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**END SEMESTER EXAMINATION – NOV / DEC 2025**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **18ME3028** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED INSTRUMENTATION IN THERMAL ENGINEERING** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | List and describe the different types of errors encountered in experimental measurements. | CO1 | An | 10 |
|  | b. | The resistance of a certain size of copper wire is given as R = R0[1+α(T-20)] where R0 = 6Ω ± 0.3 percent is the resistance at 20℃, α = 0.004℃-1 ± 1 percent is the temperature coefficient of resistance, and the temperature of the wire is T = 30 ± 1℃. Calculate the resistance of the wire and uncertainty. | CO1 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Compare the performance of thermocouples, RTDs, and thermistors for high-temperature measurement applications. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 3. |  | Explain the working of different types of apparatus for measuring the thermal conductivity of liquids and gases | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Explain **gas chromatography principle and c**ompare **packed column** and **capillary column** gas chromatographs in terms of performance and resolution. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 5. |  | Discuss major elements of data acquisition and processing system. Analyze how errors propagate through each stage of a data acquisition system. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Compare static, dynamic, and transient pressure measurement techniques used in thermal systems. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 7. |  | Explain the techniques used for measuring the viscosity of liquids and gases. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Illustrate how a **factorial design** helps in studying interaction effects among process parameters. | CO6 | A | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Explain the need for **systematic experimental design** in thermal research. | CO6 | A | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Identify experimental data and predict correlation. |
| CO2 | Interpret uncertainties in various measurements. |
| CO3 | Apply measurement techniques of intensive and extensive properties. |
| CO4 | Analyze specific functional characteristics of thermal instruments. |
| CO5 | Estimate the control system parameters using analog and digital controllers. |
| CO6 | Formulate concepts to reduce errors in measurements. |

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**END SEMESTER EXAMINATION – NOV/DEC 2025**

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| **Course Code** | **18ME3029** | **Duration** | **3hrs** |
| **Course Title** | **BIOMASS ENERGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Compare the environmental impact of biomass with fossil fuels and discuss whether the advantages of biomass outweigh its disadvantages in combating climate change. | CO1 | An | 10 |
|  | b. | Write the significance of fixed carbon and volatile matter in biomass combustion. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Explain transesterification process to convert vegetable oil into biodiesel. Analyze the factors that influence the efficiency of the transesterification reaction. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 3. |  | Compare fixed-dome and floating-drum digesters in terms of cost, efficiency, and maintenance. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain why pyrolysis is considered environmentally friendly compared to traditional incineration. | CO4 | A | 10 |
|  | b. | Analyze the challenges of using pyrolysis oil as a direct replacement for petroleum-based fuels in engines. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 5. |  | Evaluate the economic feasibility of Fischer-Tropsch processes in producing synthetic fuels compared to refining crude oil. | CO5 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Compare the performance parameters of a diesel engine running on diesel and biodiesel blends. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 7. |  | Explain the working of downdraft gasifiers and Fluidized bed gasifier. | CO4 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Evaluate environmental and economic impacts of using biomass combustion systems in urban areas. | CO6 | E | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Analyze the economic, environmental, and social factors influencing biofuel sustainability. | CO6 | An | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Select suitable biomass for conversion, based on its properties. |
| CO2 | Analyze the performance of engines using biodiesel. |
| CO3 | Design a community biogas plant |
| CO4 | Select conditions for biomass pyrolysis & develop a small size biomass gasifier |
| CO5 | Demonstrate techniques used for liquefaction of biomass |
| CO6 | Explain the economics of production processes of bio fuels. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **20ME2004** | **Duration** | **3hrs** |
| **Course Title** | **DESIGN OF MEDICAL DEVICES AND IMPLANTS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Explain in short about the purpose of design control in medical devices. | | CO1 | U | 1 |
| 2. | What does ISO 13485 focus on? | | CO1 | R | 1 |
| 3. | Name any two metals used for biomedical implants. | | CO2 | R | 1 |
| 4. | Define biocompatibility. | | CO2 | R | 1 |
| 5. | Explain the function of a cardiac assist device. | | CO3 | U | 1 |
| 6. | Expand BiPAP. | | CO3 | R | 1 |
| 7. | Why is modulus matching important in implant design? | | CO4 | U | 1 |
| 8. | What is tribology in the context of implants? | | CO4 | R | 1 |
| 9. | How does corrosion differ from polymer degradation in biomedical implants? | | CO5 | U | 1 |
| 10. | Why are sterility tests performed on medical devices? | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Justify why a comprehensive understanding of ISO 13485 is considered as a foundational element of the medical device design process, rather than just a post-design requirement. | | CO1 | An | 3 |
| 12. | Summarize why titanium is generally considered to have excellent biocompatibility for use in implants. | | CO2 | U | 3 |
| 13. | Analyze the key engineering challenges in designing a portable oxygen concentrator (POC) compared to a large, stationary hospital unit. | | CO3 | An | 3 |
| 14. | Describe the primary function of a scaffold in cartilage repair, and what are two key properties it must possess. | | CO4 | U | 3 |
| 15. | A company is developing a new synthetic polymer for nerve guidance conduits. What factors must they analyze to ensure the polymer's degradation profile is suitable for this specific application? | | CO5 | An | 3 |
| 16. | What is the difference between hemocompatibility and general biocompatibility testing? Provide an example of a device that would require specific hemocompatibility tests. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the FDA-based medical device classification system and describe how devices are categorized into Class I, II, and III with suitable examples. | CO1 | U | 12 |
| 18. | a. | Explain the importance of modulus matching and tissue bonding in implant design. | CO2 | U | 6 |
|  | b. | Discuss the types and effects of degradation in medical implants. | CO2 | U | 6 |
| 19. |  | Explain the working principle and design considerations of an artificial heart. | CO3 | U | 12 |
| 20. |  | Discuss the role of modulus of elasticity and modulus matching in orthopedic implant design. | CO4 | An | 12 |
| 21. |  | Compare degradation issues between natural and synthetic polymers in biomedical devices. | CO5 | An | 12 |
| 22. |  | Discuss recent advancements in IoT-based medical device management systems. | CO5 | U | 12 |
| 23. |  | Elaborate in detail about the principle of dialysis equipment with its neat block diagram. | CO3 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Evaluate the significance of biocompatibility and hemocompatibility testing in risk assessment. | CO6 | E | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the class of medical devices and design cycle. |
| **CO2** | Apply the design process and different design models. |
| **CO3** | Evaluate the design procedures. |
| **CO4** | Have in-depth knowledge about blood interfacing implants |
| **CO5** | Evaluate the design quality and realization. |
| **CO6** | Test the design and evaluate the risk management involved in the design of new medical device. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **20ME2006** | **Duration** | **3hrs** |
| **Course Title** | **ENGINEERING ECONOMICS AND OPERATIONS RESEARCH** | **Max. Marks** | **100** |

***Normal Distribution Tables are permitted.***

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Calculate the profit of the company, as per the details described below:  The sales revenue of a company is Rupees 10,000, and the total cost of the company is Rupees 8000. | | CO1 | A | 1 |
| 2. | State the law of demand. | | CO1 | R | 1 |
| 3. | List some examples of the time value of money. | | CO2 | R | 1 |
| 4. | In a project, the total cash outflow is Rs 50,000 and the cash inflow is Rs 72,500 over its useful life of 3 years. Calculate the net present value of the project. | | CO2 | A | 1 |
| 5. | State a limitation of the graphical method in solving the Linear Programming problem. | | CO3 | R | 1 |
| 6. | State any two applications of the transportation problem. | | CO3 | R | 1 |
| 7. | Infer the procedure to balance an unbalanced transportation problem. | | CO4 | U | 1 |
| 8. | List some examples of assignment models. | | CO5 | R | 1 |
| 9. | Balance the following assignment table (Professors I,II III and IV and  classes A, B and C).   |  |  |  |  | | --- | --- | --- | --- | |  | A | B | C | | I | 0 | 1 | 2 | | II | 5 | 0 | 3 | | III | 7 | 8 | 4 | | IV | 11 | 10 | 5 | | | CO5 | A | 1 |
| 10. | Compare ‘ Burst event’ with ‘Merge event’. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare ‘fixed cost’ with ‘variable cost’. | | CO1 | An | 3 |
| 12. | Calculate the break-even quantity in number of units for the following description:  In a manufacturing plant, the fixed cost is computed as Rupees 5000, the unit selling price is Rupees 130, and the unit variable cost is Rupees 100. | | CO2 | A | 3 |
| 13. | Compare ‘Slack variable’ with ‘Surplus variable’. | | CO3 | An | 3 |
| 14. | Change the following transportation problem into a balanced one by putting appropriate dummy row or dummy column. Inner cells represent total cost of production:   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | Ware House 1 | Ware House 2 | Ware House 3 | Availability  (Number of Units) | | Plant 1 | 11 | 12 | 15 | 120 | | Plant 2 | 19 | 24 | 27 | 180 | | Requirement  (Number of Units) | 100 | 130 | 150 |  | | | CO4 | A | 3 |
| 15. | The following table is arrived after row wise and column wise reductions. Solve this by compulsoryallocation and give the optimal allocation.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | Lecture 1 | Lecture 2 | Lecture 3 | Lecture 4 | Lecture 5 | | Monday | 0 | 0 | 0 | 6 | 11 | | Tuesday | 6 | 0 | 4 | 4 | 0 | | Wednesday | 0 | 3 | 8 | 0 | 6 | | Thursday | 4 | 8 | 6 | 0 | 0 | | Friday | 3 | 2 | 0 | 0 | 7 | | | CO5 | A | 3 |
| 16. | Determine the critical path of the following project using a network diagram   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Activities | 1-2 | 1-3 | 2-4 | 3-4 | 4-5 | | Immediate  Predecessor | Nil | Nil | 1-2 | 1-3 | 2-4 and 3-4 | | Duration(Weeks) | 3 | 4 | 5 | 2 | 7 | | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Summarize the various determinants of demand. | CO1 | E | 6 |
|  | b. | Evaluate the various forms of demand elasticity in relation to the price of the product. | CO1 | E | 6 |
|  |  |  |  |  |  |
| 18. | a. | Discuss the aim, functions and procedure of Value Engineering. | CO2 | U | 6 |
|  | b. | The initial cost of a project is Rupees 4,000 and the forecast of year-end cash inflows is Rupees 1,900, Rupees 1,600, Rupees 1,400, Rupees 1,200 and Rupees 1,100 respectively during the 5 years of its useful life. If the rate of interest is 10%. Determine the Net Present Value (NPV) of the project | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | A machine shop has one shearing (machine A), one punching (machine B) and one de-burring machine (machine C). Time in minutes for shearing, punching and de-burring operations is given for the 5 jobs. Determine the optimal order (sequence) in which the jobs are to be processed to minimize the total time. Determine the total time to process all the jobs and idle time of each machine.   |  |  |  |  | | --- | --- | --- | --- | | Job | Shearing  Time  (Minutes) | Punching  Time  (Minutes) | De-burring  Time  (Minutes) | | 1 | 40 | 50 | 80 | | 2 | 20 | 60 | 100 | | 3 | 80 | 20 | 60 | | 4 | 50 | 30 | 70 | | 5 | 60 | 40 | 110 | | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Solve the following LPP by the graphical method:  Minimize Z=30X 1+20X 2  Subjected to the constraints  5X 1+X 2 ≥10  2X 1 +2X 2 ≥12  X 1 +4X 2 ≥12  X 1 and X 2 ≥0 | CO3 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | A food manufacturing company has 2 processing plants P1 and P2; three fruit cultivators are willing to supply fruits in the following quantities. Cultivator C1 is willing to supply 190 quintals at the rate of Rupees 100 per quintal, Cultivator C2 is willing to supply 290 quintal at the at the rate of Rupees 90 per quintal, Cultivator C3 is willing to supply 390 quintal at the rate of Rupees 80 per quintal. Cost of transportation from cultivator to plants is given below:   |  |  |  | | --- | --- | --- | |  | P1 | P2 | | C1 | 20 | 26 | | C2 | 9 | 16 | | C3 | 49 | 31 |   Plant requirements and labour costs are as follows   |  |  |  | | --- | --- | --- | | Details | Plant P1 | Plant P2 | | Requirement in Quintal | 440 | 360 | | Labour cost  Rupees/Quintal | 30 | 22 |   Processed fruits are sold at the rate of Rupees 480 per quintal. objective of this problem to maximize profit. Appraise the initial solution by **North-west corner method.** | CO4 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | In a small machine shop, there are 4 operators available to assign jobs for the day. There are 5 jobs and profit in rupees for each operator on each job is represented in the table:   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | JI | J2 | J3 | J4 | J5 | | **O 1** | 6.30 | 5.90 | 6.80 | 10.20 | 7.40 | | **O 2** | 8.00 | 10.10 | 9.00 | 8.50 | 7.30 | | **O 3** | 8.70 | 8.80 | 9.10 | 7.60 | 6.50 | | **O 4** | 7.30 | 8.30 | 6.40 | 7.70 | 8.00 |   Evaluate the **optimal assignment** and find out which job is to be rejected. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 23. | a. | Draw a network for activities (a total 10 activities) of a project, which is shown in the following table and perform forward and backward scheduling.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Activities | 1-2 | 2-3 | 2-4 | 3-5 | 3-6 | | Duration  (Days) | 2 | 3 | 5 | 4 | 1 |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Activities | 4-6 | 4-7 | 5-8 | 6-8 | 7-8 | | Duration  (Days) | 6 | 2 | 8 | 7 | 4 |   Compute the critical path of the project and also find out the total float/total  Slack of each activity. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | The activities of a project with their respective time estimates (in days) are given in the following table:   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Activities | 1-2 | 1-3 | 2-4 | 2-3 | 3-4 | 3-5 | 4-6 | 5-6 | | Optimistic  time(Days) | 2 | 4 | 2 | 2 | 0 | 3 | 6 | 1 | | Most  Probable  Time (Days) | 6 | 8 | 3 | 4 | 0 | 6 | 10 | 3 | | Pessimistic  time(Days) | 10 | 12 | 4 | 6 | 0 | 9 | 14 | 5 |   i) Draw the network of this project and compute duration, variance and standard deviation of the project (6).  ii) Evaluate the probability of completing the project within 23 and for completing the project within 25 days (4).  iii) Evaluate the probability of NOT completing the project within 25 days (2). | CO6 | E | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Correlate this subject knowledge with the engineering problems and solve them |
| **CO2** | Assess the economic feasibility of the engineering projects with reference to time value of money |
| **CO3** | Apply Linear Programming Problem (LPP) knowledge to optimize real life manufacturing and Service industry problems |
| **CO4** | Analyze the transportation problem and optimize the utilization of resources and output. |
| **CO5** | Develop their skills in decision-making analysis by allocation of resources. |
| **CO6** | Apply network analysis to schedule engineering projects |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **20ME2013** | **Duration** | **3hrs** |
| **Course Title** | **SENSOR TECHNOLOGY FOR MACHINES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define direct method of measurement. | | CO1 | R | 1 |
| 2. | List any two mechanical sensors. | | CO1 | R | 1 |
| 3. | Name one commonly used sensor for measuring wheel speed in ABS systems. | | CO2 | R | 1 |
| 4. | State the modes of heat transfer. | | CO2 | R | 1 |
| 5. | Name two semiconductor materials commonly used in sensors. | | CO3 | R | 1 |
| 6. | Identify the type of sensor that uses passive infrared radiation for detecting occupancy. | | CO3 | U | 1 |
| 7. | Define machine vision in manufacturing sector. | | CO4 | R | 1 |
| 8. | Express the principle of operation of an inductive proximity sensor. | | CO4 | U | 1 |
| 9. | Express the Seebeck effect as applied in thermocouples. | | CO5 | U | 1 |
| 10. | Define the term SCADA and state one key function of it in industrial systems. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between sensor and signal as used in measurement systems. | | CO1 | U | 3 |
| 12. | Differentiate between Hall effect sensors and reed switches with suitable examples. | | CO2 | U | 3 |
| 13. | Explain two surface processing techniques to improve sensor performance in specific applications. | | CO3 | A | 3 |
| 14. | Illuminate the structure of a CCD, which influences its performance in machine vision applications. | | CO4 | An | 3 |
| 15. | Compare and contrast the characteristics and applications of NTC and PTC thermistors. | | CO5 | U | 3 |
| 16. | Analyze the closed-loop control system, which maintains stability compared to an open-loop system. | | CO6 | An | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain in detail the working principle, components, and industrial applications of Micro-Electromechanical Systems (MEMS). | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Illustrate the working principle of Hall effect and potentiometric sensor with relevant sketches and list various industrial applications. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Classify sensor materials based on the selection criteria used for sensor design. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Demonstrate the working principles of different proximity sensors with labeled sketches and discuss their suitability for various industrial tasks. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Describe the structural components and working principle of a diaphragm pressure sensor and a Bourdon tube pressure gauge with a clear-labeled sketch. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Design a SCADA-based automated control system with suitable applications. | CO6 | C | 12 |
|  |  |  |  |  |  |
| 23. |  | Compare and contrast various temperature sensors used in industrial applications. | CO2 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Evaluate different process control methods with suitable applications. | CO6 | E | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Recognize the concept of sensors and its characteristics. |
| **CO2** | Summarize the practical approach in design of technology based on different sensors. |
| **CO3** | Categorize various sensor materials and technology used in designing sensors. |
| **CO4** | Describe the working principle of resistive, inductive and capacitive sensors and their applications. |
| **CO5** | Determine the thermocouples, piezoelectric and pyro-electric sensors and their applications. |
| **CO6** | Apply the digital and proximity sensors in Industries. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **20ME3011** | **Duration** | **3hrs** |
| **Course Title** | **MATERIALS AND CHARACTERIZATION TECHNIQUES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Explain the melting process and problems encountered during melting of steels and cast irons. | CO1 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Explain the traditional casting methods employed in foundries and describe how these techniques contribute to the manufacturing process of various metal components. | CO1 | An | 20 |
|  |  |  |  |  |  |
| 3. | a. | Explain various casting processes used for the manufacturing of alloys. | CO2 | An | 10 |
|  | b. | Explain the heat treatment methods of castings and describe the common casting defects | CO2 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Describe the inspection and heat treatment methods applied in foundries to optimize the quality and performance of castings. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 5. | a. | Explain the working principles of various rapid prototyping systems used in additive manufacturing. | CO3 | An | 10 |
|  | b. | Describe the applications of biomaterials such as Synthetic and natural biodegradable polymers in aerospace industry. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the concept of resolution in light microscopy and describe numerical aperture, magnification and depth of field. | CO4 | An | 10 |
|  | b. | Describe the principles and applications of phase contrast microscopy. | CO4 | A | 10 |
|  |  |  |  |  |  |
| 7. |  | Describe the estimation of grain size, particle size and residual stress in crystalline materials using X-ray diffraction | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Explain the principles, construction, and operation of Scanning Electron Microscopy | CO6 | A | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Describe the principles, construction, and operation of transmission electron microscopy (TEM) and explain its significance in defining the properties of materials at the nanoscale. | CO6 | A | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Familiarize the various melting practices |
| CO2 | Understand the different special casting processes |
| CO3 | Know the implication of biomaterials and RP techniques |
| CO4 | Understand the principles of light microscopy and quantity microscopy |
| CO5 | Appreciate the operating principle of X-Ray Diffraction and Diffractometry |
| CO6 | Comprehend the operating principle of SEM & TEM. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **21ME2009** | **Duration** | **3 hrs** |
| **Course Title** | **APPLICATION OF MACHINE LEARNING FOR MECHANICAL ENGINEERING SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define 'training data' | | CO1 | R | 1 |
| 2. | Name the three main components of a machine learning system. | | CO1 | R | 1 |
| 3. | Describe Ridge Regression. | | CO2 | U | 1 |
| 4. | Identify the use of kernel regression. | | CO2 | U | 1 |
| 5. | State the main goal of logistic regression. | | CO3 | R | 1 |
| 6. | Indicate the use of a node in a decision tree. | | CO3 | U | 1 |
| 7. | Recall what the "k" in k-means stands for. | | CO4 | R | 1 |
| 8. | Discuss spectral clustering. | | CO4 | U | 1 |
| 9. | List one application of CNN in mechanical engineering. | | CO5 | R | 1 |
| 10. | Indicate the key objective of condition monitoring. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare supervised learning with unsupervised learning in machine learning. | | CO1 | U | 3 |
| 12. | Describe how the lasso method aids in feature selection. | | CO2 | U | 3 |
| 13. | Differentiate between supervised and unsupervised learning. | | CO3 | U | 3 |
| 14. | Illustrate three uses of clustering in engineering. | | CO4 | A | 3 |
| 15. | Develop a simple workflow for implementing a DNN-based predictive maintenance system. | | CO5 | A | 3 |
| 16. | Interpret the importance of vibration signals in rotary machinery fault detection. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the steps involved in building a machine learning model for a mechanical engineering application. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain simple linear regression and its application in mechanical engineering. | CO2 | An | 6 |
|  | b. | Examine the advantages and disadvantages of the nearest neighbor algorithm for regression. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Analyze the working principles of a decision tree and differentiate its advantages and disadvantages in mechanical system modeling. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Examine the working of the k-means algorithm with an example. | CO4 | A | 6 |
|  | b. | Differentiate between agglomerative and divisive hierarchical clustering. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Design the process of preparing features and labels for training a deep neural network model in mechanical fault classification. Discuss how data preprocessing impacts prediction accuracy. | CO5 | C | 12 |
|  |  |  |  |  |  |
| 22. | a. | Write three common problems in mechanical engineering solved using Artificial Intelligence, giving detailed examples. | CO1 | U | 6 |
|  | b. | Explain three common metrics for checking regression model quality. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain overfitting in machine learning with an example. | CO3 | A | 6 |
|  | b. | Illustrate hierarchical clustering and its advantages over k-means clustering. | CO4 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Compare the condition monitoring techniques used for rotary and reciprocating machines using machine learning approaches. | CO6 | E | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Obtain the basics terminologies of artificial intelligence and machine learning. |
| **CO2** | Formulate and evaluate the prediction models using supervised learning algorithms. |
| **CO3** | Design and analyses the models using unsupervised learning algorithms. |
| **CO4** | Understand the basics of clustering and develop prediction model. |
| **CO5** | Understand the basics of deep learning. |
| **CO6** | Applying the concept of machine learning and deep learning in mechanical engineering related  problems. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 9 | 12 | - | - | - | 23 |
| **CO2** | - | 5 | 12 | 6 | - | - | 23 |
| **CO3** | 1 | 4 | 6 | 12 | - | - | 23 |
| **CO4** | 1 | 1 | 9 | 12 | - | - | 23 |
| **CO5** | 1 | - | 3 | - | - | 12 | 16 |
| **CO6** | - | 1 | 3 | - | 12 | - | 16 |
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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **21ME2015** | **Duration** | **3hrs** |
| **Course Title** | **DESIGN OF ELECTRIC VEHICLES AND BATTERY MANAGEMENT** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the component, which is considered, as the heart of an Electric Vehicle (EV). | | CO1 | R | 1 |
| 2. | Indicate the function of an inverter in an Electric Vehicle (EV) propulsion system. | | CO1 | U | 1 |
| 3. | State the need of clutch in conventional internal combustion engine vehicles. | | CO2 | U | 1 |
| 4. | Identify the function of power electronic switches in electric drives. | | CO2 | U | 1 |
| 5. | State the characteristics of Switched Reluctance Machines (SRM). | | CO3 | U | 1 |
| 6. | Discuss the function of a gearbox in an electric vehicle. | | CO3 | An | 1 |
| 7. | Discuss the purpose of the transmission configuration in an electric vehicle (EV). | | CO4 | An | 1 |
| 8. | List the two primary components of an electric vehicle drivetrain. | | CO4 | U | 1 |
| 9. | Name the electrolyte commonly used in lead-acid batteries. | | CO5 | R | 1 |
| 10. | List the primary functions of a Battery Management System (BMS). | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Distinguish between single-speed and multi-speed transmissions in Electric Vehicles. | | CO1 | U | 3 |
| 12. | Explain the concept of regenerative braking in electric vehicles. | | CO2 | A | 3 |
| 13. | State the main function of an inverter in a Permanent Magnet Synchronous Motor (PMSM) drive system. | | CO3 | U | 3 |
| 14. | Describe the concept of Pulse Width Modulation (PWM). | | CO4 | U | 3 |
| 15. | Analyze the advantages and limitations of lithium-polymer batteries compared to lithium-ion batteries | | CO5 | An | 3 |
| 16. | Explain the importance of key battery standards in ensuring safe and reliable battery operation. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Compare and contrast the electric vehicles with internal combustion engine vehicles. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | Illustrate the construction and operation of a DC machine with its advantages and disadvantages. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Discuss the working principle of a Permanent Magnet Synchronous Motor (PMSM) and its applications. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Compare and contrast common transmission configurations used in Electric Vehicles (EVs) with its impact on performance and efficiency. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Describe the construction and key components of a lithium-ion battery with neat sketch. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the principles of optimization-based control in Battery Management Systems (BMS). | CO6 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Compare and contrast Nickel-Metal-Hydride (NiMH) and Li-polymer batteries in terms of energy density, applications, and safety. | CO5 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Describe the various modes of power delivery in battery systems and how they affect the performance of the system. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Demonstrate the EV kinetics and dynamics. |
| **CO2** | Identify appropriate motor and converter for EV applications. |
| **CO3** | Select suitable standards for the motor drive. |
| **CO4** | Estimate transmission drive configuration and characteristics of EV. |
| **CO5** | Analyze the different battery parameters and characteristics for specific applications. |
| **CO6** | Design efficient battery management system (BMS) for EV. |

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**END SEMESTER EXAMINATION – NOV/DEC 2025**

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| **Course Code** | **22ME2001** | **Duration** | **3 hrs** |
| **Course Title** | **INDUSTRIAL APPLICATIONS OF AI TECHNIQUES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Identify the best possible way for collaboration in industry 4.0. | | | CO1 | R | 1 |
| 2. | State two important AI Characteristics. | | | CO1 | R | 1 |
| 3. | Classification is a………………machine learning technique. | | | CO2 | R | 1 |
| 4. | Name any 2 applications of Object Detection. | | | CO2 | R | 1 |
| 5. | Identify the types of machine vision systems. | | | CO3 | U | 1 |
| 6. | Define segmentation. | | | CO3 | R | 1 |
| 7. | Define (Term Frequency-Inverse Document Frequency) vectorizer. | | | CO4 | R | 1 |
| 8. | Interpret Markov Model machine learning technique. | | | CO4 | A | 1 |
| 9. | Identify one application of AI in spam mail filtering techniques. | | | CO5 | U | 1 |
| 10. | Distinguish ‘weak AI’ from ‘strong AI’. | | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Indicate the risks involved in autonomy of Mechanical systems. | | | CO1 | U | 3 |
| 12. | Identify the three principles of 3D vision software components. | | | CO2 | U | 3 |
| 13. | Explain the benefits of machine vision. | | | CO3 | A | 3 |
| 14. | Interpret Histogram of Oriented Gradients (HOG). | | | CO4 | U | 3 |
| 15. | Illustrate any two challenges in natural language processing. | | | CO5 | A | 3 |
| 16. | Appraise anomaly detection using a VI system. | | | CO6 | An | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | | |
| 17. | a. | Summarize the role of AI in Manufacturing. | CO1 | | A | 6 |
|  | b. | Evaluate Smartization at four levels of Manufacturing. | CO1 | | E | 6 |
|  |  |  |  | |  |  |
| 18. |  | Examine Supervised and Unsupervised learning with examples. | CO2 | | A | 12 |
|  |  |  |  | |  |  |
| 19. | a. | Appraise the geometry and acquisition of a Single Image in machine vision. | CO3 | | E | 6 |
|  | b | Analyze the major components of a machine vision system. | CO3 | | An | 6 |
|  |  |  |  | |  |  |
| 20. |  | Determine text summarization and multiple document text summarization with neat sketch. | CO4 | | A | 12 |
|  |  |  |  | |  |  |
| 21. |  | Assess with elements the interaction between the agent, environment, and reward system in reinforcement learning. | CO5 | | E | 12 |
|  |  |  |  | |  |  |
| 22. |  | Summarize the key approaches for successful implementation of smart manufacturing with AI techniques. | CO3 | | E | 12 |
|  |  |  |  | |  |  |
| 23. | a. | Determine the different phases of analysis in Natural Language Processing with suitable examples. | CO 4 | | A | 6 |
|  | b. | Appraise any two techniques in Object Detection Using Image Processing. | CO4 | | E | 6 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Evaluate the application of an Automated Inspection System (AIS) in a manufacturing shop floor. | | CO6 | E | 12 |

CO – COURSE OUTCOME BL – BLOOM’S LEVEL M – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Understand AI Techniques in Mechanical Systems. |
| CO2 | Classify Machine Learning Techniques. |
| CO3 | Apply various computer Vision Techniques. |
| CO4 | Compare Natural Language Processing Techniques. |
| CO5 | Analyze the Reinforcement Learning Techniques. |
| CO6 | Assess case studies on AI solutions in the production level. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23ME2001** | **Duration** | **3hrs** |
| **Course Title** | **THEORY AND PROGRAMMING OF CNC MACHINES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the principle of NC machine control loop. | | CO1 | U | 1 |
| 2. | List the major components of a CNC system. | | CO1 | R | 1 |
| 3. | Define “Machining Center.” | | CO2 | R | 1 |
| 4. | Mention any two types of CNC grinding machines. | | CO2 | R | 1 |
| 5. | Identify the purpose of ball screws in CNC machines. | | CO3 | U | 1 |
| 6. | State the use of ATC in CNC machining. | | CO3 | R | 1 |
| 7. | State the main elements considered in a process plan. | | CO4 | R | 1 |
| 8. | Identify the use of fixture. | | CO4 | U | 1 |
| 9. | Explain absolute programming. | | CO5 | U | 1 |
| 10. | Define “machine hour rate.” | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Draw the CNC architecture. | | CO1 | A | 3 |
| 12. | Examine the advantages of High-Speed Cutting vs. Conventional Cutting in CNC machines. | | CO2 | An | 3 |
| 13. | Analyze the working mechanism of feed drive systems in CNC. | | CO3 | An | 3 |
| 14. | Evaluate the significance of proper process plan sequencing in CNC turning. | | CO4 | E | 3 |
| 15. | Develop a G-code program for facing and turning operations on a cylindrical part. | | CO5 | A | 3 |
| 16. | Analyze the influence of preventive maintenance on CNC system efficiency. | | CO6 | An | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain MMI, NCK functions and PLC in CNC. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Analyze the construction and functioning of CNC machining centers and turning centers. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | Evaluate the role of drives, sideways and ATC in determining CNC accuracy. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. |  | Develop a process plan for machining a shaft given below. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Prepare a part program for the component below. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Evaluate CNC introduction costs and maintenance training requirements. | CO6 | E | 12 |
|  |  |  |  |  |  |
| 23. |  | Compare direct and indirect cost estimation of CNC operations. | CO6 | An | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Develop manual part programming for the below component. | CO5 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Apply principles of NC systems and classify CNC machines. |
| **CO2** | Select suitable CNC machine tools based on application. |
| **CO3** | Design and analyze constructional features of CNC machines. |
| **CO4** | Design process plans for CNC machining. |
| **CO5** | Develop CNC part programs using proper offsets and tools. |
| **CO6** | Evaluate operational costs and maintenance of CNC systems. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23ME2002** | **Duration** | **3hrs** |
| **Course Title** | **HYDRAULICS AND PNEUMATICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify the primary energy conversion process in a fluid power system. | | CO1 | R | 1 |
| 2. | Recall the purpose of reservoirs in hydraulic circuits. | | CO1 | R | 1 |
| 3. | Identify any three types of positive displacement pumps. | | CO2 | R | 1 |
| 4. | Draw the ANSI symbol for a double-acting cylinder. | | CO2 | A | 1 |
| 5. | Define volumetric efficiency of a hydraulic pump. | | CO3 | R | 1 |
| 6. | Identify the purpose of a regenerative circuit. | | CO3 | R | 1 |
| 7. | State the purpose of a filter in air preparation units. | | CO4 | U | 1 |
| 8. | Identify the function of cylinder cushioning in pneumatic systems. | | CO4 | R | 1 |
| 9. | Distinguish between manual and solenoid actuation. | | CO5 | U | 1 |
| 10. | Recognize the role of PLC in automation of hydraulic circuits. | | CO6 | An | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between water-based and petroleum-based hydraulic fluids. | | CO1 | U | 3 |
| 12. | Identify the factors considered in selecting a hydraulic pump for an industrial system. | | CO2 | R | 3 |
| 13. | Determine the essential parameters that must be considered for selecting suitable hydraulic cylinders. | | CO3 | An | 3 |
| 14. | Indicate the role of a lubricator in a pneumatic circuit. | | CO4 | U | 3 |
| 15. | Describe how energy losses can be minimized in pneumatic systems. | | CO5 | U | 3 |
| 16. | Explain the role of programmable logic control in coordinating the sequence of operations in a hydraulic press system. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Identify the distinct characteristics of hydraulic fluid properties and provide descriptions for each. | CO1 | U | 8 |
|  | b. | Discuss the engineering relevance and industrial applications of hydraulic systems in modern manufacturing. | CO1 | E | 4 |
|  |  |  |  |  |  |
| 18. | a. | Classify the different types of directional control valves and construct graphical symbols for 3/2 and 5/2 directional control valves. | CO2 | U | 4 |
|  | b. | Discuss the criteria adopted in selecting a suitable pump for a specific industrial application. | CO2 | E | 8 |
|  |  |  |  |  |  |
| 19. | a. | Elaborate on the constructional details and working principles of internal gear pump. | CO3 | U | 8 |
|  | b. | Explain the key parameters that influence the selection of hydraulic cylinders. | CO3 | U | 4 |
|  |  |  |  |  |  |
| 20. |  | Design a basic hydraulic system layout integrating pumps, valves, and actuators for operating an industrial press. | CO3 | C | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the working principle of rotary screw compressor used in pneumatic systems with neat sketch and its industrial applications. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain the working principle of a shuttle valve with a suitable practical example. | CO4 | U | 6 |
|  | b. | Develop displacement step diagram of pneumatic circuit for drilling operation. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 23. |  | Apply the cascade method to formulate sequencing logic for multi-cylinder pneumatic circuits in a punching machine. (A+B+B-A+). | CO5 | C | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Design and develop an electro pneumatic circuit using limit switch for double acting cylinder. | CO6 | C | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Develop hydraulic and Pneumatic systems. |
| **CO2** | Draw fluid power symbols; fluid power circuits and fluid conditioning. |
| **CO3** | Apply various types of actuation modes and control system for design of circuits. |
| **CO4** | Design pneumatic and hydraulic circuits specific to application. |
| **CO5** | Perform maintenance, testing and repair of hydraulic and pneumatic components and systems. |
| **CO6** | Analyze the performance of Programmable Logic Controllers, devices and sensors |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23ME2006** | **Duration** | **3 hrs** |
| **Course Title** | **ENGINEERING MECHANICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Discuss triangle law of forces. | | CO1 | U | 1 |
| 2. | Describe the principle of transmissibility of forces. | | CO1 | R | 1 |
| 3. | Define couple in mechanics and its effect. | | CO2 | U | 1 |
| 4. | Identify the types of supports in a beam. | | CO2 | U | 1 |
| 5. | The moment of inertia (Ixx) of a hollow circle of outer diameter (d1) and inner diameter (d2) is given by \_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO3 | R | 1 |
| 6. | The centroid for a semicircle is \_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO3 | R | 1 |
| 7. | Define the term ‘Range’ of a projectile. | | CO4 | R | 1 |
| 8. | Write the equation for velocity in motion under gravity. | | CO4 | R | 1 |
| 9. | Discuss coefficient of restitution. | | CO5 | U | 1 |
| 10. | Define angle of repose. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between coplanar forces and concurrent forces. | | CO1 | U | 3 |
| 12. | Discuss Varignon’s theorem. | | CO2 | U | 3 |
| 13. | Describe the parallel axis theorem. | | CO3 | R | 3 |
| 14. | A car moving with a velocity of 20 m/s is brought to rest by applying brakes, in 6 seconds. Calculate the retardation. | | CO4 | A | 3 |
| 15. | Explain D'Alembert’s principle. | | CO5 | U | 3 |
| 16. | Describe about the laws of friction. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Given three coplanar forces acting at a point, as shown in the figure. Determine the magnitude and direction of the resultant force.  C:\Users\Lenovo\Desktop\B1.jpg | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | A simply supported beam, AB of span 6 m is loaded as shown in figure. Determine the reactions at the supports A and B of the beam. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Calculate the moment of inertia of a T-section with flange as 150 mm × 50 mm and web as 150 mm × 50 mm about X-X and Y-Y axes through the centre of gravity of the section. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | The equation of motion of a particle moving in a straight line is given by : s = 18t + 3t2 – 2t3; where (s) is in metres and (t) in seconds.  Find (1) velocity and acceleration at start, (2) time, when the particle reaches its maximum velocity, and (3) maximum velocity of the particle. | CO4 | A | 6 |
|  | b. | A particle is projected with an initial velocity of 60 m/s and at an angle of 75º with the horizontal. Determine the time taken by the particle to reach the maximum height and Time of flight. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. |  | Two blocks of weight 150 N and 50 N are connected by a rope passing over a frictionless pulley as shown in the figure. Determine the acceleration of blocks A and B and the tension in the rope using Newton’s law of motion. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Two rollers, each weighing 50 N and of radius 10 cm rest in a  horizontal channel of width 36 cm, as shown in the figure. Analyze the  reaction at the point of contacts A, B and C.  1B | CO2 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Two weights 80 N and 120 N are connected by a rope and move along a rough horizontal plane under the action of a 40 N force, as shown in the figure. The coefficient of friction is 0.3. Evaluate the velocity of the system after 2 sec. Also calculate the tension on the rope using impulse momentum equation. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Consider a ladder of weight 390 N and length 6 m, leaning against a vertical wall at an angle of 30º. The coefficient of friction between the ladder and the wall is 0.25, and between the ladder and the floor is 0.38. A man of weight 1170 N starts to ascend the ladder. Estimate the height to which the man can ascend before the ladder begins to slip. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Solve equilibrium problems in a variety of engineering and physical scenarios. |
| **CO2** | Analyze the equilibrium of rigid bodies through the application of statics principles and vector  mechanics. |
| **CO3** | Determine centroid and moment of inertia for simple plane figures. |
| **CO4** | Solve dynamic equilibrium problems on particles by applying the concept of kinematics of  particles with rectilinear, curvilinear motions. |
| **CO5** | Apply the fundamental principles of concepts of kinetics – displacement, velocity and  acceleration in real life scenario. |
| **CO6** | Solve problems related to dry friction and analyze components that function based on the theory of friction. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23ME2007** | **Duration** | **3hrs** |
| **Course Title** | **THERMODYNAMICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1 | Define open system with an example | | CO1 | R | 1 |
| 2 | Write the work done relation for constant volume process. | | CO1 | A | 1 |
| 3 | Write the expression of the First Law of Thermodynamics for a system undergoing a cyclic process | | CO2 | A | 1 |
| 4 | Define Specific heat capacity | | CO2 | R | 1 |
| 5 | Define Coefficient of Performance (COP) of a refrigerator. | | CO3 | R | 1 |
| 6 | COP of heat pump is equal to COP of refrigerator plus one. (True/False) | | CO3 | A | 1 |
| 7 | Define dryness fraction of steam | | CO4 | R | 1 |
| 8 | Write the valuve of dryness fraction of steam along the saturated vapour line ? | | CO4 | A | 1 |
| 9 | Define Dalton’s law of partial pressure. | | CO5 | R | 1 |
| 10 | Write the valuve of the relative humidity at the dew point temperature ? | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Estimate the pdv work for a constant temperature process. | | CO1 | An | 3 |
| 12. | Explain the Quasi-Static Process with a suitable example | | CO2 | A | 3 |
| 13. | Describe Kelvin-Plank statement of second law of thermodynamics with source and sink diagram. | | CO3 | U | 3 |
| 14. | Estimate the saturation temperature, the changes in specific volume and entropy during the evaporation of steam at 1MPa. | | CO4 | An | 3 |
| 15. | Explain that the mole fraction of a gas mixture is equal to the volume faction based on the Amagat’s law. | | CO5 | A | 3 |
| 16. | Describe the psychrometric chart and draw the Dew Point temperature, Specific humidity and Enthalpy lines | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Determine the expression for pdV work under conditions of constant volume (isochoric process), constant pressure (isobaric process), constant temperature (isothermal process), and for polytropic processes. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18 |  | A gas in a piston cylinder assembly undergoes an expansion process for which the relationship between the pressure and volume is given by Pvn is Constant. The initial pressure is 3 bar and volume is 0.1m3 and the final volume is 0.2m3. Determine the work done for the process in kJ, when (i) n=0; (ii) n=1; (iii) n=1.5 and (iv) n= ∞ | CO1 | E | 12 |
|  |  |  |  |  |  |
| 19. |  | Compute the Steady Flow Energy Equation (SFEE) from the First Law of Thermodynamics for an open system | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | 10 kg of fluid per minute goes through a reversible steady flow process. The properties of the fluid at the inlet are: p₁ = 1.5 bar, ρ₁ = 26 kg/m³, C₁ = 110 m/s, and u₁ = 910 kJ/kg; and at the exit are: p₂ = 5.5 bar, ρ₂ = 5.5 kg/m³, C₂ = 190 m/s, and u₂ = 710 kJ/kg. During the passage, the fluid rejects 55 kJ/s and rises through 55 metres. Estimate: (i) The change in enthalpy (Δh); and (ii) Work done during the process (W). | CO2 | E | 12 |
|  |  |  |  |  |  |
| 21. |  | A cold storage is maintained at -5oC while the surrounding temperature is 35oC. The heat leakage from the surroundings in to the cold storage is estimated to be 29kW. Find the actual Coefficient of performance (COP) if the actual COP is 1/3rd of the ideal COP between the same working temperature. Also calculate the power required to drive the plant. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 22. |  | Steam initially at 0.3MPa and 250oC is cooled at constant volume to 80oC. (i) At what temperature will the steam become saturated vapour? (ii) Estimate the quality of steam at 80oC (iii) Determine the heat transferred per kg of steam in cooling from 250oC to 80oC. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 23. |  | A gas mixture consists of 0.4 kg of CO, 1.1 kg of CO2 and 1.5 kg of N2. Find: (i) Mass fraction of each component; (ii) Mole fraction of each component; (iii) Average molecular weight of the mixture; (iv) Gas constant of the mixture | CO5 | E | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | (i) Compute the relation for Specific Humidity  (ii) Explain briefly about Dry Bulb Temperature (DBT)  (iii) Explain briefly about Wet Bulb temperature (WBT)  (iv) Explain briefly about Dew point Temperature (DPT) | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Apply the concepts of equilibrium, processes, and cycles to various thermodynamic systems. |
| **CO2** | Analyse the first and second laws of thermodynamics for closed and open systems. |
| **CO3** | Design heat engines, heat pumps, and refrigerators. |
| **CO4** | Apply thermodynamic properties to pure substances and interpret phase diagrams. |
| **CO5** | Analyse ideal gas mixtures, including properties, equations of state, and laws |
| **CO6** | Design air-conditioning systems for domestic and industrial applications |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23ME2009** | **Duration** | **3hrs** |
| **Course Title** | **FLUID POWER CONTROL ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List three Newtonian fluids. | | CO1 | R | 1 |
| 2. | Interpret the law of hydraulics. | | CO1 | U | 1 |
| 3. | Sketch the Time Delay Valve. | | CO2 | A | 1 |
| 4. | Sketch the symbol of flow control valve. | | CO2 | A | 1 |
| 5. | Discuss the function of accumulator. | | CO3 | U | 1 |
| 6. | List hydraulic spend control circuits. | | CO3 | R | 1 |
| 7. | Identify the governing laws of gas or air. | | CO4 | R | 1 |
| 8. | Sketch the double cushioned adjustable double acting hydraulic cylinder. | | CO4 | A | 1 |
| 9. | Sketch the displacement step diagram of two double acting cylinders used in pneumatic system for the sequence of A+B+A-B-. | | CO5 | A | 1 |
| 10. | Discuss the operating cycle of programmable logic controller. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Describe three merits, demerits and applications of hydraulic systems. | | CO1 | U | 3 |
| 12. | Sketch hydraulic gear pump and name the parts. | | CO2 | A | 3 |
| 13. | Describe construction of 4/2 DCV with cross sectional diagram. | | CO3 | U | 3 |
| 14. | Sketch a simple basic hydraulic circuit. | | CO4 | A | 3 |
| 15. | Discuss the concept and applications of fluidics. | | CO5 | U | 3 |
| 16. | Sketch the proximity sensor symbol and narrate the working process. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Illustrate the Newton’s law of viscosity for hydraulic fluids and uses of it. | CO1 | A | 8 |
|  | b. | Describe the functions of hydraulic fluids. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the importance of power pack in a hydraulic system with suitable diagram. | CO2 | A | 4 |
|  | b. | Illustrate the operation of a pressure relief valve with relevant line diagram. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 19. | a. | Illustrate the function of an accumulator in a hydraulic circuit. | CO3 | A | 4 |
|  | b. | Design the hydraulic circuit for quick return motion mechanism of shaper. | CO3 | C | 8 |
|  |  |  |  |  |  |
| 20. | a. | Discuss the use of FCVs in speed control circuits. | CO4 | U | 4 |
|  | b. | Describe in detail the key factors to be considered when selecting pneumatic actuators. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 21. |  | Design a two-cylinder pneumatic circuit for a specific application and draw the displacement-step diagram. | CO5 | C | 12 |
|  |  |  |  |  |  |
| 22. | a. | Determine the overall efficiency of a pump driven by a 10 HP prime mover, if the pump delivers fluid at 40 LPM at a pressure of 10 MPa. | CO4 | A | 4 |
|  | b. | Illustrate the operation of a gear-type hydraulic motor with suitable sketches. | CO4 | A | 8 |
|  |  |  |  |  |  |
| 23. |  | Develop a synchronizing hydraulic circuit with parallel piping or cylinders and narrate the operating principle. | CO5 | A | 12 |
|  | | | | | |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe the I/O devices and the architecture of PLC. | CO6 | U | 4 |
|  | b. | Design a dual-cylinder sequencing circuit for the operation sequence A+B+B– A– using the ladder diagram method. | CO6 | C | 8 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Analyze the constructional details of both hydraulic and pneumatic systems. |
| **CO2** | Design fluid power circuits for hydraulic and pneumatic fluid conditioning. |
| **CO3** | Evaluate different types of actuation modes and employ control system design procedures for circuit design and regulation. |
| **CO4** | Design pneumatic and hydraulic circuits based on given specifications. |
| **CO5** | Apply mechanical skills to perform maintenance, testing, and repair of hydraulic and pneumatic components and systems. |
| **CO6** | Select suitable Programmable Logic Controllers (PLCs) and demonstrate comprehension of basic logic operations |



**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23ME2016** | **Duration** | **3hrs** |
| **Course Title** | **DESIGN OF MACHINE ELEMENTS** | **Max. Marks** | **100** |

**Use of PSG Data book and approved data books/materials are permitted.**

**Any missing data may be suitably assumed**

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Classify the types of machine design. | | CO1 | U | 1 |
| 2. | Define eccentricity. | | CO1 | R | 1 |
| 3. | List the type of stresses induced in shafts. | | CO2 | R | 1 |
| 4. | Define principal stress. | | CO1 | R | 1 |
| 5. | State maximum shear stress theory. | | CO1 | R | 1 |
| 6. | Define factor of safety. | | CO1 | R | 1 |
| 7. | State the function of leaf spring. | | CO5 | R | 1 |
| 8. | List out the applications of knuckle joint. | | CO4 | R | 1 |
| 9. | State the function of coupling. | | CO2 | R | 1 |
| 10. | Give example for temporary joint. | | CO4 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Write the various phases of design process. | | CO1 | A | 3 |
| 12. | Classify the factors that influence fatigue strength. | | CO3 | U | 3 |
| 13. | Differentiate ‘transmission shaft’ from ‘machine shaft’. | | CO2 | An | 3 |
| 14. | Write the different factors that influences machine design. | | CO1 | A | 3 |
| 15. | Differentiate ‘solid length’ from ‘free length’. | | CO4 | An | 3 |
| 16. | Write the function of rebound clips in a leaf spring. | | CO5 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | A rectangular block is 150mm wide and 120mm thick. It carries a load of 180kN at an eccentricity of 10mm in a plane bisecting the thickness as shown in Figure1. Calculate the maximum and minimum intensities of stress in the section.    Figure1 | CO5 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | A rod is subjected to tensile load of 20kN and transverse shear force of 15kN. Determine the rod diameter according to (i) Maximum Principal stress theory (ii) Maximum shear stress theory Take yield strength in tension as 360MPa and a factor of safety 3. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | A circular bar of 500 mm length is supported freely at its two ends. It is acted upon by a Central concentrated cyclic load having a minimum value of 20kN and a maximum value of 50kN. Determine the diameter of bar by taking factor of safety of 1.5. The material properties of bar is given by: Ultimate Strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350MPa. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Design a suitable diameter for circular shaft which is required to transmit 90kW at 120rpm. The shear stress of the shaft is not to exceed 70N/mm2 and the maximum torque exceeds the mean by 40%. | CO2 | C | 12 |
|  |  |  |  |  |  |
| 21. |  | Design a helical compression spring to carry a load of 1.5kN with a deflection of 40mm.Spring index is 5. Allowable shear stress is 400N/mm2. Modulus of rigidity for spring material is 8x104N/mm2 | CO2 | C | 12 |
|  |  |  |  |  |  |
| 22. |  | Design a muff coupling which is used to connect two steel shafts transmitting 90 kW at 250 r.p.m. The material for the shafts and key is plain carbon steel for which allowable shear and crushing stresses may be taken as 40 MPa and 80 MPa respectively. The material for the muff is cast iron for which the allowable shear stress may be assumed as 15 MPa. | CO5 | C | 12 |
|  |  |  |  |  |  |
| 23. |  | A truck spring has 12 number of leaves, two of which are full length leaves. The spring supports are 1.05 m apart and the central band is 85 mm wide. The central load is to be 5.4 kN with a permissible stress of 280 MPa. Evaluate the thickness and width of the steel leaves. The ratio of the total depth to the width of the spring is 3. Also determine the deflection of the spring. | CO6 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Design a knuckle joint to withstand an axial load of 70kN. All the parts of made up of mild steel having permissible stresses of 75MPa in tension 50MPa in shear and 90MPa in compression. | CO4 | C | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the standard design procedure, steady stresses and variable stresses in machine members |
| **CO2** | Understand the procedures involved in the design of shafts, keys, splines and couplings |
| **CO3** | Design machine components for a given load condition using design data handbook |
| **CO4** | Acquire the design knowledge about threaded fasteners, Knuckle joints, and Cotter joints, welded and riveted joints |
| **CO5** | Design and develop nonstandard machine components |
| **CO6** | Prepare a detail design layout, drawing of machine elements |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23ME2017** | **Duration** | **3hrs** |
| **Course Title** | **SMART MANUFACTURING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Expand ASRS in manufacturing. | | CO1 | R | 1 |
| 2. | Name one technology related to smart manufacturing. | | CO1 | R | 1 |
| 3. | Indicate a technology, which involves virtual replicas of physical processes. | | CO2 | U | 1 |
| 4. | Define a Smart Factory. | | CO2 | R | 1 |
| 5. | Name one essential connectivity device used in smart manufacturing. | | CO3 | R | 1 |
| 6. | Define Digital Twins in manufacturing. | | CO3 | R | 1 |
| 7. | Recall one key benefit of Digital Twins. | | CO4 | U | 1 |
| 8. | State the role of Digital Thread in smart manufacturing. | | CO4 | U | 1 |
| 9. | List any two digital tools used in smart manufacturing. | | CO5 | R | 1 |
| 10. | List four common classifications of smart materials. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare and contrast between conventional manufacturing and smart manufacturing. | | CO1 | U | 3 |
| 12. | List out the core technologies used in Smart Factories. | | CO2 | R | 3 |
| 13. | Explain the difference between Internet of Things (IoT) and Industrial Internet of Things (IIoT). | | CO3 | U | 3 |
| 14. | Explain the concept of AI culture in shaping the manufacturing workforce. | | CO4 | U | 3 |
| 15. | Differentiate between the working principles of AR and VR in smart factories. | | CO5 | U | 3 |
| 16. | Illustrate the STEP and IGES standards which support data exchange in design and fabrication. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the role and impact of Smart Manufacturing technologies with suitable examples. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Elucidate the different levels of Smart Factories with key characteristics and suitable examples. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain Machine-to-Machine (M2M) communication in smart manufacturing with suitable example. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Describe the four types of Digital Twins with examples for each type used in manufacturing. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Demonstrate the digital tools which can be integrated effectively in smart design and fabrication processes. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Differentiate between Automated Guided Vehicles (AGVs) and Autonomous Mobile Robots (AMRs) based on their navigation and application in smart factories. | CO6 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Compare and contrast agile manufacturing and mass production with their principles and process. | CO5 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Evaluate the impact and role of AI, IoT, and AR/VR technologies in creating a Smart Manufacturing Ecosystem with suitable examples. | CO6 | E | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the concepts and methods behind Smart Manufacturing. |
| **CO2** | Formulate smart manufacturing systems in the digital work environment. |
| **CO3** | Apply IoT to support the smart manufacturing. |
| **CO4** | Choose digital twin in digital manufacturing systems. |
| **CO5** | Apply design and fabrication tools in smart manufacturing. |
| **CO6** | Practice AI tools in industrial environment. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23ME2018** | **Duration** | **3hrs** |
| **Course Title** | **HEAT AND MASS TRANSFER** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | **Explain** the significance of contact resistance in composite walls. | | CO1 | U | 1 |
| 2. | **Define** thermal conductivity. | | CO1 | R | 1 |
| 3. | **State** Newton’s law of cooling. | | CO2 | R | 1 |
| 4. | **Explain** the significance of the Grashof number in free convection. | | CO2 | U | 1 |
| 5. | **State** Planck’s law of radiation. | | CO3 | U | 1 |
| 6. | **Define** radiosity. | | CO3 | R | 1 |
| 7. | **Describe** how fouling affects pumping power in a heat exchanger. | | CO4 | U | 1 |
| 8. | **Identify** the heat exchanger commonly used in automobile radiators. | | CO4 | U | 1 |
| 9. | **State** the two primary types of condensation. | | CO5 | R | 1 |
| 10. | **Explain** the physical significance of Sherwood number. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between fin efficiency and fin effectiveness with examples. | | CO1 | An | 3 |
| 12. | Analyze how thevelocity and thermal boundary layers develop along the plate. | | CO2 | An | 3 |
| 13. | Differentiate between radiation from a perfect black body and a grey body using Stefan–Boltzmann law. | | CO3 | An | 3 |
| 14. | Compare flow in Condenser and Evaporator heat exchangers in terms of temperature distribution. | | CO4 | An | 3 |
| 15. | Describe the formation mechanism of slug flow in a heated tube during flow boiling | | CO5 | U | 3 |
| 16. | Compare diffusionandconvection in mass transfer. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Derive the general differential equation of heat conduction in Cartesian coordinates for variable thermal conductivity k (x,y,z). | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | Air stream at 27℃is moving at 0.3 m/s across a 100 W electric bulb at 127℃. If the bulb is approximated by a 60 mm dimeter sphere, estimate the heat transfer rate and the percentage of power loss due to convection. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | A pipe carrying steam having an outside diameter of 20 cm runs in a large room and is exposed to air at a temperature of 30℃. The pipe surface temperature is 400℃. Calculate the loss of heat to the surroundings per meter length of pipe due to thermal radiation. The emissivity of the pipe surface is 0.8. What would be the loss of heat due to radiation if the pipe is enclosed in a 40 cm diameter brick conduit of emissivity 0.91? | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Water enters a counter flow double pipe heat exchanger at 15℃ flowing at the rate of 1300 kg/h. It is heated by oil having specific heat of 2000 J/kgK flowing at the rate of 550 kg/h from the inlet temperature of 94℃. For an area of 1m2 and an overall heat transfer coefficient of 1075W/m2K, determine the total heat transfer and the outlet temperatures of water and oil. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Illustrate the pool boiling curve with a neat sketch and analyze all boiling regimes, describing the physical mechanisms in each. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | An Aluminium sphere weighing 5.5 kg and initially at a temperature of 200℃ is suddenly immersed in a fluid at 15℃. The convective heat transfer coefficient is 58 W/m2K. Estimate the time required to cool the Aluminium to 95℃ using the lumped capacity method of analysis. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Hot Oil with a capacity rate of 2500 W/K flows through a double pipe heat exchanger. It enters at 360℃ and leave at 300℃. Cold fluid enters at 30℃and leaves at 200℃. If the overall heat transfer coefficient is 800 W/m2K, determine the heat exchanger area required for a) Parallel flow and b) Counter flow. | CO4 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | CO2 and air experience equimolar counter diffusion in a circular tube whose length and diameter are 1m and 50 mm respectively. The system is at a total pressure of 1 atm and a temperature of 25 C. The ends of the tube are connected to large chambers in which the species concentrations are maintained at fixed values. The partial pressure of CO2 at one end is 190 mm of Hg while at the other end is 95 mm of Hg. Estimate the mass transfer rate of CO2 and air through the tube. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Formulate and analyze a heat transfer problem involving any of the three modes of heat transfer. |
| **CO2** | Obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer |
| **CO3** | Evaluate radiation heat transfer between black, gray surfaces and the surroundings. |
| **CO4** | Design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary. |
| **CO5** | Apply boiling and condensation correlations to two phase flow processes. |
| **CO6** | Apply mass transfer correlations to process–based problems. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **SUSTAINABLE ENERGY TECHNOLOGIES** | **Duration** | **3hrs** |
| **Course Title** | **23ME2037** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define the term: Energy. | | CO1 | R | 1 |
| 2. | Cite an example of fossil fuel. | | CO1 | U | 1 |
| 3. | Define the term: Sustainability. | | CO2 | R | 1 |
| 4. | Explain the scope of sustainable development. | | CO2 | A | 1 |
| 5. | List any one type of wind energy rotor. | | CO3 | R | 1 |
| 6. | Name the difference between roll and yaw. | | CO3 | R | 1 |
| 7. | Define: photovoltaic effect. | | CO4 | R | 1 |
| 8. | Cite the meaning of tandem solar cells. | | CO4 | U | 1 |
| 9. | Define the term: Bio mass. | | CO5 | R | 1 |
| 10. | List any one type of fuel cell. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the types of energy. | | CO1 | A | 3 |
| 12. | Recall the significance of sustainable energy systems. | | CO2 | R | 3 |
| 13. | Discuss the market perspectives of hydro power plants. | | CO3 | U | 3 |
| 14. | Choose the materials used in PV cells. | | CO4 | A | 3 |
| 15. | Cite the types of biofuels. | | CO5 | U | 3 |
| 16. | Explain thermodynamic potential. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain in detail nuclear fuel resources and their diverse applications. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the Energy Life Cycle. | CO1 | An | 6 |
|  | b. | Explain the Sustainable Development Goal 5. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain the working of a horizontal axis wind turbine, with neat sketch. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Analyze the performance of photovoltaic solar energy conversion system | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Identify the biomass relevance to energy production, with applications. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Illustrate the recent developments in hydro turbine rotor technology. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Examine the fundamentals of solar cell operation, with neat sketches. | CO4 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Describe any one hydrogen production method, with neat sketch. | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Evaluate fossil, nuclear, and renewable energy resources for sustainable energy production |
| **CO2** | Analyze energy systems from a systems perspective to measure sustainability |
| **CO3** | Apply principles of system design to develop wind turbine rotor |
| **CO4** | Design photovoltaic cells and measure their performance |
| **CO5** | Analyze Biomass waste and convert it to useful energy |
| **CO6** | Assess the feasibility of deploying fuel cell systems for different applications |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23ME2044** | **Duration** | **3 hrs** |
| **Course Title** | **INDUSTRIAL SAFETY ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define industrial safety. | | CO1 | R | 1 |
| 2. | Describe a safety survey. | | CO1 | U | 1 |
| 3. | List one mechanical cause of accident. | | CO2 | R | 1 |
| 4. | State the meaning of the 4 E’s in accident prevention. | | CO2 | R | 1 |
| 5. | Give one example of a physical hazard. | | CO3 | U | 1 |
| 6. | Describe the point of operation. | | CO3 | U | 1 |
| 7. | Define workplace layout. | | CO4 | R | 1 |
| 8. | State the primary objective of occupational hygiene. | | CO5 | R | 1 |
| 9. | Illustrate TLV stand in occupational hygiene | | CO5 | U | 1 |
| 10. | Discuss why the matte paint is preferred over glossy paint on factory walls and equipment. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the purpose of safety sampling. | | CO1 | A | 3 |
| 12. | Differentiate between a reportable and a non-reportable accident. | | CO2 | U | 3 |
| 13. | Describe three machine-guarding methods. | | CO3 | U | 3 |
| 14. | Discuss the 'Sort' and 'Shine' steps in the 5S methodology. | | CO4 | U | 3 |
| 15. | Differentiate between acute and the chronic occupational exposure effects. | | CO5 | U | 3 |
| 16. | Describe the role of housekeeping in preventing occupational hazards. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the structure and objectives of safety audit in industry. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the process of accident investigation and analysis. | CO2 | A | 6 |
|  | b. | Analyze the difference between accident and near- miss incidents with suitable examples. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the various types of hazards – physical, chemical, and biological – with suitable examples. | CO3 | A | 6 |
|  | b. | Illustrate the principles and policy requirements of Zero Mechanical State (ZMS) in industrial maintenance. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. |  | Assess the product, process and fixed types of plant layouts and their suitability in various industrial scenarios including safety implications. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. |  | Illustrate the steps involved in conducting an Industrial Hygiene Survey. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Describe the organizational structure and responsibilities for safety in an industry. | CO1 | U | 6 |
|  | b. | Explain the impact of improper use of hand tools and portable power tools on industrial safety, and propose preventive measures. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the principles and key elements of a workplace housekeeping plan. | CO4 | A | 6 |
|  | b. | Illustrate the 5S approach and critically evaluate its role in promoting workplace safety and efficiency. | CO5 | E | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Discuss benefits of Proper Industrial Lighting. | CO6 | U | 6 |
|  | b. | Analyze the problem of glare in industrial environments and discuss measures to minimize its effects. | CO6 | An | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the various basic concepts and its importance of safety in process industries. |
| **CO2** | Evaluate the safety performance of an organization from accident records. |
| **CO3** | Identify the industrial hazards and minimize or eliminates the risk faced. |
| **CO4** | Design features for a process industry and safety in the operation of various machinery in the industry. |
| **CO5** | Understand the health and welfare provisions given in the Factories Act. |
| **CO6** | Identify the notifiable occupational diseases and the impact arising out of work and develop methods for the prevention of such diseases. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **FLUID MECHANICS** | **Duration** | **3hrs** |
| **Course Title** | **24ME2001** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Capillarity. | | CO1 | R | 1 |
| 2. | Distinguish Gauge pressure from Vacuum pressure. | | CO1 | U | 1 |
| 3. | Describe stream tube. | | CO2 | U | 1 |
| 4. | Distinguish ‘Ideal fluid’ from ‘Real fluid’. | | CO2 | U | 1 |
| 5. | Give an example for turbulent flow. | | CO3 | R | 1 |
| 6. | List two application of Bernoulli’s equation. | | CO3 | R | 1 |
| 7. | List the basic dimensions. | | CO4 | R | 1 |
| 8. | Describe secondary dimensions. | | CO4 | U | 1 |
| 9. | Define boundary layer thickness. | | CO5 | R | 1 |
| 10. | List few minor losses in pipelines. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Distinguish cohesive and adhesive forces. | | CO1 | U | 3 |
| 12. | Define center of pressure. | | CO2 | R | 3 |
| 13. | Distinguish ‘streak line’ from ‘streamline’. | | CO3 | U | 3 |
| 14. | Draw a velocity profile for a developing pipe flow. | | CO4 | A | 3 |
| 15. | Derive the dimension of viscosity. | | CO5 | A | 3 |
| 16. | Illustrate a viscid cone profile of a pipe flow. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | The dynamic viscosity of an oil used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4m and rotates at 190 rpm, calculate the power lost in the bearing for a sleeve length of 90 mm. The thickness of the film is 1.5mm. | CO1 | A | 6 |
|  | b. | A pipe contains an oil of specific gravity 0.8. A differential manometer connected at the two points A and B of the pipe shows a difference in mercury level as 20 cm. Find the difference of pressure at the two points. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. |  | A U-tube manometer is used to measure the pressure of water in a pipeline that exceeds atmospheric pressure. The right limb of the manometer contains mercury and is open to the atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line if the difference in the level of mercury in the limbs of the U-tube is 10 cm and the free surface of mercury is in level with the center of pipe. If the pressure of water in pipeline is reduced to 9810 N/m2, calculate the new difference in the level of mercury. Sketch the arrangements in both cases. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | If for a two-dimensional potential flow; the velocity potential is given by φ = x(2y-1). Determine the velocity at the point P (4, 5). Determine also the value of stream function ψ at the point P | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | An orifice meter with an orifice diameter of 15 cm is inserted in a pipe of 30 cm diameter. The pressure difference measured by a mercury oil differential manometer on the two sides of the orifice meter gives a reading of 50 cm of mercury. Find the rate of flow of oil of specific gravity 0.9 when the coefficient of discharge of the orifice meter is 0.64. | CO4 | A | 8 |
|  | b. | Derive Bernoulli’s equation from Euler’s equation and summarize the assumptions used. | CO4 | A | 4 |
|  |  |  |  |  |  |
| 21. |  | Explain the concept of boundary layer over flat plates with a neat velocity profile sketch. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Derive the three-dimensional continuity equation for a steady flow process. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | The attacking force R of a rocket during flight can be considered as dependent upon the rocket length (Ɩ), velocity (v), air viscosity (μ), air density (ρ) and the bulk modulus of air (K). Express the functional relationship between these variables and attacking force using Buckingham’s theorem. | CO5 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Find the head lost due to friction in a pipe of diameter 300 mm and length 50 m, through which water is flowing at a velocity of 3 m/s using (i) Darcy formula, (ii) Chezy's formula for which C = 60. Take kinematic viscosity for water = 0.01 stoke | CO6 | E | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Analyze the properties and behavior of advanced nanofluids and magnetic fluids in various applications. |
| **CO2** | Interpret pressure measurements using various types of manometers, including differential manometers. |
| **CO3** | Apply continuity and momentum equations to analyze fluid flow rates and patterns. |
| **CO4** | Evaluate energy losses in the fluids by applying Bernoulli’s equation |
| **CO5** | Assess fluid dynamics scenarios through similitude and model studies. |
| **CO6** | Analyze flow characteristics of laminar and turbulent flow in circular conduits. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **25ME202** | **Duration** | **3hrs** |
| **Course Title** | **MANUFACTURING TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | Identify the requirements/properties of machine tool materials. | 1a | R | 1 |
| 2. | List two materials used in the manufacturing of cutting tools. | 1b | R | 1 |
| 3. | List two popular tool manufacturers and their products. | 2a | U | 2 |
| 4. | Distinguish ‘spindle speed’ from ‘cutting speed’ during the drilling operation. | 2b | U | 2 |
| 5. | Cite two milling cutters with respect to their geometry. | 3a | R | 3 |
| 6. | State two applications of the milling process. | 3b | R | 3 |
| 7. | Discuss two materials used in the manufacturing of grinding wheels. | 4a | U | 4 |
| 8. | Cite the objectives of the grinding operation in the industrial set-up. | 4b | U | 4 |
| 9. | Choose two liquids that are used as dielectric fluids in Electrical Discharge Machining (EDM). | 5a | A | 5 |
| 10. | Cite two specific industrial applications of Electrical Discharge Machining (EDM). | 5b | U | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | Determine the machining time of the following turning operation. A mild steel rod with a 50 mm diameter and 500 mm long is to be turned on a lathe. This rod is to be reduced to 45 mm diameter in one pass when the cutting speed is 30 m/min and the feed is 0.7 mm/rev. | 1a | A | 1 |
| 12. | Infer the effects of spindle speed and feed on the thrust force and torque during the drilling process in the drilling machine. | 1b | An | 2 |
| 13. | Compare ‘up milling’ with ‘down milling’ with suitable diagrams and highlight their industrial applications. | 2a | A | 3 |
| 14. | Infer the grinding wheel coding system with an example. | 2b | An | 4 |
| 15. | Interpret the uses (or) applications of the Electrical Discharge Machine (EDM) to manufacture complex geometrical profiles for the automobile and aerospace industries. | 2c | A | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | Summarize the various materials used in the manufacture of cutting tools and explain their specific properties and relevance in achieving high-precision machining of engine components in the automotive manufacturing industry. | 1c | U | 1 |
| **(OR)** | | | | |
| 17 | Explain the construction and working principle of a lathe enable the precision turning of a propeller shaft in an automotive engine manufacturing plant, and include a neat diagram along with its industrial relevance. | 1e | An | 1 |
|  | | | | |
| 18 | Explain the constructional details and working principle of a radial drilling machine facilitate drilling operations on large flanges and heavy cast components in a fabrication industry, and include a neat diagram along with its industrial applications. | 2b | An | 2 |
| **(OR)** | | | | |
| 19 | Distinguish the uniqueness and industrial applications of the following operations performed in the drilling machine   1. Boring 2. Reaming 3. Tapping 4. Counter Sinking | 2c | An | 2 |
|  | | | | |
| 20 | Interpret any five milling operations performed in the milling machine with suitable sketches, and indicate the industrial applications of each one of them. | 3d | A | 3 |
| **(OR)** | | | | |
| 21 | Explain the constructional details and working principle of a horizontal milling machine, which support the machining of keyways and slots in heavy gear components in an industrial gearbox-manufacturing unit. Include neat sketches and state its industrial applications, advantages and limitations. | 3f | A | 3 |
|  | | | | |
| 22 | Illustrate the construction and working principle of a surface-grinding machine, which support the production of flat, high-precision die plates in the tool manufacturing industry. Include a neat diagram and state its industrial applications. | 4c | An | 4 |
| **(OR)** | | | | |
| 23 | Explain the constructional details and working principle of a cylindrical grinding machine, which is used in an automotive manufacturing plant for producing high-precision shaft components. Include a neat diagram and discuss its major industrial applications, advantages and limitations. | 4e | An | 4 |
| **Compulsory Question:** | | | | |
| 24 | In a precision aerospace component manufacturing industry, complex turbine blade slots and irregular profiles must be produced with high dimensional accuracy and minimal thermal distortion. Justify the use of Wire Electrical Discharge Machine (EDM) for the above purpose along with its working principle in accomplishing these intricate machining requirements. | 5d | E | 5 |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **25ME203** | **Duration** | **3hrs** |
| **Course Title** | **LOGIC BUILDING USING ‘C’ PROGRAMMING FOR MECHANICAL ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | Identify the different C data types used to store various engineering parameters. | 1a | R | 1 |
| 2. | Record the use of arithmetic operators in solving unit-conversion problems. | 1b | R | 1 |
| 3. | Infer the relevance of selecting appropriate data types for stress analysis | 2a | U | 2 |
| 4. | Identify the role of *break* and *continue* statements in controlling iterative machining operations. | 2b | U | 2 |
| 5. | Describe the importance of mass estimation in sub-assemblies and its role in engineering design. | 3a | R | 3 |
| 6. | Label the sequence of steps for a C program that takes crank parameters as input, calculates piston displacement, and displays the result using formatted output. | 3c | R | 3 |
| 7. | Cite two main types of functions in C. | 4a | U | 4 |
| 8. | Cite a C function to store cutting force, feed rate, and spindle speed for machining operations. | 4b | U | 4 |
| 9. | Write a C program segment that stores the temperatures at 5 different points of a heat exchanger in an array and prints them. | 5a | A | 5 |
| 10. | Write a C program snippet that reads the speeds of 4 rotating machine shafts into an array and displays the highest speed. | 5c | A | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | Compute unit conversion using meters = inches \* 0.0254;to translate dimensions, retain numerical precision, and standardize measurements across engineering computations. | 1a | A | 1 |
| 12. | Compute the strain from measured displacement and gauge length using input/output operations and relational operators. | 2b | An | 2 |
| 13. | Employ the increment operator in a loop to simulate repeated mechanical actions and monitor process iterations dynamically. | 3a | A | 3 |
| 14. | Illustrate a C function called calcTorque() that receives force and radius as arguments and returns the torque using: | 4b | An | 4 |
| 15. | A rectangular steel beam is used in the construction of a bridge support.  The beam has a width of 0.25 m and a height of 0.6 m.It is subjected to an applied bending moment of 80 kNm.The allowable stress for the steel material is 160 MPa. Develop a ‘C’ program to determine:  The moment of inertia (I) of the beam cross-section. I​=12bh3​  The induced bending stress (σ) in the beam.  The factor of safety (FOS).  Decide whether the beam is SAFE or UNSAFE under the given loading condition. Given FOS=Strength of Materials/Working stress | 5c | A | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | Consider a wooden plank (rectangular beam) being used as a small bridge between two supports. The plank is supported at both ends (simply supported beam).A person stands at the center of the plank, applying a central load (W).  Beam details:  Length of plank L=2 m,  Width b=0.1 m  Height h=0.15 m,  Person’s weight (Load) W=600 N.  Develop a ‘C ‘ program to calculate the stress and Moment of Inertia. Given, | 1c | A | 1 |
| **(OR)** | | | | |
| 17 | Generated imageDevelop a C Program to automate the stress calculation using the given equation for a given rectangular steel beam which is placed across two supports in a workshop (simply supported) as shown in the figure. A motor assembly weighing 2000 N is lifted at the center of the beam using a chain hoist as shown in the given figure. | 1d | C | 1 |
|  | | | | |
| 18 | A pressure vessel experiences an internal force of 1,20,000 N over an area of 400 mm². Two materials are available:  Aluminum: Tensile Strength = 300 MPa  Titanium: Tensile Strength = 900 MPa  Safety Factor = 3.  Write a C program that selects the better material based on safety. | 2b | A | 2 |
| **(OR)** | | | | |
| 19 | If a conveyor belt in a manufacturing plant starts from rest and accelerates  uniformly to reach a speed of 10 km/h in 20 seconds, calculate the distance  a package will travel on the belt during this time using C programming. Given: v=u+at. | 2c | An | 2 |
|  | | | | |
| 20 | Develop a C program to simulate the heating, soaking, and controlled cooling process in a heat treatment furnace. | 3d | C | 3 |
| **(OR)** | | | | |
| 21 | Illustrate if-else logic to automate material property selection, match allowable stress values, and ensure accurate material-based safety assessment. | 3f | A | 3 |
| 22 | During a vehicle engine testing lab, the piston kinematics of a 1500 cc, 4-cylinder petrol engine used in a compact car is studied.  Where Crank radius (R) = 0.045 m, Connecting rod length (L) = 0.18 m Engine speed (N) = 3600 rpm, Crank angle (θ) = 60° (1.047 radians). Develop a ‘C’ program to calculate:  Piston displacement.    Piston velocity. | 4b | C | 4 |
| **(OR)** | | | | |
| 23 | A gas-turbine maintenance team needs a ‘C ‘program to manage an inventory of turbine blades.  Each blade record should store the following details:  Blade ID (unique number)  Material grade (e.g., Inconel 718, René 80)  Cooling type (solid/hollow / shrouded)  Quantity in stock  Last inspection date  Remaining service cycles  Write a ‘C’ program to:  Search for blades required for a specific turbine model.  Update stock levels during maintenance or shutdown replacement.  Flag blades that have exceeded their allowed service cycles.  Create a reorder alert when stock falls below a minimum limit. | 4e | C | 4 |
|  | | | | |
| **Compulsory Question:** | | | | |
| 24 | In a heat exchanger test setup, a technician records several temperature readings at different locations along the exchanger during operation.  Develop a ‘C’ program that stores all these temperature values in an array.  Temperature Difference (ΔT)=    Average Temperature: | 5d | C | 5 |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **25ME204** | **Duration** | **3hrs** |
| **Course Title** | **LINEAR ALGEBRA AND CALCULUS FOR MECHANICAL ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | A robotic arm’s Jacobian matrix in 2-DOF planar motion is  *Find*  to determine joint velocities from end-effector velocities. | 1a | R | 1 |
| 2. | For stress transformation matrices A and B of the same order, *find*  (i).  (ii).  where λ and μ are scalars representing strain-energy. | 1b | R | 1 |
| 3. | The vibration displacement of a machine part is given by . *Estimate* the instantaneous rate of change with respect to . | 2a | U | 2 |
| 4. | If the strain function in a metal plate is . *Test* whether the mixed partial derivatives  and are equal. | 2c | U | 2 |
| 5. | *Find* the divergence at the point of the velocity field  of fluid in a coolant pipe. | 3e | R | 3 |
| 6. | *Compute* the gradient at for the potential energy given by  of a spring system. | 3c | R | 3 |
| 7. | A damped spring-mass system obeys **.** Solve for . | 4b | U | 4 |
| 8. | *Find* the PI of the differential equationrepresenting the a robotic arm actuator. | 4c | U | 4 |
| 9. | The displacement of a vibrating rectangular plate satisfies. *Find* the general solution. | 5b | E | 5 |
| 10. | A pressure-oscillation model leads to a differential equation whose characteristic roots are 0, 1, 2, 3. *Give* the complementary function of the governing ODE. | 5d | A | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | For a rotating shaft, vibration energy is modeled using . *Classify* the quadratic energy form without reducing it to canonical form. | 1b | A | 1 |
| 12. | *Determine* the gradient and the -direction curvature (second derivative) of the temperature field in a plate given by. | 2b | An | 2 |
| 13. | A drone follows the spatial path . *Compute* its velocity and acceleration at . | 3b | E | 3 |
| 14. | *Solve* the vibration equation  for a damped spring–mass system. | 4c | E | 4 |
| 15. | *Find* the function  from the fluid flow relation is given by . | 5c | E | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | *Estimate* the principal stresses by diagonalizing the stiffness matrix by means of orthogonal transformation. | 1e | E | 1 |
| **(OR)** | | | | |
| 17 | *Express* the energy of a 3-DOF rotor system in principal coordinates by reducing the quadratic form to canonical form by an orthogonal transformation. | 1d | An | 1 |
|  |  |  |  |  |
| 18 | *Estimate* the mixed partial derivative  of the stream function given by. | 2b | An | 2 |
| **(OR)** | | | | |
| 19 | *Design* an open-top oil container of volume 32 cubic ft. Find dimensions that minimize material used for its construction. | 2e | E | 2 |
|  |  |  |  |  |
| 20 | *Show* that the gradients lie in a common plane for the given strain fields represented by ,  and . | 3c | A | 3 |
| **(OR)** | | | | |
| 21 | For a given potential field function, *find* ,  and  at the point . | 3f | E | 3 |
| 22 | A spring–mass system obeys . *Find* the steady-state and transient response using method of Variation of Parameters. | 4c | E | 4 |
| **(OR)** | | | | |
| 23 | *Solve* the differential equation for the deflection of a beam under distributed load. | 4e | E | 4 |
| **Compulsory Question:** | | | | |
| 24 | *Determine* the response of a high-order control system governed by the differential equaton. | 5d | E | 5 |