -- | 100 | 1 |

**Course objectives:**

• To understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.
• To provide the concept of the Horizons of Maintenance Management and strategies used in industries.
• To impart the knowledge in Maintenance of Mechanical Equipments / Items used in Mining industries.
• To understand the conceptual description of Equipments, Methods & Mechanical Maintenance procedures.

**1.0 Organization and Management of the Maintenance Function.** (3 HRS)

1.1. – Redefining Maintenance- Delivery Reliability.
1.2.- Effective Maintenance Organization.
1.3.- Operating Policies of effective Maintenance.
1.4.- SixSigma Concept in Maintenance- Application of Quality Management Principles.

**2.0 The Horizons of Maintenance Management** (5 HRS)

2.1.- Corrective Maintenance
2.2.- Reliability based Preventive Maintenance.
2.3.- Predictive Maintenance.
2.4.- Condition Monitoring based Maintenance.
2.5.- Computer based Maintenance Management System (CMMS).
2.6.- Total Productive Maintenance (TPM).

**3.0 Maintenance of Mechanical Equipments / Items used in Mining (For indicative purpose).** (4 HRS)

3.1.- Bearings.
3.2.- Flexible Coupling for power transmission.
3.3.- Cranes: Overhead& Gantry.
3.4.- Lifting and Pulling device (Chain Pulley Block)
3.5.- Belt Drives.
3.6.- Mechanical Variable Speed Drives.
3.7.- Gear Drives and Speed Reducers.
3.8.- Pumps.
3.9.- Introduction to Underground Mining Machineries in operation in SECL- Side Discharge Loader / Load Haul Dumper/ Continuous Miner/ High Wall Mining Equipment / Long wall Mining **Equipments – Conceptual description of Equipments, Methods & Mechanical Maintenance procedures.**
3.10.- Case Studies.

4.0 Tools of Maintenance Engineering (3 HRS)
4.1.- Root Cause Analysis.
4.2.- Plant Maintenance Module in System Application Product (SAP) in ERP Platform.

After studying this course, the students are able to:

CO1 Implement the principles, functions and practices adapted in industry for the successful management of maintenance activities.
CO2 Evaluate the concept of the Horizons of Maintenance Management and strategies used in industries.
CO3 Explain the knowledge in Maintenance of Mechanical Equipments / Items used in Mining industries.
CO4 Analyze the conceptual description of Equipments, Methods & Mechanical Maintenance procedures.

Reference:


1. Maintenance Engineering and Maintenance by Sri R C Mishra & Sri K Pathak
2. Maintenance Engineering and Management by Sri D R Kiran
3. Computerized Maintenance Management system made easy by Sri Kishan Bagadia.
4. Modern ERP by Marianne Bradford.


**Course Outcomes and their mapping with Programme Outcomes:**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | | | | | 1 | | | | | 2 | 2 | 2 | | 1 |
| CO2 | 1 | 1 | | | | 1 | | | | | 2 | 2 | 2 | | |
| CO3 | 1 | | | | | 1 | | | | | 1 | 2 | 2 | | |
| CO4 | 1 | | | | | 1 | | | | | 2 | 1 | 2 | | 1 |

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

**Evaluation system**

Industry Integrated course / one credit courses will be evaluated by the course instructor / department faculty concerned and will carry a total of 100 marks for internal assessment such as assignments, seminars, quiz, projects, etc.


Course Prepared by
1. **Sri A K Jha**, GM(E&M)/HOD, SECL HQ, Bilaspur and
2. **Sri Durgadas Adhikary**, Chief Manager (E&M), SECL HQ, Bilaspur

**Guru Ghasidas Vishwavidyalaya**
**(A Central University)**
Department of Mechanical Engineering

| CODE | COURSE NAME | HOURS PER WEEK | | | CIA | SEA | CREDIT |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| MEUETO1 | Fundamentals of Thermodynamics | 3 | - | - | 40 | 60 | 3 |

**Course Objectives:**

1 To understand the basic laws of thermodynamics and heat transfer

2 To understand the principle of operation of thermal systems like I C Engine, boilers, turbines, condensers etc.

UNIT-1 Introduction

Fundamental Concepts System, surrounding and universe, Concept of continuum, Property, State, Path, process, Cyclic process, Energy and its form, Work and heat, Enthalpy.

UNIT-2 Laws of Thermodynamics

Laws of thermodynamics: Concepts of Temperature, Zeroth law. First law of thermodynamics. Concept of processes, Flow processes and control volume, Flow work, Steady flow energy equation, Mechanical work in a steady flow of process

Second law: Essence of second law, Thermal reservoir, Heat engines, COP of heat pump and refrigerator. Statements of second law, Carnot cycle, Concept of Entropy.

UNIT-3 Thermal Power Plant

Thermal Power Plant Layout; Rankine Cycle, Major components of thermal power plant, Condensers, Cooling Towers.

UNIT-4 Power Producing Machines

Internal combustion engines, basic cycles; Turbines: Basic cycle of turbines, Impulse and Reaction Turbines.

UNIT-5 Power Consuming Machines

Pumps, compressors; Basic of refrigeration cycles, Environmental- friendly refrigerants, and Air conditioners.

TEXT BOOKS:


1 P.K. Nag, Engineering Thermodynamics, Tata McGraw-Hill, 6th Edition , 2022

2 Sonntag, Borgnakke, Van Wylen, Fundamentals of Thermodynamics, Wiley, 8thEdition,2012.

3 Y.A.Cengel and M.A.Boles, Thermodynamics: an Engineering Approach, McGraw Hill, 9th Edition, 2019

REFERENCE BOOKS:

1 Moran & Shapiro, Fundamentals of Engineering Thermodynamics, Willey, 8th Edition, 2014.

WEB RESOURCES

1 https://www2.engineering.com/Library/ArticlesPage/tabid/85/ArticleID/218/Thermodynamics.aspx
2 https://open.umn.edu/opentextbooks/textbooks/1252
3 https://www2.engineering.com/Library/ArticlesPage/tabid/85/ArticleID/218/Thermodynamics.aspx
4 https://onlinecourses.nptel.ac.in/noc23_me65/preview#:~:text=This%20course%20is%20on%20basic,pure%20substance%20and%20practical%20applications.

| **Course Outcomes (COs):** After completion of the course, the students will be able to | |
|---|---|
| CO1 | Explain the basic concepts of thermodynamics such as heat and work. |
| CO2 | Describe the various laws of thermodynamics |
| CO3 | Describe the working principle of thermal power plants and the associated parts. |
| CO4 | Describe the various energy interactions between heat and work. |
| CO5 | Explain the various thermal machines based on thermodynamics. |

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | | | | | | | | | 2 | | 3 | | |
| CO2 | 3 | 2 | | | | | | | | | 2 | | 3 | | |
| CO3 | 3 | 2 | | | | | | | | | 2 | | 3 | | |
| CO4 | 3 | 2 | | | | | | | | | 2 | | 3 | | |
| CO5 | 3 | 2 | | | | | | | | | 2 | | 3 | | |

# Guru Ghasidas Vishwavidyalaya
# Central University
## Department of Mechanical Engineering

| CODE | COURSE NAME | HOURS PER WEEK | | | CIA | SEA | CREDIT |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| MEUELT1 | Heat And Mass Transfer LAB | -- | -- | 2 | 20 | 30 | 1 |

Course objectives:

1. To understand and identify various modes of heat transfer and their applications in various heat transfer equipment.
2. Apply the theoretical concepts to perform heat transfer analysis experimentally.

**List of Experiments**:

1. To find the thermal conductivity of insulating powder and metal rod.
2. To find the critical radius of insulating material.
3. To determine the overall and individual film heat transfer coefficient in finned tube heat exchanger.
4. Study and calculate the efficiency of fin in natural and forced convection.
5. To study about parallel flow and counter flow heat exchanger.
6. To find average surface heat transfer coefficient for a pipe and plot the surface temperature distribution along the length of pipe.
7. To study about emissivity measurement apparatus.
8. To study about the regenerative heat exchanger.
9. To determine total thermal resistance & thermal conductivity of composite wall.
10. To determine the overall & individual film heat transfer coefficient in 1:2 shell & tube heat exchanger.
11. To determine the thermal conductivity of lagging material.
12. To study about drop wise and film wise condensation.
13. To estimate the film heat transfer coefficient between the medium in which the body is heated.
14. To find the effectiveness of U-Tube finned heat exchanger.
15. To determine the overall & individual film heat transfer coefficient for the condensation of vapour on a vertical pipe.
16. To determine the Stefan Boltzmann constant.
17. To determine the surface heat transfer coefficient for a vertical tube losing heat by natural convection.
18. To determine the surface heat transfer coefficient for a vertical tube losing heat by forced convection.
19. To estimate the film heat transfer coefficient for axial and radial convection phenomenon.
20. To find the effectiveness of cross flow heat exchanger.

**Name of the Equipment**:

1. Heat transfer From Pin Fin
2. Parallel Flow & Counter Flow H.E.
3. Heat Transfer in Force Convection
4. Emissivity Apparatus
5. Regenerative Heat Exchanges
6. Vertical Condenser
7. Composite Wall Apparatus
8. Lagged Pipe Apparatus
9. Critical Radius of Insulating Material
10. Heat Conduction Apparatus
11. Heat Transfer through Natural Convection
12. Unsteady Heat Transfer
13. Stefan Boltzmann Apparatus
14. Drop wise &Filmwise Condensation
15. Thermal Conductivity of Insulating Powder
16. Thermal Conductivity of Metal Rod
17. Finned Tube Heat Exchanges
18. Shell & Tube Heat Exchangers
19. U-Tube Finned Heat Exchanges
20. Cross- Flow Hear Exchanges
21. Radiation Heat Transfer Apparatus

TEXTBOOKS:
1. Heat and Mass Transfer, Cengel, McGraw Hill
2. Heat & Mass Transfer, DS Kumar, Katsons
3. Heat Transfer, JP Holman, McGraw Hill
4. Heat Transfer, SP Sukhatme, Tata McGraw Hill
5. Heat & Mass Transfer, SC Sachadeva, EEE

REFERENCE BOOKS:
Fundamentals of heat and mass transfer.– Frank P. Incropera, David P. Dewitt, Wiley India Edition

WEB RESOURCES
https://www.iitk.ac.in/me/heat-transfer-laboratory
https://iitr.ac.in/Departments/Mechanical%20and%20Industrial%20Engineering%20Department/Research/Heat%20Transfer%20Laboratory.html
https://vlab.amrita.edu/index.php?sub=1&brch=194

**Course Outcomes and their Mapping with Program Outcomes:**

| After completion of the course, the students will be able to | | |
|---|---|---|
| COs | Statement | Highest BTL |
| CO1 | Investigate experimentally the thermal conductivity of insulating material, lagged pipe and metal rod. | K3 |
| CO2 | Conduct the transient heat conduction experiment and obtain variation of temperature with time of the spherical and cylindrical objects. | K3 |
| CO3 | Obtain the value of convective heat transfer coefficients in forced convection and natural convection experiments. | K3 |
| CO4 | Able to obtain radiation properties such as emissivity of a test plane and Stefan-Boltzmann's constant experimentally. | K3 |
| CO5 | Understand the phenomenon of boiling and condensation. | K3 |
| CO6 | Estimate the effectiveness of different types of heat exchangers. | K3 |
| CO7 | Estimate the effectiveness of pin fin under natural and forced convection situations. | K3 |
| CO8 | Perform critical radius of insulation of a lagged pipe. | K3 |

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 1 | | | | | | | 1 | | | | 2 | 1 | |
| CO2 | 3 | 1 | | | | | | | 1 | | | | 2 | 1 | |
| CO3 | 3 | 2 | 2 | 1 | | | | | 1 | | | | 2 | 1 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | 1 | | | | 2 | 1 | |
| CO5 | 3 | 1 | | | | | | | 1 | | | | 2 | 1 | |
| CO6 | 3 | 2 | 2 | 1 | | | | | 1 | | | | 2 | 1 | 1 |
| CO7 | 3 | 2 | 2 | 1 | | | | | 1 | | | | 2 | 1 | 1 |
| CO8 | 3 | 1 | | | | | | | 1 | | | | 2 | 1 | |

**Guru Ghasidas Vishwavidyalaya**
**(A Central University)**
Department of Mechanical Engineering

| CODE | COURSE NAME | HOURS PER WEEK | | | CIA | SEA | CREDIT |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| **MEUDPV1** | **Mini Project – II** | **-** | **-** | **3** | **30** | **20** | **2** |

**Course Objectives:**

1 Learn to enumerate considerations for designing a component/model/product/service
2 Fabrication of model/component/product
3 Prepare bill of materials
4 Carry out economic analyses

Procedure for allocation of Research topic:

1. A group of students shall be allocated one Project supervisor from among the faculty members
2. The model building or fabrication is largely based on Do-It-Yourself mode of learning.
3. The group shall complete fabrication of the model/component as part of the mini-project work.

| WEB RESOURCES | |
|---|---|
| 1 | https://www.youtube.com/c/PracticalEngineeringChannel |
| 2 | https://www.youtube.com/user/EngineeringExplained |
| 3 | https://www.instructables.com/workshop/projects/ |
| 4 | https://hackaday.com/tag/diy-projects/ |
| 5 | https://engineering.stackexchange.com/ |
| 6 | https://www.opensourceecology.org/ |
| 7 | https://grabcad.com/ |

| **Course Outcomes (COs): After the course completion, student shall be able to** | |
|---|---|
| CO1 | List out design considerations in making a model/component/service/product |
| CO2 | Demonstrate ability to fabricate model/component |
| CO3 | Evaluate cost and economic analyses |

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | 2 | | | | | | | 2 | 2 | | 2 | 2 | | |
| CO2 | 2 | 2 | | | | | | | 2 | 2 | | 2 | 2 | | |
| CO3 | 1 | 1 | | | | | | | 2 | 2 | | 1 | 2 | | |

**Guru Ghasidas Vishwavidyalaya**
**Central University**
Department of Mechanical Engineering

| CODE | COURSE NAME | HOURS PER WEEK | | | CIA | SEA | CREDIT |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| MEUELT2 | TOM LAB | | | 2 | | | |

Course objectives:

1. Impart knowledge on inversions of four bar, single slider and double slider chain.
2. To demonstrate working of Cam and followers and plot displacement v/s angle of rotation curves.
3. Make students understand various types of governors.
4. To impart knowledge on various epicyclic gear trains and Coriolis acceleration components.
5. Make students understand the practical vs. theoretical torque relation of the gyroscope and its applications.
6. Demonstrate the static and dynamic balancing, whirling of the shaft, and vibration.

| S.No. | Title of Experiments |
|---|---|
| 1 | Study of Four-bar chain, single slider chain, Double slider chain, and their inversions. |
| 2 | Study of various types of cams and follower pairs;<br>Find the angular displacement of the cam follower pair.<br>Study of the spring compression effect on bounce. |
| 3 | Study the watt Governor to calculate the governor's height, and perform the test. |
| 4 | Study the effect of varying the mass of the central sleeve of Porter and Proell Governor and perform the test. |
| 5 | Study the effect of initial spring compression of Hartnell Governor and perform the test. |
| 6 | Determine the Coriolis acceleration component at various rotation speeds and water flow rates. |
| 7 | Study of Epicyclic gear train apparatus and;<br>(a) Measure the Epicyclic Gear Ratio<br>(b) Measure input, holding, and output torque. |
| 8 | Study of Motorized Gyroscopic Apparatus and determine the Gyroscopic. |
| 9 | Study and perform the Static and Dynamic Balancing of shafts. |
| 10 | Study the Whirling phenomenon, Measure the natural frequency of the steel shaft and compare the measured natural frequency with the theoretical one. |
| 11 | Verify the relation of simple and compound pendulums by Universal Vibration apparatus. |

Name of the Equipment:

1. Universal Vibration Apparatus
2. Cam Analysis Apparatus
3. Whirling of shaft Apparatus
4. Static & dynamic balancing demonstrator
5. Motorized gyroscope
6. Journal bearing Apparatus
7. Coriolis's Components of Acceleration Apparatus
8. Epicyclic Gear Train Apparatus
9. Universal Governor Apparatus
10. Slip and Creep Measurement Apparatus

11. Four-bar link Mechanism
12. Reciprocating Engine Mechanism
13. Whit Worth's Quick Return Mechanism
14. Epicycle Gear Train Apparatus

TEXTBOOKS:

1. Theory of Machines - S. S. Ratan, McGraw Hill Education India
2. Theory of Machines -Thomas Beven, Pearson Publications
3. Theory of Mechanisms and Machines -Amitabh Ghosh and Ashok Kumar Mallik, East West Press
4. Theory of Machines and Mechanisms- John J. Uicker Jr., Gordon R. Pennock, and Joseph E. Shigley, McGraw Hill Education India
5. Mechanisms and Machines Theory-J.S. Rao & R.V. Dukkipati, Wiley Eastern Limited

REFERENCE BOOKS:

Theory of Machines– R. S. Khurmi, J. K. Gupta, S. Chand Publications.

WEB RESOURCES

https://mm-nitk.vlabs.ac.in/
https://www.vlab.co.in/broad-area-mechanical-engineering
http://vlabs.iitkgp.ac.in/kdm/
https://www.mathworks.com/matlabcentral/fileexchange/123370-mechanisms-and-machines-virtual-lab

**Course Outcomes and their Mapping with Program Outcomes:**

| After completion of the course, the students will be able to | | |
|---|---|---|
| COs | Statement | Highest BTL |
| CO1 | Find inversions of four bar, single slider and double slider chain. | K3 |
| CO2 | Demonstrate cam and followers' experiment and plot displacement v/s angle of the rotation curve. | K3 |
| CO3 | Calculate height and speed for various types of governors. | K3 |
| CO4 | Calculate the gear ratio and Coriolis acceleration component. | K3 |
| CO5 | Determine the gyroscopic couple, static and dynamic balancing, vibration | K3 |

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | | | | | | | 3 | | | 1 | 1 | | |
| CO2 | 3 | | | | | | | | 3 | | | 1 | 1 | | |
| CO3 | 3 | | | | | | | | 3 | | | 1 | 1 | | |
| CO4 | 3 | | | | | | | | 3 | | | 1 | 1 | | |
| CO5 | 3 | | | | | | | | 3 | | | 1 | 1 | | |

**Guru Ghasidas Vishwavidyalaya**
**Central University**
Department of Mechanical Engineering

| CODE | COURSE NAME | HOURS PER WEEK | | | CIA | SEA | CREDIT |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| MEUELT3 | MODELLING AND SIMULATION-I LAB | 1 | - | 2 | 20 | 30 | 2 |

Course objectives:
1. To learn the basic features of part modelling.
2. To learn basic features, methods and metrics of mesh generation
3. To perform analysis of simple systems in mechanical engineering domain

| S.No. | List of Laboratory activities |
|---|---|
| 1 | Concept of planes and sketches – how to create planes and sketches |
| 2 | Solid from Sketches, Using primitives |
| 3 | Design Modeler concepts – Using Frozen, Hidden, Suppressed, Active |
| 4 | Meshing – Simple geometries, features |
| 5 | Meshing – Complex geometries |
| 6 | Advanced Meshing features |
| 7 | Static Structural analysis |
| 8 | Vibration analysis |
| 9 | Fluid flow analysis in pipes and ducts |
| 10 | Steady state thermal analysis |
| 11 | Conjugate heat transfer |
| 12 | Modelling and simulation of manufacturing processes, etc. |

REFERENCE BOOKS:
1. ANSYS DESIGN MODELER Theory Manual
2. ANSYS DESIGN MODELER Tutorials

WEB RESOURCES

YouTube videos

**Course Outcomes and their Mapping with Program Outcomes:**

| After completion of the course, the students will be able to | | |
|---|---|---|
| COs | Statement | Highest BTL |
| CO1 | Use basic modelling features in creating a solid model | K3 |
| CO2 | Understand mesh metrics and develop suitable mesh | K3 |
| CO3 | Apply suitable components for analysis of mechanical systems | K3 |

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 1 | - | 3 | | | | 3 | 3 | | 3 | 3 | 3 | 3 |
| CO2 | 1 | 1 | 1 | 2 | 3 | | | | 3 | 3 | | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | | | | 3 | 3 | | 3 | 3 | 3 | 3 |

# SCHOOL OF STUDIES OF ENGINEERING AND TECHNOLOGY

## DEPARTMENT OF MECHANICAL ENGINEERING

Scheme of Teaching and Evaluation 2024-25 (As per NEP-2020)

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

(Effective from the Academic year 2024-25)

### VI-SEMESTER SCHEME OF TEACHING & EVALUATION 2024-25

| S. N. | Course Type | Course Code | Course Title | Teaching Hours/week | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory lectures | Tutorial | Practical/Drawi | Examination in Hours | CIA Marks | SEA Marks | Total Marks | |
| | | | | L | T | P | | | | | |
| 1 | Department Core | MEUFTT1 | Machine Design – II | 3 | 1 | - | | 40 | 60 | 100 | 4 |
| 2 | Department Core | MEUFTT2 | Finite Element Analysis | 3 | - | - | | 40 | 60 | 100 | 3 |
| 3 | Department elective | MEUFTP1 | Machine Tool Technology | 3 | - | - | | 40 | 60 | 100 | 3 |
| | | MEUFTP2 | Product Design & Development | | | | | | | | |
| | | MEUFTP3 | Material Characterization | | | | | | | | |
| 4 | Industry Course | MEUFTI1 | Metal Cutting | 1 | - | - | | 100 | - | 100 | 1 |
| | | MEUFTI2 | Environment Friendly Power Generation from Coal | | | | | | | | |
| 5 | Open Elective | MEUFTO1 | Fundamentals of Fluid Mechanics* | | - | - | | 40 | 60 | 100 | 3 |
| 6 | Project | MEUFPV1 | Mini Project | | | 3 | | 20 | 30 | 50 | 2 |
| 7 | Practical | MEUFLT1 | MTT Lab | - | - | 2 | | 20 | 30 | 50 | 1 |
| 8 | Practical | MEUFLT2 | Modeling and Simulation – II Lab | - | - | 2 | | 20 | 30 | 50 | 1 |
| | | | | | | | | | | | |
| **Total** | | | | **10** | **1** | **7** | | **320** | **330** | **650** | **18** |
| *** Not for ME students** | | | | | | | | | | | |

**Credit Definition:**

➢1-hour lecture **(L)** per week per semester = **1 Credit**

➢1-hour tutorial **(T)** per week per semester = **1 Credit**

➢2-hour Practical/Drawing**(P)** per week per semester = **1 Credit**

- **Four credit** courses are to be designed for **50** hours of Teaching-Learning process.
- **Three credit** courses are to be designed for **40** hours of Teaching-Learning process.
- **Two credit** courses are to be designed for **30** hours of Teaching-Learning process.
- **One credit** courses are to be designed for **15** hours of Teaching-Learning process

**Note: The above is applicable only to THEORY courses**

**CIA: Two internal Class Tests, each of 15 Marks.**

**Assignment: 10 Marks**

**SEA: Semester End Assessment – 60 marks**

**Guru Ghasidas Vishwavidyalaya**
**Central University**
Department of Mechanical Engineering

| CODE | COURSE NAME | HOURS PER WEEK | | | CIA | SEA | CREDIT |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| MEUFTT1 | MACHINE DESIGN - II | 3 | 1 | - | 40 | 60 | 4 |

Course objectives:

1. Make students understand the types of springs and designs based on load.
2. Impart the knowledge of gear terminology and use the design data to calculate gear parameters.
3. Enabling students to use the design catalogue to select suitable bearings.
4. To impart knowledge on various types of belt drive and brakes.

| | |
|---|---|
| UNIT – I | Spring Design |
| | Springs: Spring Materials and Their Mechanical Properties, Equation for Stress and Deflection, Helical Coil Springs of Circular Section for Tension, Compression and Torsion, Dynamic Loading, Fatigue Loading, Wahl Line, Leaf Spring and Laminated Spring. |
| UNIT – II | Gear Design |
| | Gears: Spur Gears, Gear Drives, Classification of Gears, Selection of Type of Gears, Law of Gearing, Force Analysis, Gear Tooth Failures, Selection of Material, Number of Teeth, Face Width, Beam Strength of Gear Tooth, Effective Load on Gear Tooth, Estimation of Module, Gear Design for Maximum Power Transmitting Capacity.<br>Helical Gears, Terminology of Helical Gears, Virtual Number of Teeth, Tooth Proportions, Force Analysis, Beam Strength of Helical Gears, Effective Load on Gear Tooth, Wear Strength of Helical Gears.<br>Bevel Gears, Terminology of Bevel Gears, Force Analysis, Beam Strength of Bevel Gears, Wear Strength of Bevel Gears, Effective Load on Gear Tooth. |
| UNIT – III | Bearings |
| | Rolling Contact Bearings, Types of Ball and Roller Bearings, Selection of Bearing for Radial and Axial Load, Bearing Life, Mounting and Lubrication.<br>Journal Bearing - Contact Type and Clearance Type. Journal Bearings: Types of Lubrication, Viscosity, Hydrodynamic Theory of Lubrication, Sommerfeld Number, Heat Balance, Self-contained Bearings, Bearing Materials |
| UNIT – IV | Belt and Rope Drives |
| | Belt Drive: Flat and V-belts, Belt Constructions, Geometrical Relationships for Length of the Belt, Analysis of Belt Tensions, and Condition for Maximum Power, Selection of Flat & V-Belts, and Adjustment of Belt Tensions. Pulleys for Flat & V-belts, Wire rope and stress in wire ropes. |
| UNIT -V | Gear Boxes |
| | Geometric progression- Standard step ratio- Ray diagram, kinematics layout Design of sliding mesh gear box- Design of multi-speed gear box for machine tool applications- Constant mesh gear box- Speed reducer, Variable speed gear box. |

TEXTBOOKS:


1. Machine Design- J. E. Shigley -McGraw Hill Publications.
2. Design of Machine Elements - V. B. Bhandari, TMH Publications.
3. Machine Design, Spott, TMH Publications.
4. PSG - Design Data Book – PSG College, Coimbatore.
5. Principles of Mechanical Design, R. Phelan, McGraw Hill Pub

REFERENCE BOOKS:

1. Machine Design – R. S. Khurmi, Chand Publications.

WEB RESOURCES:

https://www.tokaibane.com/en/spring-design/compression-springs-formulas
https://www.cedengineering.com/userfiles/Introduction%20to%20Gear%20Design-R1.pdf
https://edurev.in/t/85326/Chapter-5-V-Belt-And-Rope-Drives-Machine-Design--M
https://cybra.lodz.pl/Content/3714/DesignBasicInd.pdf

**Course Outcome and their mapping with Program Outcomes:**

| After completion of the course, the students will be able to | | |
|---|---|---|
| COs | Statement | Highest BTL |
| CO1 | Design Coil and leaf springs for specific load applications | K3 |
| CO2 | Determine the Gear Parameters for static load conditions | K3 |
| CO3 | Select the bearings from the catalogue based on design parameters | K3 |
| CO4 | Calculate the design parameters of various types of belts and rope drives. | K3 |
| CO5 | Design of Gear Boxes for variable speed applications | K3 |

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO5 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 2 | | | | | | 2 | | 2 | 2 | | |
| CO2 | 3 | 2 | 3 | 2 | | | | | | 2 | | 2 | 2 | | |
| CO3 | 3 | 2 | 3 | 2 | | | | | | 2 | | 2 | 2 | | |
| CO4 | 3 | 2 | 3 | 2 | | | | | | 2 | | 2 | 2 | | |
| CO5 | 3 | 2 | 3 | 2 | | | | | | 2 | | 2 | 2 | | |

**Guru Ghasidas Vishwavidyalaya**
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Department of Mechanical Engineering

| CODE | COURSE NAME | HOURS PER WEEK | | | CIA | SEA | CREDIT |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| MEUFTT2 | FINITE ELEMENT ANALYSIS | 3 | - | - | 40 | 60 | 3 |

Course objectives:

1. Learn fundamental philosophy of domain discretization and formulation techniques
2. One- and two-dimensional analysis using FE concepts
3. Numerical integration for 2D and 3D elements
4. Learn basics of dynamic analysis using FEM

| | |
|---|---|
| UNIT – I | Introduction to FEM |
| | Equilibrium of continuum-Differential formulation, Energy Approach-Integral formulation, Variational formulation. Overview of approximate methods for the solution of the mathematical models: Rayleigh-Ritz methods, Methods of Weighted Residuals |
| UNIT – II | One-dimensional analysis – Spring and bar element |
| | Modelling and discretization, Shape functions, elements and Degrees-of-Freedom, Strain – displacement relation, Local and Global equations, Applications of FEA. Iso-Sub-Super parametric formulations. Natural Coordinate systems and Shape functions: Basic concept of natural coordinate.<br>1D Elements Structural Problems: Linear and Quadratic elements, Elimination and Penalty Approach, Properties of global stiffness matrix. 1D thermal conduction and fluid flow problems. |
| UNIT – III | One-dimensional analysis – Beams and Frames |
| | Formulation of Truss element – coordinate transformation, Plane truss. Beam: Elementary beam theory, Beam Element formulation, plane frames, various loading and boundary conditions.<br>1-D natural coordinate, Shape functions in natural coordinate system, Convergence requirements, Compatibility and completeness |
| UNIT – IV | Two-dimensional analysis |
| | 2-D natural coordinate, Concept of shape functions, Shape function for plain elements, Shape functions using Lagrange polynomials. Shape functions for serendipity family elements<br>Gauss Quadrature formula, Gauss Quadrature in two and three dimensions. Plane stress and plane strain matrices. Triangular (CST, LST) and Rectangular (Q4, Q8) Elements: Shape function, Jacobian matrix, strain-displacement matrix, stress-strain relationship matrix, force vector, Limitations of elements. |
| UNIT -V | Plates and Shells |
| | Introduction, thin and thick plates: Kirchoff theory, Mindlin plate element, conforming and nonconforming elements, degenerated shell elements, reduced and selective integration, shear locking and hour glass phenomenon.<br>Formulation of dynamic problems, consistent and lumped mass matrices, Solution of eigenvalue problems: Transformation methods Jacobi method, Vector Iteration methods, subspace iteration method. |

TEXTBOOKS:


1. Text book of Finite Element Analysis, Seshu P., PHI.
2. Fundamentals of Finite element Analysis, David V. Hutton, McGraw Hill

REFERENCE BOOKS:

1. A First Course in the Finite Element Method, Daryl L. Logan, Thompson Learning.
2. Concepts and Applications of Finite Element Analysis, R D Cook, D S Malkus, M E Plesha, and R J Witt, Wiley.
3. Introduction to Finite Elements in Engineering, Chandrupatla T. R. and Belegunda A. D., PHI.
4. Finite element Method in Engineering, S S Rao, Elsevier.
5. The Finite Element Method – A Practical Course, Liu G. R. and Quek S. S., Butterworth Heinemann.

WEB RESOURCES:

1. NPTEL courses
2. Coursera

**Course Outcome and their mapping with Program Outcomes:**

| After completion of the course, the students will be able to | | |
|---|---|---|
| COs | Statement | Highest BTL |
| CO1 | Understand the basic FE formulations techniques | K3 |
| CO2 | Solve elementary problems with 1D elements | K4 |
| CO3 | Apply FE techniques to solve 1D beam and plane frame problems | K4 |
| CO4 | Formulate FE solution using 2D elements | K3 |
| CO5 | Understand application of FE techniques to simple plate and shell problems | K3 |

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO5 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | | | | | | | | | 3 | 1 | |
| CO2 | 3 | 3 | 2 | 1 | | | | | | | | | 3 | 1 | |
| CO3 | 3 | 3 | 2 | 1 | | | | | | | | | 3 | 1 | |
| CO4 | 3 | 3 | 2 | 1 | | | | | | | | | 3 | 1 | |
| CO5 | 3 | 3 | 2 | 1 | | | | | | | | | 3 | 1 | |

**Guru Ghasidas Vishwavidyalaya**
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| CODE | COURSE NAME | HOURS PER WEEK | | | CIA | SEA | CREDIT |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| MEUFTP1 | Machine Tool Technology | 3 | - | - | 40 | 60 | 3 |

Course objectives:

1. Impart knowledge and principles in material removal processes.
2. apply the fundamentals and principles of metal cutting to practical applications using lathes, milling machines, grinding machines, and drill presses, Computer Numerical Control etc
3. To demonstrate the fundamentals of machining processes and machine tools.
4. To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms
5. To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes.
6. Understand the computer controlled manufacturing such as CNC, NC, DNC, CAM & Robotics.

| | |
|---|---|
| UNIT – I | **Theory of Metal Cutting** |
| | Introduction: Metal Removal Processes, Theory Of Metal Cutting: Chip Formation, Orthogonal Cutting- Oblique Cutting- Machinability of metal. Cutting Tool-Classification of cutting tools-Single point Cutting Tool Geometry-Cutting Tool Materials, Tool Wear, Tool Life, and Cutting Fluids-Functions and properties. |
| UNIT – II | **Lathe and Operations** |
| | Centre Lathe-Construction- Various Operations, Taper Turning Methods, Thread Cutting operation, Lathe Attachments & Accessories. |
| UNIT – III | **Reciprocating Machine Tools** |
| | Shaper -Principal parts, Classification, Specification of shaper, Shaper Mechanisms, Types- Hydraulic shaper. Cutting Speed, Feed, Depth of cut & machining time-Various shaper operations-Introduction to Planer -Principal parts and working of Double housing Planer, Principal parts of Slotter-Working of slotter |
| UNIT – IV | **Drilling and Milling Machines** |
| | Drilling operations- Twist drill geometry –Radial drilling machine-Jigs and Fixtures-Definition-Need of Jigs and Fixtures Drill Jig-Locating devices. .Milling-Classification, Column and knee type milling machine - Milling cutters and classification-Fundamentals of milling processes-Milling operations |
| UNIT -V | **Super Finishing Processes** |
| | Abrasive Processes- Grinding Wheel – Specifications And Selection, Types Of Grinding Process – Cylindrical Grinding, Surface Grinding, Centre less Grinding– Super finishing process- Honing, Lapping, Super Finishing, Polishing And Buffing<br>**Batch production:** NC Part programming. CNC machines, Finishing: Micro finishing, Introduction to 3D and 4D printing, Rapid prototyping |

TEXTBOOKS:


1. Rao, P.N., *Manufacturing Technology, Vol I & II*, Tata Mcgraw Hill Publishing Co., New Delhi, 1998

2. Sharma, P.C., *A Textbook Of Production Technology – Vol I And II*, S. Chand & Company Ltd., New Delhi, 1996

REFERENCE BOOKS:

1. Manufacturing science By A. Ghosh& A.K. Mallik East West Press Pvt. Ltd New Delhi
2. Manufacturing Process by O P Khanna Dhanpat Rai Publication
3. Manufacturing Engg. And technology by S. Kalpakjian& S.R. Schmid, Addision Wesley Longman, New Delhi

WEB RESOURCES:

https://www.youtube.com/watch?v=JSWxaFQQm3g
https://www.youtube.com/watch?v=galm5_6SUcM
https://www.youtube.com/watch?v=McF7OULzspg
https://www.youtube.com/watch?v=hah8-30Ecz8

**Course Outcomes and their Mapping with Program Outcomes:**

| COs | Statement |
|---|---|
| CO1 | Understand the cutting tool geometry, mechanism of chip formation and mechanics of orthogonal cutting |
| CO2 | Identify basic parts and operations of machine tools including lathe, shaper, planer, drilling, boring, milling and grinding machine. |
| CO3 | perform locating and clamping devices to produce a component. |
| CO4 | Select a machining operation and corresponding machine tool for a specific application in real time. |
| CO5 | Understanding the computer controlled manufacturing such as CNC, NC, DNC,CAM & Robotics. |

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 1 | | | | | | | | | 1 | 1 | | |
| CO2 | 2 | 1 | 1 | | | | | | | | | 1 | 1 | | |
| CO3 | 2 | 1 | 1 | | | | | | | | | 1 | 1 | | |
| CO4 | 3 | 2 | 1 | | | | | | | | | 1 | 1 | | |
| CO5 | 3 | 2 | 1 | | | | | | | | | 1 | 1 | | |

**Guru Ghasidas Vishwavidyalaya**
**Central University**
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| CODE | COURSE NAME | HOURS PER WEEK | | | CIA | SEA | CREDIT |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| MEUFTP2 | PRODUCT DESIGN AND DEVELOPMENT | 3 | | - | 40 | 60 | 3 |

Course objectives:

1. Make students understand the common features of a Product.
2. Impart the knowledge of Engineering Design in product development.
3. Enabling students to forecast the product development process.
4. To impart knowledge on various product architecture.

| | |
|---|---|
| UNIT – I | Introduction |
| | Need for IPPD – New Product design (NPD) – NPD Process- Product Life Cycle (PLC) – Product design: Concepts and steps- Product Analysis - Generic Product Development process- Identifying the Customer needs Process - Plan and establishing product specifications – structured approach. |
| UNIT – II | Concept generation, Concept selection and Testing |
| | Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits – Concept Testing Process. |
| UNIT – III | Product architecture |
| | Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system-level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications. |
| UNIT – IV | Industrial Design |
| | Integrate process design –Robust design – Integrating CAE, CAD, CAM tools – Ergonomics in Product design- Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology-driven products –user-driven products – assessing the quality of industrial design. |
| UNIT -V | Design for Manufacturing and Product Development |
| | Design for Manufacturing: Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimizing system complexity. – Design for Assembly - Guidelines – DFMA Guidelines Design guidelines for the different processes: Casting, machining, Injection moulding, welding Prototype basics – principles of prototyping – planning for prototypes. |

TEXTBOOKS:

1. Karl T. Ulrich and Steven D. Eppinger, ”Product Design and Development”, McGraw-Hill International – 7th Edition - 2020.

REFERENCE BOOKS:

1. Kemnneth Crow, “Concurrent Engg./Integrated Product Development”, DRM Associates, 26/3, Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, “Effective Product Design and Development”, Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.

3. Staurt Pugh, "Tool Design –Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New York, NY.

WEB RESOURCES:

https://www.centennialcollege.ca/programs-courses/full-time/product-design-and-development/
https://ocw.mit.edu/courses/15-783j-product-design-and-development-spring-2006/
https://www.productplan.com/glossary/product-design/
https://www.designingbuildings.co.uk/wiki/Design_for_Manufacture_and_Assembly_(DfMA)

**Course Outcome and their mapping with Program Outcomes:**

| After completion of the course, the students will be able to | | |
|---|---|---|
| COs | Statement | Highest BTL |
| CO1 | Associate all the stakeholders for effective NPD in an organization | K3 |
| CO2 | Predict the feasible concept for product development | K2 |
| CO3 | Explain the various processes involved in product architecture | K2 |
| CO4 | Defend the significance of the Industrial Design process in product development. | K3 |
| CO5 | Discuss the cost involved in project execution and product-making. | K3 |

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO5 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 2 | | | | | | 2 | | 2 | 2 | | |
| CO2 | 3 | 2 | 3 | 2 | | | | | | | | 2 | 2 | | |
| CO3 | 3 | 2 | 3 | 2 | | | | | | 2 | | 2 | 2 | | |
| CO4 | 3 | 2 | 3 | 2 | | | 2 | 2 | | | 2 | 2 | 2 | | |
| CO5 | 3 | 2 | 3 | 2 | | | | | | 2 | 2 | 2 | 2 | | |

**Guru Ghasidas Vishwavidyalaya**
**Central University**
Department of Mechanical Engineering

| CODE | COURSE NAME | HOURS PER WEEK | | | CIA | SEA | CREDIT |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| MEUFTP3 | MATERIALS CHARACTERIZATION TECHNIQUES | 3 | - | - | 40 | 60 | 3 |

Course objectives:

1. To classify materials characterization techniques
2. To understand the principles and operation of different characterization tools
3. Explain the operation variables on the formation of quality images/results
4. Select suitable characterization tools based on the need of the analysis

| | |
|---|---|
| UNIT – I | **Optical Microscopy** |
| | Fundamentals of optics, Optical microscope and its instrumental details, Variants in optical microscopes and image formation, Phase contrast, Polarized light, Sample preparation and applications of optical microscopes. |
| UNIT – II | **Electron Microscopy** |
| | **Scanning Electron Microscopy (SEM)** - Introduction, Instrumentation, Contrast formation, Operational variables, Specimen preparation, imaging modes, Applications, Limitations.<br>**Transmission Electron Microscopy (TEM) -** Introduction, Instrumentation, Specimen preparation-pre thinning, final thinning, Image modes- mass density contrast, diffraction contrast, phase contrast, Applications, Limitations. |
| UNIT – III | **X-ray diffraction** |
| | **X-ray diffraction:** Fundamentals of X-ray generation and scattering, properties and applications of X-rays, absorption of X-rays and filters, Bragg's law, X-Ray diffraction and applications, working principles of diffractometer, diffraction methods, diffraction intensities, factors affecting intensity, 'structure factor' calculations, Indexing of XRD patterns. |
| UNIT – IV | **Thermal Characterizations** |
| | **Thermal Analysis -** Introduction, Common characteristics- Instrumentation, experimental parameters, Different types used for analysis, Thermo-gravimetry, Differential Scanning Calorimetry, Differential Thermal Analysis, Dynamic Mechanical Analysis. |
| UNIT -V | **Magnetic Characterizations** |
| | **Magnetic characterization techniques -** Introduction to Magnetism, Measurement Methods, Measuring Magnetization by Force, Measuring Magnetization by Induction method, Types of measurements using magnetometers: M-H loop, temperature dependent magnetization, time dependent magnetization. |

**Text/ Reference Books:**


1. Characterization of Materials (Materials Science and Technology: A Comprehensive Treatment, Vol 2A & 2B, VCH (1992).
2. Semiconductor Material and Device Characterization, 3rd Edition, D.K. Schroder, Wiley-IEEE Press (2006).
3. Materials Characterization Techniques, S Zhang, L. Li and Ashok Kumar, CRC Press (2008).
4. Physical methods for Materials Characterization, P.E. J. Flewitt and R K Wild, IOP Publishing (2003).
5. Characterization of Nanophase materials, Ed. Z L Wang, Willet-VCH (2000).
6. Thermal Analysis of Materials, Robert F. Speyer, Marcel Dekker Inc., New York, 1994.

7. David B. Williams, C. Barry Carter, Transmission Electron Microscopy, Springer 2009.
8. Cullity B. D., 'Elements of X-ray Diffraction', 4th Edition, Addison Wiley, 1978.

**Course Outcome and their mapping with Program Outcomes:**

After completion of the course, the students will be able to:

| **COs** | **Course Outcomes** | **Bloom's Taxonomy** |
|---|---|---|
| CO1 | Study the principles and methods of analyzing the optical structure of materials | Understand |
| CO2 | Understand the working and analysis of the images of electron microscopy | Understand |
| CO3 | Determine crystal structure, lattice parameter, phase identification, and residual stress analysis using XRD | Evaluate |
| CO4 | Analyze the specimen by thermal analysis to study high temperature behavior of materials | Analyze |
| CO5 | Analyze the magnetic behavior of materials | Analyze |

| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 2 | - |
| **CO2** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 2 | - |
| **CO3** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 2 | - |
| **CO4** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 2 | - |
| **CO5** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 2 | - |
| **Avg.** | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | 3 | 2 | - |

| Sub Code | L | T | P | Duration | IA | ESE | Total | Credits |
|---|---|---|---|---|---|---|---|---|
| MEUFTI1 | 1 | 0 | 0 | -- | 100 | -- | 100 | 1 |

## Metal Cutting (One Credit Course)

**Course Objectives:**

- To provide students with a comprehensive understanding of the principles and techniques of metal cutting
- To develop students' proficiency in using various metal cutting tools and machines
- To enhance students' ability to interpret engineering drawings and select appropriate metal cutting methods for specific applications
- To cultivate students' problem-solving skills in analyzing and resolving issues related to metal cutting processes

**Course Content**

Basics of Metal Cutting - Various operations - Concepts of stationary and rotary tools 3hrs

Cutting tool evolution – Cutting tool materials – Latest trends in the cutting tools – Grades and Geometries – Coating processes of cutting tools 6 hrs

Workpiece materials – Properties- Cutting tool selection – Machining Concepts – High Speed Machining – Cutting fluids – Wet and Dry Machining 3 hrs

Machine tools – Turning lathe – VMC – HMC – Twin mill centre – Clamping systems – Fixtures 3 hrs

Course Outcomes

CO1 Students will be able to explain the fundamental concepts and theories related to metal cutting, including the mechanics of chip formation, tool wear, and cutting forces

CO2 Students will demonstrate competence in operating and setting up different types of metal cutting machines, such as lathes, milling machines, and bandsaws.

CO3 Students will be able to interpret engineering drawings and select appropriate cutting tools, speeds, and feeds for specific machining operations

CO4 Students will develop the ability to analyze and troubleshoot common problems in metal cutting processes, such as chatter, surface roughness, and dimensional inaccuracies

**References:**


1. Fundamentals of Metal Cutting and Machine Tools, B.L.Juneja, G.S.Sekhon and Nitin Seth, 2nd edition, New Age International (P) Ltd, 2005.
2. Metal cutting & Tool Design By Ashok Kumar Singh, 1st edition, Vayu Education of India; First Edition, 2014.
3. Metal cutting Theory & Practice, Stephenson, David A.; Agapiou, John S, CRC press, 1997.
4. Machining & Machine Tools, AB Chattopadhyay, Wiley; Second edition, 2017
5. CNC Machines & Automation, Khusdeep Ghoyal, S.K. Kataria & Sons; 2014.


**Course Outcomes and their mapping with Programme Outcomes:**

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | | 1 | | | 2 | | | | | 1 | | 1 | 1 | |
| CO2 | 3 | | 2 | | 1 | 1 | | | | | | | 1 | | 2 |
| CO3 | 3 | 2 | | | | 1 | 1 | | | | | | | 2 | 1 |
| CO4 | 1 | 1 | | 1 | | 2 | 1 | | | | | | 1 | 1 | |

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

**Proposed Evaluation system**

Industry Integrated course / one credit courses will be evaluated by the course instructor / department faculty concerned and will carry a total of 100 marks for internal assessment such as assignments, seminars, quiz, projects, etc.

Course developed by

**B.R.Naresh, B.E., MBA,**

| Sub Code | L | T | P | Duration | IA | ESE | Total | Credits |
|---|---|---|---|---|---|---|---|---|
| MEUFTI2 | 1 | 0 | 0 | -- | 100 | -- | 100 | 1 |

## Environment friendly power generation from coal (One Credit Course)

Course Objectives:

- To understand the importance and challenges associated with power generation from coal in the context of environmental sustainability.
- To explore various technologies and techniques for mitigating the environmental impact of coal-based power generation.
- To examine the potential of clean coal technologies and their application in reducing emissions from coal-fired power plants.
- To promote critical thinking and problem-solving skills in identifying innovative solutions for reducing the carbon footprint of coal-based power generation

Course content

Session 1

Basic aspects of thermal power generation: Power plant cycle, Fuels and its handling, ash handling, Turbine, Feed water heaters, Generator, Condenser, Cooling tower and its types etc.,

Session 2 &3

Types of fuel and its preparation, constituents of fuel and its effect on emission.

Furnace, types of burner, Fuels combustion in boiler – Coal, biomass, co-combustion in the boiler, combustion arrangement, Tangential firing, front and rear wall firing systems.

Session 4 & 5

Air requirement in boiler – Primary, Secondary air, Flue gas generation, Gas velocity, Ash formation, types of waste generation in a power plant, non hazardous, hazardous, waste storage, waste disposal.

Session 6 & 7

Pollutant formation in the boiler, SOx, NOx, CO2, Particulate matter etc. measurement of pollutants, instruments, emission norms, various measures to reduce emission.

Session 8 &9

Heat transfer mechanism in boiler and in auxiliaries like air pre heater, Economiser, Water wall, Super heater, Reheater etc.,

Session 10 & 11

Particulate Matter formation and its control methods. – ESP, bag filter, ash handling systems, Dry and wet ash evacuation its effect on water consumption.

Session 12 & 13

SOx formation and its control techniques – different types, FGD, Wet FGD, Dry FGD, Ammonia FGD, effect of FGD on power plant operation, gypsum formation etc.,

Session 14 &15

NOx formation and its control techniques – different types, SCR, SNCR, combustion modification, effect of NOx control on power plant operation etc.,

Total Hours: 15

References


1. Power Generation from Solid Fuels (Power Systems) by Hartmut Spliethoff
2. Abatement systems for SOx, NOx, and particles — Technical options by Stanley C. Wallin
3. Environmental Impact of Power Generation, By The Royal Society of Chemistry, R.E. Hester, R. M. Harrison


Course outcomes

By the end of this course, students will be able to

CO1 Explain the environmental impact of coal-based power generation, including greenhouse gas emissions, air pollution, and water usage.

CO2 Identify and evaluate different technologies for reducing emissions and improving the efficiency of coal-fired power plants, such as advanced combustion techniques, flue gas desulfurization, and carbon capture.

CO3 Understand the concept of clean coal technologies and their application in minimizing environmental pollutants.

Course Outcomes and their mapping with Programme Outcomes:

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 1 | | | 1 | | 2 | 3 | | | | 1 | 2 | 2 | | |
| CO2 | 2 | | | | | 2 | 3 | | | | 1 | 2 | 2 | | 1 |
| CO3 | 2 | | 1 | | | 2 | 3 | | | | 1 | 2 | 1 | | |

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Proposed Evaluation system

Industry Integrated course / one-credit course will be evaluated by the course instructor/department faculty concerned and will carry a total of 100 marks for internal assessment such as assignments, seminars, quizzes, projects, etc.

Course developed by


Dr. M. Muthuraman, M.E (NIT, Trichy), Ph.D. (Japan)
Additional General Manager,
Environment Management Group (EMG),
NTPC Sipat,
Bilaspur 495 555

| CODE | COURSE NAME | HOURS PER WEEK | | | CIA | SEA | CREDIT |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| MEUFTO1 | Fundamentals of Fluid Mechanics | 3 | - | - | 40 | 60 | 3 |

**Course Objectives: The student shall**

1 To familiarize with the properties of fluids and the applications of fluid mechanics

2 To formulate and analyze problems related to calculation of forces in fluid structure interaction

3 To understand the concept of fluid measurement, types of flows and dimensional analysis

4 To understand boundary layer concepts

UNIT-1 **Fundamentals**

Fundamentals of Fluid Mechanics: Introduction; Applications; Concept of fluid; Difference between solids, liquids and gases; Concept of continuum; Ideal and real fluids; Fluid properties

UNIT-2 **Fluid Statics**

Fluid Statics: Concept of static fluid pressure; Pascal's law and its engineering applications; Hydrostatic paradox; Pressure distribution in a liquids

UNIT-3 **Fluid Kinematics**

Fluid Kinematics: Classification of fluid flows; Lagrangian and Euler flow descriptions; Velocity and acceleration of fluid particle; Local and convective acceleration; Normal and tangential acceleration; Flow rate and discharge mean velocity; One dimensional continuity equation; Continuity equation

UNIT-4 **Fluid Dynamics**

Fluid Dynamics: Euler's equation of motion; Bernoulli's equation using principle of conservation of energy; equation of motion and its applications to steady state ideal and real fluid flows

UNIT-5 **Fluid Devices**

Fluid devices; Conversion of mechanical to fluid energy - applications

TEXT BOOKS:

1 Yunus A Cengel, Fluid Mechanics-Fundamentals and Applications, McGraw Hill, 4th Edition, 2019

REFERENCE BOOKS:

1 F.M. White, Fluid Mechanics, McGraw Hill, 9th Edition, 2022

2 P.N. Modi and S.M. Seth, Hydraulics and Fluid Mechanics Including Hydraulics Machines, SBH, 22nd Edition, 2019

WEB RESOURCES

1 https://nptel.ac.in/courses/112104118

2 https://onlinecourses.nptel.ac.in/noc21_me75/preview

3 https://edurev.in/courses/24694_Fluid-Mechanics-and-Hydraulic-Machines

| **Course Outcomes (COs): After the course completion, student shall be able to** | |
|---|---|
| CO1 | Understand the concept of fluids and their properties |
| CO2 | Distinguish various types of flows and learn flow measurement methods |
| CO3 | Apply the concept to solve the problems related to fluid statics |
| CO4 | Apply concepts to solve problems on fluid kinematics |
| CO5 | Demonstrate working principle of various fluid-based devices |

| CO | PO | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 | 1 |
| CO2 | 3 | 2 | 2 | | | | | | | | | | 3 | 1 | 1 |
| CO3 | 3 | 2 | 2 | | | | | | | | | | 3 | 1 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 | 1 |

# Guru Ghasidas Vishwavidyalaya
# Central University
## Department of Mechanical Engineering

| CODE | COURSE NAME | HOURS PER WEEK | | | CIA | SEA | CREDIT |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| MEUFLT1 | MTT LAB | - | - | 2 | 20 | 30 | 1 |

Course objectives:

- To understand the working principles of various machines viz lathe, Drilling, milling, shaping and types of Machine Tools used in machining.
- To understand the Super Finishing Processes, CNC machines, Introduction to 3D and 4D printing, Rapid prototyping
- Learn about different alignment techniques and use of jigs & fixtures

| S.No. | Title of Experiments |
|---|---|
| 1 | To Perform Various Lathe Operations Such As Plain Turning, Step Turning, Taper Turning Knurling And Chamfering On A Given Material Made Of Mild Steel. |
| 2 | To Perform Milling Operation On The Given Specimen (Mild Steel) & Get To Its Correct Dimensions. |
| 3 | To Perform Surface Grinding Operation On The Given Work Piece. |
| 4 | To Drill The Given Work Piece As Required And Then To Perform Counter Drilling, Counter Sinking, Tapping Operations On The Given Work Piece. |
| 5 | To Make A Slot On The Given Work Piece |
| 6 | To Understand the computer controlled manufacturing such as CNC, NC, DNC, CAM & Robotics. |

TEXTBOOKS:

1. Rao, P.N., Manufacturing Technology, Vol I & II, Tata Mcgraw Hill Publishing Co., New Delhi, 1998
2. Sharma, P.C., A Textbook Of Production Technology – Vol I And II, S. Chand & Company Ltd., New Delhi, 1996

REFERENCE BOOKS:

1. Manufacturing science By A. Ghosh A.K. Mallik East West Press Pvt. Ltd New Delhi
2. Manufacturing Process by O P Khanna Dhanpat Rai Publication
3. Manufacturing Engg. And technology by S. Kalpakjian S.R. Schmid, Addision Wesley Longman, New Delhi

WEB RESOURCES

YouTube videos

**Course Outcomes and their Mapping with Program Outcomes:**

| COs | Statement |
|---|---|
| CO1 | Carry out various operations on lathe machine |
| CO2 | Perform milling and surface grinding operations. |
| CO3 | Perform various drilling operations |
| CO4 | Understanding the computer controlled manufacturing such as CNC, NC, DNC, CAM & Robotics. |

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | | | | | | | 3 | | | 1 | 1 | | |
| CO2 | 3 | | | | | | | | 3 | | | 1 | 1 | | |
| CO3 | 3 | | | | | | | | 3 | | | 1 | 1 | | |
| CO4 | 3 | | | | | | | | 3 | | | 1 | 1 | | |

**Guru Ghasidas Vishwavidyalaya**
**Central University**
Department of Mechanical Engineering

| CODE | COURSE NAME | HOURS PER WEEK | | | CIA | SEA | CREDIT |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| MEUFLT2 | MODELLING AND SIMULATION-II LAB | - | - | 2 | 20 | 30 | 1 |

Course objectives:
1. To learn the basic features in analysis using FEA software.
2. To perform analyses of various problems with 1D and 2D elements
3. To perform analysis of dynamic systems in mechanical engineering domain

| S.No. | List of Laboratory activities |
|---|---|
| 1 | Introduction to Finite Element Analysis software - ANSYS |
| 2 | Solve 1D – Structural, thermal and fluid problems |
| 3 | Solve Plane truss problems, include problems with symmetry. |
| 4 | Solve Beam problems with different boundary and loading conditions |
| 5 | Solve 2D problems using different element types. Also analyse effect of element formulation and number of elements |
| 6 | Solve plate and shell problems |
| 7 | Solve Dynamic problems |

REFERENCE BOOKS:
1. ANSYS Theory Manual
2. ANSYS Tutorials

WEB RESOURCES

YouTube videos

**Course Outcomes and their Mapping with Program Outcomes:**

| After completion of the course, the students will be able to | | |
|---|---|---|
| COs | Statement | Highest BTL |
| CO1 | Use basic modelling features in creating a solid model | K3 |
| CO2 | Understand mesh metrics and develop suitable mesh | K3 |
| CO3 | Apply suitable components for analysis of mechanical systems | K3 |

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 1 | - | 3 | | | | 3 | 3 | | 1 | 3 | 1 | |
| CO2 | 1 | 1 | 1 | 2 | 3 | | | | 3 | 3 | | 1 | 3 | 1 | |
| CO3 | 3 | 3 | 3 | 2 | 3 | | | | 3 | 3 | | 1 | 3 | 1 | |

# Guru Ghasidas Vishwavidyalaya
# Central University
## Department of Mechanical Engineering

| CODE | COURSE NAME | HOURS PER WEEK | | | CIA | SEA | CREDIT |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| MEUETT4 | Automobile Engineering | 3 | - | - | 40 | 60 | 3 |

Course objectives:

1. This introduces the student about automobiles, its components and give them a brief idea about electric vehicles and its importance.
2. To study the importance of assembly components of automobiles.
3. The course provides the knowledge of various transmission, drive shaft design, four and all-wheel drive systems.
4. To study the importance of steering system, suspension system, braking system, and wheels & tires.
5. The course gives basic technical foundation regarding electric vehicles.

| | |
|---|---|
| UNIT – I | Introduction to automobiles |
| | Main units of automobile chassis & body, different systems of the automobile, description of the components of IC engine, automobiles & electric prime movers. Resistance to motion, tractive effort & traction, road performance curves. Introduction to Electric vehicles: Understanding the foundations of the electric vehicles, basics of electric motors, basics of motor controller (EVs). |
| UNIT -II | Transmission system & gear box |
| | Layout of transmission system, main function of the different components of transmission system, traditional & modern transmission system, clutch, four wheel drives. Hotchkiss & torque tube drive. Ward Leonard Speed Control System. Communication Protocols (in case of EVs).<br>Gear box: Sliding mesh, constant mesh & synchromesh gear box, overdrive, torque converter, semi & fully automatic transmission. Hook's joint, Propeller shaft, differential, rear axles, types of rear axles, front axles and front wheel drive. |
| UNIT -III | Front wheel geometry, steering system, wheels & tires |
| | Camber, Castor, Kingpin inclination, toe-in & toe-out, condition for true rolling motion of wheels during steering. Components of steering mechanism, power steering.<br>Wheels & tires: Types of wheels, Slip angle, under & over steering, tire specification, tubeless tire. |
| UNIT IV | Suspension & Safety system, Braking system |
| | Suspension & Safety system: Types of suspension system, leaf spring, coil spring & torsion bar. Telescopic type shock absorber, pneumatic suspension system, air bag, crash resistance & passenger comfort.<br>Braking system: Hydraulic braking system, braking of vehicles when brake is applied to rear, front and all four wheel, theory of internal shoe brake, disc brake, power brake & antilock braking system. |
| UNIT V | Modern Vehicle Technology |
| | Fuel cells technology for vehicles, Types of fuel cells, Current state of the technology, Potential & challenges, Latest engine technology. Basics of |

| | |
|---|---|
| | Lithium-ion batteries (used in EVs), Battery management system (in EVs), Charging technology and implementation (in EVs).Connecting Rods - Forces Acting on the Connecting Rod - Design of Connecting Rod.<br>Crankshafts - Design Procedure for Crankshaft - Design for Centre Crankshaft - Side or Overhung Crankshaft. |

TEXT BOOKS:

1. Automobile Engineering, K.K. Ramalingam, Scitech Publications Pvt Ltd.
2. Automobile Technology, Dr. N.K. Giri, Khanna Publishers.
3. Automobile Engineering, Prof. Amitosh De, Galgotia Publications Pvt Ltd.
4. Modern Transmission Systems, A.W.Judge, Chapman & Hall Ltd.
5. Automotive Mechanics-Principle & Practice, Josepe Heitner, East West Press.
6. Torque Converter, P.M.Heldt, Chilton Book Co.

**Course Outcome and their mapping with Program Outcomes:**

| After completion of the course, the students will be able to | | |
|---|---|---|
| COs | Statement | Highest BTL |
| CO1 | Understanding design and analysis of transmission & drive system, Analyse use of suitable materials in making automobile components. | K3 |
| CO2 | Design the shaft and temporary joins for varied application graduates will be able to demonstrate & get an idea in identifying understand the problems in conventional automobiles & electric vehicles. | K2 |
| CO3 | Course will develop a strong base for understanding future developments in the automobile industry to the graduates. | K2 |
| CO4 | Understand importance and features of different systems like axle, differential, brakes, steering, suspension, and balancing etc. | K2 |
| CO5 | Identify Modern technology and safety measures used in Automotive Vehicles | K2 |

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO5 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | | | | | | | | | | 1 | | |
| CO2 | 3 | 3 | 3 | | | | | | | | | | 1 | | |
| CO3 | 3 | 3 | 2 | | | | | | | | | | 1 | | |
| CO4 | 3 | 3 | 2 | | | | | | | | | | 1 | | |
| CO5 | 3 | 3 | 2 | | | | | | | | | | 1 | | |