**EST 110 ENGINEERING GRAPHICS**

CO 1 Draw the projection of points and lines located in different quadrants

CO 2 Prepare multiview orthographic projections of objects by visualizing them in different positions

CO 3 Draw sectional views and develop surfaces of a given object

CO 4 Prepare pictorial drawings using the principles of isometric and perspective projections to visualize objects in three dimensions.

CO 5 Convert 3D views to orthographic views CO 6 Obtain multiview projections and solid models of objects using CAD tools

**EST 120 MECHANICAL ENGINEERING**

CO 6 Analyse thermodynamic cycles and calculate its efficiency

CO 7 Illustrate the working and features of IC Engines

CO 8 Explain the basic principles of Refrigeration and Air Conditioning

CO 9 Describe the working of hydraulic machines

CO 10 Explain the working of power transmission elements

CO 11 Describe the basic manufacturing, metal joining and machining processes.

**ME201 MECHANICS OF SOLIDS**

CO 1 Determine the stresses, strains and displacements of structures by tensorial and graphical (Mohr's circle) approaches

CO 2 Analyse the strength of materials using stress-strain relationships for structural and thermal loading

CO 3 Perform basic design of shafts subjected to torsional loading and analyse beams subjected to bending moments

CO 4 Determine the deformation of structures subjected to various loading conditions using strain energy methods

CO 5 Analyse column buckling and appreciate the theories of failures and its relevance.

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**MET 203 MECHANICS OF FLUIDS**

CO1 Define Properties of Fluids and Solve hydrostatic problems

CO2 Explain fluid kinematics and Classify fluid flows

CO3 Interpret Euler and Navier-Stokes equations and Solve problems using Bernoulli's equation

CO4 Evaluate energy loses in pipes and sketch energy gradient lines

CO5 Explain the concept of boundary layer and its applications

CO6 Use dimensional Analysis for model studies.

**MET 20 METALLURGY& MATERIALSCIENCE**

CO 1 Understand the basic chemical bonds, crystal structures (BCC, FCC, and HCP), and their relationship with the properties.

CO 2 Analyze the microstructure of metallic materials using phase diagrams and modify the microstructure and properties using different heat treatments.

CO 3 How to quantify mechanical integrity and failure in materials.

CO 4 Apply the basic principles of ferrous and non-ferrous metallurgy for selecting materials for specific applications.

CO 5 Define and differentiate engineering materials on the basis of structure and properties for engineering applications

**MEL 201 COMPUTER AIDEDMACHINE DRAWING**

CO1 Apply the knowledge of engineering drawings and standards to prepare standard dimensioned drawings of machine parts and other engineering components.

CO2 Prepare standard assembly drawings of machine components and valvesusing part drawings

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and bill of materials.

CO3 Apply limits and tolerances to components and choose appropriate fits for given assemblies

CO 4 Interpret the symbols of welded, machining and surface roughness on the component drawings.

CO 5 Prepare part and assembly drawings and Bill of Materials of machine components and valves using CAD software

MET 283 FLUID MECHANICS AND MACHINERY

CO 1 Define Properties of Fluids and Solve hydrostatic problems

CO 2 Explain fluid kinematics and Classify fluid flows

CO 3 Interpret Euler's equation and Solve problems using Bernoulli's equation

CO 4 Explain the working of turbines and Select a turbine for specific application.

CO 5 Explain the characteristics of centrifugal and reciprocating pumps.

**MET 285 MATERIALSCIENCE ANDTECHNOLOGY(MINOR)**

CO 1 Understand the basic chemical bonds, crystal structures and their relationship with the properties.

CO 2 How to quantify failure of materials

CO 3 Given a hypothetical or real problem with an electronic materials device or process, explain the cause of the problem and propose solutions.

CO 4 Understand how materials interact at the nanoscale

CO 5 Define and differentiate engineering materials on the basis of structure and properties for engineering applications.

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**MET20 ENGINEERING THERMODYNAMICS**

CO1 Understand basic concepts and laws of thermodynamics

CO2 Conduct first law analysis of open and closed systems

CO3 Determine entropy and availability changes associated with different processes

CO4 Understand the application and limitations of different equations of state

CO5 Determine change in properties of pure substances during phase change processes

CO6 Evaluate properties of ideal gas mixtures.

**MET 204 MANUFACTURING PROCESS**

CO 1 Illustrate the basic principles of foundry practices and special casting processes, their advantages, limitations and applications.

CO 2 Categorize welding processes according to welding principle and material.

CO 3 Understand requirements to achieve sound welded joint while welding different similar anddissimilar engineering materials.

CO 4 Student will estimate the working loads for pressing, forging, wire drawing etc. processes

CO 5 Recommend appropriate part manufacturing processes when provided a set of functional requirements and product development constraints.

**MET 206 FLUID MACHINERY**

CO1 Explain the characteristics of centrifugal and reciprocating pumps

CO2 Calculate forces and work done by a jet on fixed or moving plate and curved plates

CO3 Explain the working of turbines and Select a turbine for specific application.

CO4 Analyse the working of air compressors and Select the suitable one based on application.

CO5 Analyse gas turbines and Identify the improvements in basic gas turbine cycles.

CO6 Explain the characteristics of centrifugal and reciprocating pumps

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## MET 284 THERMODYNAMICS

CO1 Understand basic concepts and laws of thermodynamics
CO2 Conduct first law analysis of open and closed systems
CO3 Determine entropy changes associated with different processes
CO4 Understand the application and limitations of the ideal gas equation of state
CO5 Determine change in properties of pure substances during phase change processes
CO6 Evaluate properties of ideal gas mixtures

## MET 282 THEORY OF MACHINES

CO 1 Interpret basic principles of mechanisms and mechanism based on velocity and acceleration. List the machines and Analyse a given basic types of mechanical clutches.

CO2 Describe the theories of gears and gear trains. List the basic selection requirements of different types of mechanical brakes.

CO 3 Develop the profile of CAMs as per the requirements and to understand cam profile.

CO 4 Explain the dynamic balancing of revolving and reciprocating masses. Describe the fundamentals of gyroscope and its application.

CO 5 Analyse the performance of governors and flywheels.

## MET 294 ADVANCED MECHANICS OF FLUIDS

**CO 1** Apply conservation equations of fluid mechanics
**CO 2** Use potential flow theory in fluid problems
**CO 3** Utilize approximate solutions of the Navier-Stokes equations
**CO 4** Compute effect on boundary layers.
**CO 5** Explain turbulence and turbulence modelling

## MET 301 MECHANICS OF MACHINERY

**CO 1** Explain the fundamentals of kinematics, various planar mechanisms and interpret the basic prin
**CO 2** Perform analysis and synthesis of mechanisms
**CO 3** Solve the problem on cams and gear drives, including selection depending on requirement.
**CO 4** Calculate the gyroscopic effect in various situations

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**CO 5** Analyse rotating and reciprocating masses for its unbalance

**MET303 THERMAL ENGINEERING**

**CO 1** Explain the working of steam power cycle and related components
**CO 2** Discuss the working of steam turbines and methods for evaluating the performance
**CO 3** Illustrate the performance testing and evaluation of IC engines
**CO 4** Explain the combustion phenomenon and pollution in IC engines
**CO 5** Discuss the principles of refrigeration and air-conditioning and basic design considerations

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## MET 307 Machine Tools and Metrology

| | |
|---|---|
| CO 1 | Analyze various machining process and calculate relevant quantities such us velocities, forces and powers. |
| CO 2 | Analyze of the tool nomenclature with surface roughness obtainable in each machining processes. |
| CO 3 | Understand the limitations of various machining process with regard to shape formation and surface texture. |
| CO 4 | Demonstrate knowledge of the underlying principles of measurement, as they relate to mechanical measurement, electronic instrumentation, and thermal effects. |
| CO 5 | Get an exposure to advanced measuring devices and machine tool metrology. |

## MET 302 HEAT & MASS TRANSFER

| | |
|---|---|
| **CO 1** | Apply principles of heat and mass transfer to engineering problems |
| **CO 2** | Analyse and obtain solutions to problems involving various modes of heat transfer |
| **CO 3** | Design heat transfer systems such as heat exchangers, fins, radiation shields etc. |
| **CO 4** | Define laminar and turbulent boundary layers and ability to formulate energy equation in flow systems. |

## MET 304 DYNAMICS AND DESIGN OF MACHINERY

| | |
|---|---|
| **CO 1** | Do engine force analysis and to draw turning moment diagrams |
| **CO 2** | Analyse free and forced vibrations of single degree of freedom systems |
| **CO 3** | Determine the natural frequencies of a two degree of freedom vibrating system and to calculate the stresses in a structural member due to combined loading |
| **CO 4** | Design machine elements subjected to fatigue loading and riveted joints |
| **CO 5** | Design welded joint and close coiled helical compression spring |

## MET 306 ADVANCED MANUFACTURING ENGINEERING

| | |
|---|---|
| CO 1 | To be conversant with the advanced machining process and to appreciate the effect of process parameters on the surface integrity aspects during the advanced machining process. |
| CO 2 | CNC programming, select appropriate tooling and fixtures. |
| CO 3 | To categorize the various nontraditional material removal process based on energy sources and mechanism employed. |
| CO 4 | Analyze the processes and evaluate the role of each process parameter during micro machining of various advanced material removal processes. |
| CO 5 | Explain the processes used in additive manufacturing for a range of materials and applications. |

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## MET 312 NON DESTRUCTIVE TESTING

| | |
|---|---|
| CO 1 | Have a basic knowledge of surface NDT which enables to carry out various inspections in accordance with the established procedures. |
| CO 2 | The students will be able to differentiate various defect types and select the appropriate NDT methods for the specimen. |
| CO 3 | Calibrate the instrument and evaluate the component for imperfections. |
| CO 4 | Have a basic knowledge of ultrasonic testing which enables them to perform inspection of samples. |
| CO 5 | Have a complete theoretical and practical understanding of the radiographic testing, interpretation and evaluation. |

## MET 322 COMPUTATIONAL FLUID DYNAMICS

| | |
|---|---|
| CO 1 | Understanding the governing equations dominating fluid flow and heat transfer and their mathematical and physical nature. |
| CO 2 | Understand finite difference method to fluid flow problems and the level of errors associated with these methods. |
| CO 3 | Understand and apply finite volume method to fluid flow and heat transfer problems. |
| CO 4 | Understand and apply finite volume method to diffusion and convection problems and various interpolation schemes. |
| CO 5 | Understand various methods in numerically solving Navier Stokes equation for incompressible flows. |
| CO 6 | Understand various graphical techniques to present post processed results. |

## MET 332 ADVANCED MECHANICS OF SOLIDS

| | |
|---|---|
| CO 1 | Formulate the field equations of Elasticity. |
| CO 2 | Model some engineering problems as two-dimensional, for easy solutions involving a Stress Function. |
| CO 3 | Develop solutions for axi-symmetric problems for applications in thick pressure vessels and in rotating circular discs. |
| CO 4 | Extend the basic ideas related to theory of elastic flexure, for skewed loading and for beams which are curved. |
| CO 5 | Apply solution methods for torsion in components with non-circular cross sections and thin walled structures. |

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**MET 342 IC ENGINE COMBUSTION AND POLLUTION**

| | |
|---|---|
| CO1 | Explain the basic concepts of fuel air mixing |
| CO2 | Understand the combustion process of SI engine |
| CO3 | Understand the combustion process of CI engine |
| CO4 | Explore various alternate fuels in IC engine |
| CO5 | Describe emission control technologies of IC engine |

**MET AUTOMOBILE ENGINEERING**

| | |
|---|---|
| CO 1 | Explain different automotive systems and subsystems . |
| CO 2 | Illustrate the principles of transmission, suspension, steering and braking systems of an automobile. |
| CO 3 | Build a basic knowledge about the technology in electric vehicles. |
| CO 4 | Summarize the concept of aerodynamics in automobiles. |

**MET 362 PRODUCT DESIGN AND DEVELOPMENT**

| | |
|---|---|
| CO 1 | Determine the life cycle of a product and product development process |
| CO 2 | Develop knowledge of robust design and conceptual design |
| CO 3 | Introduce the concept of Design for Manufacturing and Assembly in product design. |
| CO 4 | Use value engineering in the development of product |
| CO 5 | Incorporate ergonomics and rapid prototyping in product development. |

**MET 372 ADVANCED METAL JOING TECHNIQUES**

| | |
|---|---|
| CO 1 | Explain the physics, equipment, applications of EBW and LBW. |
| CO 2 | Summarise the physics, equipment, applications of diffusion welding and adhesive bonding processes. |
| CO 3 | Contrast the physics, equipment, applications of explosive welding with friction welding. |
| CO 4 | Outline the physics, equipment, applications of ultrasonic welding and brazing. |
| CO 5 | Illustrate the physics, equipment, applications of plasma arc welding and magnetically impelled arc butt welding. |
| CO 6 | Select an appropriate welding technique to resolve a metal joining problem. |

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**Semester 7**

## DESIGN OF MACHINE ELEMENTS MET401

| | |
|---|---|
| CO 1 | Design shafts based on strength, rigidity and design for static and fatigue loads, design flat belts and connecting rod of IC engines |
| CO 2 | Design clutches and brakes |
| CO 3 | Analyse sliding contact bearings and understand design procedure of journal, ball and roller bearings. |
| CO 4 | Design Spur gear and helical gear |
| CO 5 | Design Bevel gears and worm gears |

## MECHANICAL ENGINEERING LAB MEL411

| | |
|---|---|
| CO 1 | Get practical knowledge on design and analysis of mechanisms in the machines. |
| CO 2 | Measure the cutting forces associated with milling machining operations. |
| CO 3 | Apply the basic concepts of hydraulic and pneumatic actuators and their applications in product and processes |
| CO 4 | Use appropriate systems for data acquisition and control of product and processes |

## MEQ413 SEMINAR

| | |
|---|---|
| CO1 | Identify academic documents from the literature which are related to her/his areas of interest (Cognitive knowledge level: Apply). |
| CO2 | Read and apprehend an academic document from the literature which is related to her/ his areas of interest (Cognitive knowledge level: Analyze). |
| CO3 | Prepare a presentation about an academic document (Cognitive knowledge level: Create). |
| CO4 | Give a presentation about an academic document (Cognitive knowledge level: Apply). |
| CO5 | Prepare a technical report (Cognitive knowledge level: Create). |

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## MET455
## QUALITY ENGINEERING AND MANAGEMENT

| | |
|---|---|
| CO 1 | To be conversant with important terms for quality management in organisations |
| CO 2 | Have a complete theoretical and practical understanding of the contributions of Quality Gurus |
| CO 3 | Demonstrate knowledge of the underlying principles of strategic quality management |
| CO 4 | Identify various human dimensions of TQM |
| CO 5 | Implement different tools and techniques in TQM |
| CO 6 | Implement different statistical quality control techniques |

## MET473
## AIR CONDITIONING AND REFRIGERATION

| | |
|---|---|
| CO 1 | Explain the basics of refrigeration process. |
| CO 2 | Analyse the vapour compression refrigeration system and to improve the performance. |
| CO 3 | Describe vapour absorption and steam refrigeration system. |
| CO 4 | Design refrigeration system by selecting suitable components and environmentally refrigerant. |
| CO 5 | Evaluate the cooling load and capacity requirement of ac machine |

## MED415 PROJECT PHASE I

| | |
|---|---|
| CO1 | Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: Apply). |
| CO2 | Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: Apply). |
| CO3 | Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: Apply). |
| CO4 | Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: Apply). |
| CO5 | Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: Analyze). |
| CO6 | Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: Apply). |

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## Semester 8

## MET402 MECHATRONICS

| CO Nos | Course Outcomes | Level of learning domain |
|---|---|---|
| CO 1 | Explain the sensors and actuators used in mechatronics | 2 |
| CO 2 | Design hydraulic and pneumatic circuits for automation. | 6 |
| CO 3 | Explain the manufacturing processes used in MEMS | 2 |
| CO 4 | Demonstrate the various components of a CNC machine | 2 |
| CO 5 | Create a PLC program | 6 |
| CO 6 | Explain the robotic sensors and vision system | 2 |

## MED416 PROJECT PHASE II

| | |
|---|---|
| CO1 | Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: Apply). |
| CO2 | Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: Apply). |
| CO3 | Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: Apply). |
| CO4 | Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: Apply). |
| CO5 | Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: Analyze). |
| CO6 | Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: Apply). |

## MET414 QUALITY MANAGEMENT

| | |
|---|---|
| CO 1 | To be conversant with important terms for quality management in organisations |
| CO 2 | Have a complete theoretical and practical understanding of the contributions of Quality Gurus |
| CO 3 | Demonstrate knowledge of the underlying principles of strategic quality management |
| CO 4 | Identify various human dimensions of TQM |
| CO 5 | Implement different tools and techniques in TQM |
| CO 6 | Identify core and extended modules of ISO 9000 family of standards |

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## MET466 TECHNOLOGY MANAGEMENT

| | |
|---|---|
| CO 1 | Be conversant with important terms for technology management in organisations |
| CO 2 | Explain the need of technology forecasting |
| CO 3 | Understand the essence of technology acquisition |
| CO 4 | Describe the elements of technology strategy |
| CO 5 | Outline the basics of innovation |
| CO 6 | Identify human factors in technology management |

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