# List of New Course(s) Introduced

**Department : *Mechanical Engineering***

**Programme Name : *B.Tech.***

***Academic Year: 2024-25***

## *List of New Course(s) Introduced*

| Sr. No. | Course Code | Name of the Course |
|---|---|---|
| 01. | MEUETI1 | Innovation and Design Thinking |
| 02. | MEUGTD3 | Maintenance Engineering and Management |
| 03. | MEUETO1 | Fundamentals of Thermodynamics* |
| 04. | MEUFTT2 | Finite Element Analysis |
| 05. | MEUFTP1 | Machine Tool Technology |
| 06. | MEUFTP2 | Product Design & Development |
| 07. | MEUFTP3 | Material Characterization |
| 08. | MEUFTI1 | Metal Cutting |
| 09. | MEUFTI2 | Environment Friendly Power Generation from Coal |
| 10. | MEUFTO1 | Fundamentals of Fluid Mechanics* |

# Minutes of Meetings (MoM) of Board of Studies (BoS)

**Academic Year: 2024-25**

**School : School Of Studies of Engg. & Technology**

**Department : *Mechanical Engineering***

**Date and Time : 03-07-2024 ,3:30 PM**

**Venue : Online**

The scheduled meeting of member of Board of Studies (BoS) of Department of Mechanical Engineering, School of Studies of Engg. & technology, Guru Ghasidas Vishwavidyalaya, Bilaspur was held to design and discuss the B. Tech. III year (V and VI semesters) scheme and syllabi.

The following members were present in the meeting:

1. Dr. Soumya Gangopadhyay (External Expert Member BoS,Dept. of Mechanical Engg., IIT Bhilai)
2. Prof. S.P. Anbuudaysankar (Chairman, BoS, Dept. of Mechanical Engg.)
3. Dr.Pankaj Kumar Gupta (Member BoS, Assoc. Professor, Dept. of Mechanical Engg.)
4. Dr. Jasinta Poonam Ekka(Member BoS, Assoc. Professor, Dept. of Mechanical Engg.)
5. Mr. Roshan Singh Navlur, (Member, Industry Expert, Director, CADMATIC)
6. Dr. T.G. Loganathan (Invited member,Assoc. Prof., Dept. of Mechanical Engineering)

The following points were discussed during the meeting

1. The course syllabi for 7th and 8th semesters of B.Tech. III Year was discussed. With the consent of all the members, the course scheme and syllabi for the 5 th and 6 th semesters in B.Tech. III year Mechanical Engineering was finalized.

2. The committee discussed and approved the scheme and syllabi of B.Tech. III Year ,5 th and 6 th semesters

The following new courses were introduced in the of B. Tech. III year (V and VI Semesters):

- Innovation and Design Thinking (MEUETI1)
- Maintenance Engineering and Management (MEUGTD3)
- Fundamentals of Thermodynamics*(MEUETO1)
- Industrial Sustainability (MEUGTP1)
- Machine Tool Technology (MEUFTP1)
- Product Design & Development (MEUFTP2)
- Material Characterization (MEUFTP3)
- Metal Cutting (MEUFTI1)
- Environment Friendly Power Generation from Coal (MEUFTI2)
- Fundamentals of Fluid Mechanics*(MEUFTO1)

Signature & Seal of HoD

# Scheme and Syllabus

## 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/Drawing | Examination 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 | Open Elective | MEUETO1 | Fundamentals of Thermodynamics* | 3 | - | - | | 40 | 60 | 100 | 3 |
| 6 | Practical | MEUELT1 | HMT Lab | - | - | 2 | | 20 | 30 | 50 | 1 |
| 7 | Practical | MEUEPV1 | Mini Project - II | - | - | 3 | | 20 | 30 | 50 | 2 |
| 8 | Practical | MEUELT2 | TOM 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**

# 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**

| 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

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.

## 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.

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| 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,

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| 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

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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 | |

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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

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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 | | |

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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.

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| 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.

**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 |
|---|---|---|---|---|---|---|---|---|
| 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

| 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,

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

| 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

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

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 | 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 |