

**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **14ME2015 / 17ME2011** | **Duration** | **3hrs** |
| **Course Name** | **THERMAL ENGINEERING I** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define ‘Boiler Efficiency’. | | CO1 | R | 1 |
| 2. | Write any two factors on which the boiler efficiency depends. | | CO1 | U | 1 |
| 3. | Define ‘Nozzle efficiency’. | | CO2 | R | 1 |
| 4. | Write the reason for high velocity flow in the divergent portion of steam nozzle. | | CO2 | R | 1 |
| 5. | Write the advantages of steam turbines over steam engines. | | CO3 | U | 1 |
| 6. | State the advantages of reheating of steam. | | CO3 | R | 1 |
| 7. | Write the comparison between Rankine cycle and Carnot cycle. | | CO4 | U | 1 |
| 8. | Write any two advantages of regenerative cycle over simple Rankine cycle. | | CO4 | R | 1 |
| 9. | Define ‘isothermal efficiency of air compressor’. | | CO5 | R | 1 |
| 10. | Define ‘Coefficient of performance’. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Define and explain ‘Equivalent Evaporation’. | | CO1 | An | 3 |
| 12. | Explain supersaturated expansion of steam in a nozzle. | | CO2 | U | 3 |
| 13. | Write three main differences between impulse and reaction turbine. | | CO3 | U | 3 |
| 14. | Explain basic Rankine cycle with neat diagram. | | CO4 | U | 3 |
| 15. | Write any three application of compressed air in the industry. | | CO5 | An | 3 |
| 16. | Explain simple vapour compression system with neat diagram. | | 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. | a. | Explain with the help of neat diagrams i) Cochran Boiler ii) Babcock and Wilcox Boiler. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Derive the expression for discharge through the nozzle and condition for its maximum value. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Write different methods of compounding of steam turbines. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | In a steam turbine, steam at 20 bar, 360 C is expanded to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Assume ideal processes, find per kg of steam the network and the cycle efficiency. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | An air compressor takes in air at 1 bar and 20 C and compresses it according to the law pv1.2=constant. It is then delivered to a receiver at a constant pressure of 10 bar. R= 0.287 kJ/kg K. Determine i) Temperature at the end of compression ii) Work done and heat transfer during compression per kg of air. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | A steam generator evaporates 18000 kg/h of steam at 12.5 bar and a quality of 0.97 from feed water at 105 C, when coal is fired at the rate of 2040 kg/h. If the Higher calorific value of the coal is 27400 kJ/kg, find i) The heat rate of boiler in kJ/h ii) The equivalent evaporation iii) The thermal efficiency. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | Dry saturated steam enters a frictionless adiabatic nozzle with negligible velocity at a temperature of 300 C. It is expanded to a pressure of 5000 kPa. The mass flow rate is 1 kg/s. Calculate the exit velocity of steam. | CO2 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain Ammonia- water vapour absorption refrigeration system and write the comparison between vapour absorption and compression systems. | CO6 | A | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Estimate the performance of a steam generator |
| **CO2** | Analyze the flow through steam nozzles |
| **CO3** | Determine the efficiency of the impulse and reaction turbine using velocity triangles |
| **CO4** | Describe vapour power cycles |
| **CO5** | Calculate the efficiency of a reciprocating air compressor |
| **CO6** | Evaluate Coefficient of performance of Refrigeration systems |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 1 | 12 | 15 | - | - | 29 |
| **CO2** | 2 | 3 | 12 | 12 | - | - | 29 |
| **CO3** | 1 | 4 | 12 | - | - | - | 17 |
| **CO4** | 1 | 4 | - | 12 | - | - | 17 |
| **CO5** | 1 | - | - | 15 | - | - | 16 |
| **CO6** | 1 | 3 | 12 | - | - | - | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **14ME2019 / 16ME2011 / 17ME2024 / 18ME2010** | **Duration** | **3hrs** |
| **Course Name** | **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. | Define Critical Thickness of Insulation. | | CO1 | R | 1 |
| 2. | Write the physical significance of thermal diffusivity. | | CO1 | U | 1 |
| 3. | Compare the average and local heat transfer coefficients. | | CO2 | U | 1 |
| 4. | Define ‘Entry length’ for a tube flow. | | CO2 | R | 1 |
| 5. | State ‘Wien displacement law’. | | CO3 | U | 1 |
| 6. | What is the purpose of ‘radiation shields? | | CO3 | R | 1 |
| 7. | List the effects of fouling factor on heat exchanger design | | CO4 | U | 1 |
| 8. | Write the working principle of ‘regenerators’ | | CO4 | R | 1 |
| 9. | Define Nucleate Boiling. | | CO5 | R | 1 |
| 10. | Define Schmidt numbers. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | A hollow sphere 10cm I.D. and 30cm O.D. of a material having thermal conductivity 50 W/mK is used as a container for liquid chemical mixture. Its inner and outer surface temperatures are 300oC and 100oC respectively. Determine the heat flow rate through the sphere? | | CO1 | An | 3 |
| 12. | Define Grashof number and explain its significance in free convection heat transfer. | | CO2 | U | 3 |
| 13. | Two black square plates of size 1\*1m are placed parallel to each other at the distance of 0.4 m. One plate is maintained at a temperature of 900 C and the other at 400 C. Find the net exchange of energy due to radiation between the two plates? | | CO3 | An | 3 |
| 14. | Draw the graphs for temperature distribution of fluids in a) condenser b) evaporator | | CO4 | U | 3 |
| 15. | Distinguish between film wise and drop wise condensation. | | CO5 | An | 3 |
| 16. | Write the importance of Sherwood and Lewis numbers. | | 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 a steady state heat conduction equation in Cartesian coordinates | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Air at 20o is flowing along a heated flat plate at 134oC at a velocity of 3m/s. the plate is 2m long and 1.5 m wide. Calculate the thickness of the hydrodynamic boundary layer and the skin friction coefficient at 40 cm from the leading edge of the plate. The kinematic viscosity of air at 20oC may be taken at 15.06×10-6 m2/s. | CO2 | An | 6 |
|  | b. | An air stream at 0oC is flowing along a heated plate at 90oC at a speed of 75 m/s. the plate is 45 cm long and 60 cm wide. Assuming the transition of boundary layer to take place at Re= 5\*105 calculate the average values of friction coefficient and heat transfer coefficient for the full length of the plate. Hence calculate the rate of energy dissipation from the plate. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. |  | Calculate the net radiant heat exchange per m 2 area for two large parallel plates at temperatures of 427 oC and 27 oC. ɛ ℎ𝑜𝑡 𝑝𝑙𝑎𝑡𝑒 = 0.9 and ɛ𝑐𝑜𝑙𝑑 𝑝𝑙𝑎𝑡𝑒 = 0.6. If a polished aluminum shield is placed between them, find the % reduction in the heat transfer ɛ 𝑠ℎ𝑖𝑒𝑙𝑑 = 0.4 . | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Derive an expression for LMTD in a Parallel flow heat exchanger. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Discuss in detail the Flow Boiling phenomena with neat sketch. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Water enters a cross flow heat exchanger (both the fluids unmixed) at 5C and flows at the rate of 4600kg/h to cool 4000kg/h of air that is initially at 40C. Assume U value to be 150 W/m2Kfor an exchanger surface area of 25m2, calculate the exit temperature of air and water. Cp of air and water is 1010 J/kg K and 4180 J/kg K. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | A 40 \* 40 cm copper slab 5 mm thick at a uniform temperature of 250 C suddenly has it surface temperature lowered at 30 C. Find the time at which the slab temperature becomes 90 C. density is 9000 kg/ m3, specific heat 0.38 kJ/kgK, thermal conductivity 370 W/mK and convective heat transfer coefficient is 90 W/m2K. | CO1 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | An open pan 20 cm in diameter and 8 cm deep contains water at 25 oC and is exposed to dry atmospheric air. If the rate of diffusion of water vapor is 8.54 x 10- 4 kg/h estimate the diffusion coefficient of water in air. | CO6 | An | 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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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 1 | 12 | 15 | -- | - | 29 |
| **CO2** | 1 | 4 | - | 12 | - | - | 17 |
| **CO3** | 1 | 1 | - | 15 | - | - | 17 |
| **CO4** | 1 | 4 | 12 | 12 | - | - | 29 |
| **CO5** | 1 | - | 12 | 3 | - | - | 16 |
| **CO6** | 1 | 3 | - | 12 | - | - | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **14ME2026** | **Duration** | **3 hrs** |
| **Course Name** | **MECHANICS OF MACHINES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Discuss degrees of freedom. | | CO1 | U | 1 |
| 2. | Define a lower pair. | | CO1 | R | 1 |
| 3. | The component of acceleration, parallel to the velocity of the particle at a given instant is \_\_\_\_\_\_\_ component. | | CO1 | U | 1 |
| 4. | State pressure angle with respect to cams. | | CO2 | R | 1 |
| 5. | List the types of cams. | | CO2 | R | 1 |
| 6. | Define a reverted gear train. | | CO3 | R | 1 |
| 7. | Define train value of the gear train. | | CO3 | R | 1 |
| 8. | Name the types of journal bearings. | | CO3 | R | 1 |
| 9. | List the functions of bearings. | | CO3 | R | 1 |
| 10. | Discuss slip in belt drive. | | CO3 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List the different types of constrained motions. | | CO1 | R | 3 |
| 12. | Describe Coriolis component of acceleration. | | CO1 | U | 3 |
| 13. | Discuss **the different motions of the follower.** | | CO2 | U | 3 |
| 14. | Describe the terms: (i) Module, and; (ii) Pressure angle (in relation with gear drives). | | CO3 | U | 3 |
| 15. | The number of teeth on a gear is 80. Module and addendum is 12 mm. Calculate the addendum circle radius of the gear. | | CO3 | A | 3 |
| 16. | Discuss the types of flat belt drives. | | CO3 | 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. | a. | Sketch and explain any two inversions of a four bar chain. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | The crank of a slider crank mechanism rotates clockwise at a constant speed of  300 rpm. The crank is 150 mm and the connecting rod is 600 mm long.  Evaluate: (i) linear velocity at mid-point of connecting rod and (ii) angular  velocity of connecting rod, at crank angle of 45º from the inner dead centre  position. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Sketch the profile of a cam operating a knife-edge follower from the data given:  (i) Cam lift = 40 mm during 90° of cam rotation  (ii) Dwell for the next 30°  (iii) Follower to return to its initial position during 60° of cam rotation  (iv) Follower to dwell for remaining 180° of cam rotation  Sketch the profile of the cam when the line of stroke is offset 20 mm from the  axis of the cam shaft. Outstroke and return stroke takes place with simple harmonic motion. The radius of the base circle of the cam is 40 mm. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Two involute gears of 20º pressure angle are in mesh. The number of teeth on pinion is 20 and the gear ratio is 2; module is 5 mm. Assuming addendum equal to one module, calculate the angle turned through by the pinion when one pair of teeth are in mesh. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Sketch a cam profile for operating the exhaust valve of an oil engine. It is  required to give equal uniform acceleration and retardation during opening and  closing of the valve. Outstroke takes place during 60º of cam rotation; Dwells  for the next 30°; return stroke takes place during the next 60º of cam rotation and  the follower dwells for the remaining period. The lift of the valve is 37.5 mm and the least radius of the cam is 40 mm. The follower is provided with a roller of radius 20 mm and its line of stroke passes through the axis of the cam. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | An epicyclic gear train is arranged as shown in the fig. Estimate the number of  revolutions the arm makes, to which the pinions B and C are attached, when  A makes one revolution clockwise and D makes half a revolution anticlockwise.  The number of teeth on gears A and D are 40 and 90 respectively. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | Indicate the important factors upon which a belt drive is selected. | CO3 | U | 4 |
|  | b. | Compute the power transmitted by a belt running over a pulley of 600 mm diameter at 200 rpm. The coefficient of friction between the belt and the pulley is 0.25, angle of lap 160 degree and maximum tension in the belt is 2500 N. | CO3 | A | 8 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Calculate the power transmitted by a single plate clutch at a speed of 2000 rpm, if the outer and inner radii of friction surfaces are 150 mm and 100 mm respectively. The maximum intensity of pressure at any point of contact surface should not exceed 0.8 x 105N/m2. Take both sides of the plate as effective and the coefficient of friction = 0.3. Assume uniform wear. | CO3 | A | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | determine mobility, position, velocity and acceleration of links in mechanism. |
| **CO2** | design cam motion profiles, for different types of follower mechanisms. |
| **CO3** | analyze gear trains and design transmission devices considering friction. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 4 | 5 | 12 | 12 | - | - | 33 |
| **CO2** | 2 | 3 | 12 | 12 | - | - | 29 |
| **CO3** | 4 | 11 | 35 | 12 | - | - | 62 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **14ME2028 / 17ME2027 / 18ME2017** | **Duration** | **3hrs** |
| **Course Name** | **DESIGN OF TRANSMISSION SYSTEMS** | **Max. Marks** | **100** |

|  |  |  |  |
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| **Q. No.** | **Questions** | **CO/ BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | |
| 1. | A\_\_\_\_\_\_\_\_\_\_\_ bearing supports the load acting along the axis of the shaft. | CO1 / R | 1 |
| 2. | What is the usual clearance provided in hydrodynamic bearing per mm of diameter of shaft? | CO1 / U | 1 |
| 3. | The distance between the hinge center of a link and the corresponding hinge center of the adjacent link is called \_\_\_\_\_\_\_\_\_\_\_\_. | CO2 / A | 1 |
| 4. | Write the use of pulley Crown in belt drive. | CO2 / R | 1 |
| 5. | The gears are termed as medium velocity gears if their peripheral velocity is \_\_\_ | CO3 / U | 1 |
| 6. | The size of gear is usually specified by\_\_\_\_\_\_\_\_\_\_\_\_\_. | CO3 / A | 1 |
| 7. | When large gear reductions are needed \_\_\_\_\_\_\_\_\_ gears are used. | CO4/ An | 1 |
| 8. | Number of teeth on Ratchet arrester varies from\_\_\_\_\_\_\_\_\_\_\_. | CO5 / E | 1 |
| 9. | A brake commonly used in railway trains is\_\_\_\_\_\_\_\_\_\_\_. | CO5 / A | 1 |
| 10. | Geneva mechanism is mainly used for\_\_\_\_\_\_\_\_\_\_\_\_. | CO6 / R | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | Explain the various types of Roller bearings. | | CO1 / R | 3 |
| 12. | Write the difference between flat and V-belt drive. | | CO2 / U | 3 |
| 13. | Discuss the various types of gear tooth failures. | | CO3 / U | 3 |
| 14. | Define pitch cone and pitch angle. | | CO4 / R | 3 |
| 15. | Derive the structural formula of a 9 speed gearbox. | | CO5 / E | 3 |
| 16. | What are the main applications of power screws? | | 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. | Design a Journal Bearing for a centrifugal pump, if diameter of Journal is 120 mm, load on Journal is 30 kN and speed of Journal is 1000 rpm. | CO1 / A | 12 |
|  |  |  |  |  |
| 18. | a. | Design a fabric belt to transmit 12kW at 450rpm from an engine to be a line shaft at 1200rpm. Diameter of the engine pulley is 600mm and the distance of the shaft from the engine is 2m. | CO2 / E | 12 |
|  |  |  |  |  |
| 19. | a. | Design a spur gear to transmit 22.5 kW at 900 rpm; speed reduction is 2.5; Material for pinion is C15 steel. Take a pressure angle of 20 degree and the working life of the gears as 10,000 hrs. | CO3 /An | 12 |
|  |  |  |  |  |
| 20. | a. | Design a pair of helical gears for the following data.  Power = 7.5 kW  Speed of pinion =1400 rpm  Speed reduction = 3  Pressure angle = 20°  Helix angle = 10°, Select the materials and heat treatment. | CO3 / E | 12 |
|  |  |  |  |  |
| 21. | a. | Design a worm gear drive to transmit 12 kW at 1200 rpm. The speed reduction desired is 30 : 1. The worm is made of hardened steel and the wheel of phosphor bronze. Check the heating capacity of gears and determine the efficiency. | CO4 /An | 12 |
|  |  |  |  |  |
| 22. | a. | A single plate clutch, effective on both sides, is required to transmit 25 kW at 3000 r.p.m. Determine the outer and inner diameters of the frictional surface if the coefficient of friction is 0.255, the ratio of diameters is 1.25 and the maximum pressure is not to exceed 0.1 N/mm2. Also, determine the axial thrust to be provided by springs. Assume the theory of uniform wear. | CO5 /An | 12 |
|  |  |  |  |  |
| 23. | a. | A Geneva wheel is to have six slots. Driving crank radius is 50 mm. Determine various dimensions of Geneva wheel. | CO6 / U | 8 |
| b. | Write short notes on differential screw and compound screw. | CO6 / R | 4 |
|  |  |  |  |  |
|  |  | **Compulsory:** | | |
| 24. | a. | Design a 9 speed gearbox for a milling machine with speeds ranging from 56 - 900 rpm. The input speed is 720 rpm; Make a neat sketch of the gearbox. Indicate the No. of teeth on all the gears and their speeds. | CO5 / E | 12 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the working principles of mechanical components employed in mechanical transmission systems. |
| CO2 | Apply suitable theories and basic engineering principles and procedures to design the transmission elements. |
| CO3 | Select appropriate engineering design data from standard data books for mechanical transmission components. |
| CO4 | Design, transmission systems based on the requirements. |
| CO5 | Design and Draw speed reducer, multispeed gear box. |
| CO6 | Evaluate the torque, power and other functional requirements of power transmission Elements. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / BL | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 1 | 12 | - | - | - | 17 |
| CO2 | 1 | 3 | 1 | - | 12 | - | 17 |
| CO3 | - | 4 | 1 | 12 | 12 | - | 29 |
| CO4 | 3 | - | - | 13 | - | - | 16 |
| CO5 | - | - | 1 | 12 | 16 | - | 29 |
| CO6 | 5 | 8 | 3 | - | - | - | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **14ME2029 / 17ME2020 / 18ME2016** | **Duration** | **3hrs** |
| **Course Name** | **DESIGN OF MACHINE ELEMENTS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions**  **(Use of Approved Data Book & Data Sheets are permitted)** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Describe Young’s Modulus. | | CO1 | R | 1 |
| 2. | Define the term Poisson’s ratio. | | CO1 | R | 1 |
| 3. | Name any two commonly used materials for sliding contact bearings. | | CO2 | R | 1 |
| 4. | Illustrate how the stress concentration in a component can be reduced. | | CO2 | U | 1 |
| 5. | Define critical speed of shafts. | | CO3 | R | 1 |
| 6. | Discuss the function of a coupling. | | CO3 | U | 1 |
| 7. | State why are square threads are preferred to V-threads for power transmission. | | CO4 | R | 1 |
| 8. | List any two types of welded joints. | | CO4 | R | 1 |
| 9. | Define ‘coefficient of fluctuation of speed’. | | CO5 | R | 1 |
| 10. | Distinguish the function of a brake from that of a clutch. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Describe the terms (i) Elastic limit, and (ii) Factor of safety. | | CO1 | U | 3 |
| 12. | Discuss Soderberg's equation and state its application. | | CO2 | U | 3 |
| 13. | Illustrate any three types of keys and their applications. | | CO3 | U | 3 |
| 14. | Discuss the terms (i) Spring index, and (ii) Spring ratio. | | CO4 | U | 3 |
| 15. | Summarize the use of ribs in pistons. | | CO5 | U | 3 |
| 16. | Name a few materials used for brake linings. | | 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. | a. | An overhang crank with pin and shaft is shown in Fig. A tangential load of  15 kN acts on the crank pin. Analyze the maximum principal stress and the maximum shear stress at the centre of the crankshaft bearing. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | A shaft rotating at constant speed is subjected to variable load. The bearings  supporting the shaft are subjected to stationary equivalent radial load of 3 kN for 10 per cent of time, 2 kN for 20 per cent of time, 1 kN for 30 per cent of time and no load for remaining time of cycle. If the total life expected for the bearing is 20 × 106 revolutions at 95 per cent reliability. Calculate the dynamic load rating of the ball bearing. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | A solid circular shaft is subjected to a bending moment of 3000 N-m and a torque of 10 000 N-m. The shaft is made of 45C8 steel having ultimate tensile stress of 700 MPa and an ultimate shear stress of 500 MPa. Assuming a factor of safety as 6, determine the diameter of the shaft. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Analyze and design a cotter joint to support a load varying from 30 kN in compression to 30 kN in tension. The material used is carbon steel for which the following allowable stresses may be used. The load is applied statically.  Tensile stress = compressive stress = 50 MPa; shear stress = 35 MPa and crushing stress = 90 MPa. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | A four stroke diesel engine has the following specifications:  Brake power = 5 kW; Speed = 1200 r.p.m.; Indicated mean effective pressure = 0.35 N / mm2 ; Mechanical efficiency = 80 %.  Estimate: (i) Bore and length of the cylinder; (ii) thickness of the cylinder head | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | The load on a bolt consists of an axial pull of 10 kN together with a transverse  shear force of 5 kN. Calculate the diameter of bolt required according to  (i) Maximum principal stress theory, and; (ii) Maximum shear stress theory. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Examine and design a leaf spring for the following specifications:  Total load = 140 kN; Number of springs supporting the load = 4; Maximum number of leaves = 10; Span of the spring = 1000 mm; Permissible deflection = 80 mm. Take Young’s modulus, E = 200 kN/mm2 and allowable stress in spring material as 600 MPa. | CO4 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | A multiple disc clutch has five plates having four pairs of active friction  surfaces. If the intensity of pressure is not to exceed 0.127 N/mm2, find the power transmitted at 500 r.p.m. The outer and inner radii of friction surfaces are 125 mm and 75 mm respectively. Assume uniform wear and take coefficient of friction = 0.3. | CO6 | A | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the standard design procedure for Design of machine elements. |
| **CO2** | Analyze stresses acting on components and determine the size based on theories of failure. |
| **CO3** | Design machine components for a given load condition using design data hand books. |
| **CO4** | Decide specifications as per standards given in design data and select standard components to improve interchangeability. |
| **CO5** | Design and develop nonstandard machine components. |
| **CO6** | Prepare a detail design layout and drawing of machine components. |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 3 | 12 | 12 | - | - | 29 |
| **CO2** | 1 | 4 | - | 12 | - | - | 17 |
| **CO3** | 1 | 4 | 12 | - | - | - | 17 |
| **CO4** | 2 | 3 | 12 | 12 | - | - | 29 |
| **CO5** | 1 | 3 | - | 12 | - | - | 16 |
| **CO6** | 3 | 1 | 12 | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **14ME4002** | **Duration** | **3hrs** |
| **Course Name** | **APPLIED THERMAL ENGINEERING AND EXPERIMENTAL METHODS** | **Max. Marks** | **100** |

**ANSWER ALL QUESTIONS (5 X 20 = 100 Marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Q. No.** | **Sub Div.** | **Questions** | **CO/BL** | **M** |
| 1. | a. | Explain principle of increase of entropy. | CO1 / U | 5 |
| b. | Calculate the entropy change of the universe because of the following processes: i) A copper block of 600 g mass and with Cp of 150 J/K at 1000C is placed in a lake at 80C. ii) the same block at 80C, is dropped from a height of 100 m into the lake. iii) Two such blocks at 100 and 00C are joined together. | CO1 / A | 15 |
| **(OR)** | | | | |
| 2. |  | In a steam boiler, the hot gases from a fire transfer heat to water which vaporizes at a constant temperature of 242.60C (3.5 MPa). The gases are cooled from 1100 to 4300C and have an average specific heat, cp=1.046 kJ/kgK over this temperature range. The latent heat of vaporization of steam at 3.5 MPa is 1753.7 kJ/kg. If the steam generation rate is 12.6 kg/s and there is negligible heat loss from the boiler, Calculate i) the rate of heat transfer ii) the rate of loss of exergy of the gas iii) the rate of gain of exergy of the steam iv) the rate of entropy generation. Take T0 = 210C. | CO1 / A | 20 |
|  |  |  |  |  |
| 3. | a. | Distinguish between laminar and turbulent flow. | CO1 / U | 5 |
| b. | Write conservation of mass, momentum, and energy equation for convection heat transfer. | CO1 / R | 7 |
| c. | Explain thermal boundary layer with neat sketches. | CO1 / U | 8 |
| **(OR)** | | | | |
| 4. |  | An experiment is designed to study microscale forced convection. Water at Tm,i=300 K is to be heated in a straight, circular glass tube with a 50-μm inner diameter and a wall thickness of 1 mm. Warm water at T∞= 350 K, V= 2 m/s is in cross flow over the exterior tube surface. The experiment is to be designed to cover the operating range , where ReD is the Reynolds number associated with the internal flow. Calculate the pressure drop from the entrance to the exit of the tube for ReD=2000. | CO1 / A | 10 |
| b. | Calculate the pressure drop for flow of water in a 15 mm-long 100µm circular microchannel flowing at a temperature of 300 K and with a flow Reynolds number of (i) 10, (ii) 100 and (iii) 1000. Also calculate the corresponding water flow rates in kilogram per second. | CO1 / A | 10 |
| 5. | a. | A certain length measurement is made with the following results   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Readings | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | X, in m | 49.36 | 50.12 | 48.98 | 49.24 | 49.26 | 50.56 | 49.18 | 49.89 |   Calculate the standard deviation, the mean reading, and the uncertainty. | CO1 / A | 15 |
| b. | Explain the need of uncertainty analysis in the preliminary stages of experimental planning. | CO1 / U | 5 |
| **(OR)** | | | | |
| 6. |  | Explain the working principle of the following with neat sketches i) Bourdon-tube pressure gauge ii) Diaphragm and Bellows gauges. | CO1 / U | 20 |
|  |  |  |  |  |
| 7. |  | The following data are taken from a certain heat-transfer test. The expected correlation equation is y=axb. Plot the data in an appropriate manner and use the method of least squares to obtain the heat correlation.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | X | 2040 | | 2580 | | 2980 | | 3220 | | 3870 | | 1690 | | 2130 | | 2420 | 2900 | | Y | 33.2 | | 32.0 | | 42.7 | | 57.8 | | 126.0 | | 17.4 | | 21.4 | | 27.8 | 52.1 | | X | | 3310 | | 1020 | | 1240 | | 1360 | | 1710 | | 2070 | | | Y | | 43.1 | | 18.8 | | 19.2 | | 15.1 | | 12.9 | | 78.5 | |   Calculate the mean deviation of these data from the best correlation. | CO1 /An | 20 |
| **(OR)** | | | | |
| 8. | a. | Classify optimization problems and explain with examples. | CO1 / U | 15 |
| b. | Explain regression analysis. | CO1 / U | 5 |
|  | | **COMPULSORY QUESTION** |  |  |
| 9. | a. | Explain the preparation of nano-fluids using two step method with an example. | CO1 / R | 10 |
| b. | Explain the characterization of nano-fluids using Scanning Electron Microscope (SEM). | CO1 / U | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Ability to apply the knowledge in analyzing the heat transfer performance of thermal systems, also will be conversant with measurement techniques, data acquisition and processing. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / BL | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 17 | 73 | 70 | 20 | - | - | 180 |
|  | | | | | | | **180** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **17ME3036** | **Duration** | **3hrs** |
| **Course Name** | **TWO PHASE FLOW AND HEAT TRANSFER** | **Max. Marks** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Q. No.** | **Sub Div.** | **Questions** | **CO/ BL** | **Marks** |
| 1. | a. | Explain different flow regimes in a horizontal diabatic flow with neat sketches. | CO1 / U | 15 |
|  | b. | Explain the significance of Lockhart- Martinelli correlation. | CO1 / A | 5 |
| **(OR)** | | | | |
| 2. | a. | Describe two-phase flow patterns in vertical pipes with neat sketches. | CO1 / U | 10 |
|  | b. | A two phase fluid is flowing upwards in a vertical pipe of internal diameter of 20 mm. The fluid properties are as follows  liquid density = 60 x 10 3 kg/m3, vapour density = 2x 10 3 kg/m3, liquid viscosity = 0.4 kg/ms, vapour viscosity = 0.01 kg/ms. | CO1 / A | 10 |
|  |  |  |  |  |
| 3. |  | Explain the variation of major parameters of drum during transient conditions. | CO2 / U | 20 |
| **(OR)** | | | | |
| 4. | a. | Differentiate natural and forced circulation in boiler tubes. | CO2 / U | 5 |
|  | b. | Derive the momentum equation for a separated flow model. Hence derive the expression for different components of pressure drop for the separated flow model. | CO2 / A | 15 |
|  |  |  |  |  |
| 5. |  | A packed bed of solid particles of density 2500 kg/m3, occupies a depth of 1 m in a vessel of cross sectional area of 0.04 m2. The mass of solids in the bed is 50 kg and the surface volume mean diameter of the particles is 1 mm. A liquid of density 800 kg/m3 and viscosity 0.002 Pa.s flows upwards through the bed.   1. Calculate the voidage of the bed 2. Calculate the pressure drop across the bed when the volume flow rate of liquid is 1.44 m3/h 3. Calculate the pressure drop across the bed when it become fluidized | CO3 / A | 20 |
| **(OR)** | | | | |
| 6. |  | Write short notes on i) Expanded bed ii) Oscillating fluidized beds iii) Effect of fluid velocity on pressure gradient iv) Bed porosity | CO3 / U | 20 |
|  |  |  |  |  |

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| --- | --- | --- | --- | --- |
| 7. | a. | Sketch the film-wise condensation on a vertical wall showing the film thickness, velocity and temperature profiles. | CO4 / U | 5 |
|  | b. | Dry Steam at 1000C condenses on the outside surface of a horizontal pipe of O.D.=2.5 cm. The pipe surface is maintained at 840C by circulating water through it. Determine the rate of formation of condensate per metre length of the pipe. | CO4 / A | 15 |
| **(OR)** | | | | |
| 8. | a. | Explain the differences between pool boiling and flow boiling | CO5 / U | 5 |
|  | b. | Draw the pool boiling curve and identify the different boiling regimes. Also, explain the characteristics of each regime. | CO5 / R | 15 |
|  | | **Compulsory**: |  |  |
| 9. | a. | Write short notes on i) liquid hold up ii) Bubble growth gas hold up iii) Gas liquid fluidization. | CO6 / U | 10 |
|  | b. | Explain gas-liquid particle operation with neat sketches. | CO6 / R | 10 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Ability to understand vertical, horizontal and inclined two phase flow. |
| CO2 | Ability to determine effective pressure head in boiler tubes. |
| CO3 | Ability to choose various types of fluidized beds. |
| CO4 | Ability to evaluate heat transfer during condensation. |
| CO5 | Ability to heat transfer with change of phase in boiling. |
| CO6 | Ability to explain various gas-liquid fluidization. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / BL | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | 25 | 15 | - | - | - | 40 |
| CO2 | - | 25 | 15 | - | - | - | 40 |
| CO3 | - | 20 | 20 | - | - | - | 40 |
| CO4 |  | 5 | 15 | - |  |  | 20 |
| CO5 | 15 | 5 | - | - | - | - | 20 |
| CO6 | 10 | 10 | - | - | - | - | 20 |
|  | | | | | | | **180** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18ME2014** | **Duration** | **3hrs** |
| **Course Name** | **SOLID MECHANICS** | **Max. Marks** | **100** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO/BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | |
| 1. | Compressive Strain is\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO1 / R | 1 |
| 2. | Hooke’s law is applicable within\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO2 / R | 1 |
| 3. | Poisson’s ratio is\_\_\_\_\_\_\_\_\_\_\_\_. | | CO2 / U | 1 |
| 4. | The relationship between Young’s modulus (E), Bulk modulus (K) and Poisson’s ratio (µ) is given by\_\_\_\_\_\_\_\_\_\_. | | CO 3 / R | 1 |
| 5. | The stress at which extension of a material takes place more quickly as compared to increase in load, is called\_\_\_\_\_\_\_\_\_\_\_\_. | | CO 3 / U | 1 |
| 6. | When a section is subjected to two equal and opposite forces tangentially to the section, the stress produced is known as\_\_\_\_\_\_\_\_\_\_\_\_. | | CO 4 / U | 1 |
| 7. | The length of a wire is increased by 1 mm on the application of a certain load. In a wire of the same material but of twice the length and half the radius, the same force will produce an elongation of\_\_\_\_\_\_\_\_\_\_\_\_. | | CO4 / R | 1 |
| 8. | In Mohr’s Circle, the Y–axis is called as\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO5 / R | 1 |
| 9. | The point of contra flexure occurs in case of\_\_\_\_\_\_\_\_\_\_\_. | | CO5 / U | 1 |
| 10. | Bending moment at supports in case of simply supported beam is always\_\_\_\_\_\_\_\_\_\_\_. | | CO 5 / A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | State Hooke‘s law. | | CO1 / R | 3 |
| 12. | Draw the SF and BM diagrams for the simply supported beam of length L subjected to UDL of w/m length through its length. | | CO2 / U | 3 |
| 13. | What are the assumptions made in the theory of torsion? | | CO 3 / R | 3 |
| 14. | Write the strain displacement matrix of CST element. | | CO4 / R | 3 |
| 15. | Distinguish between close and open helical coil springs. | | CO5 / R | 3 |
| 16. | What is meant by Double-Integration method? | | CO 6 / 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. |  | An axial pull of 35000 N is acting on a bar consisting of three lengths as shown in figure. If the Young's modulus=2.1x105 N/mm2, determine:  i. Stresses in each section and  ii. Total extension of the bar | CO1 / A | 12 |
| 18. |  | A cantilever of length 2.0 m carries a uniformly distributed load of 1 kN/m run over a length of 1.5m from the free end. Draw the shear force and bending moment diagrams for the cantilever. | CO 3 / E | 12 |
| 19. |  | Derive the slope and deflection expression of a simply supported beam with an eccentric point load using double integration method. | CO4 /An | 12 |
| 20. |  | A hollow shaft, having an internal diameter 40% of its diameter, transmits 562.5 kw power at 100 r.p.m. Determine the external diameter of the shaft if the shear stress is not to exceed 60 N/mm2 and the twist in a length of 2.5 m should not exceed 1.3 degrees. Assume maximum torque=1.25 mean torque and modulus of rigidity=9×104 N/mm2. | CO4 / A | 12 |
| 21. |  | A cylindrical vessel is 1.5 m diameter and 4 m long is closed at ends by rigid plates. It is subjected to an internal pressure of 3 N/mm2. If the maximum principal stress is not exceed 150 N/mm2, find the thickness of the shell. Assume E=2×105N/mm2and Poisson’s ration=0.25.Find the changes in diameter, length and volume of the shaft. | CO5 /An | 12 |
| 22. | a. | Define principal stresses and principal plane. | CO 5 / R | 2 |
| b. | A closed cylindrical vessel made of steel plates 4 mm thick with plane ends, carries fluid under a pressure of 3 N/mm2. The dia of cylinder is 25 cm and length is 75 cm, calculate the longitudinal and hoop stresses in the cylinder wall and determine the change in diameter, length and volume of the cylinder. Take E=2.1×105N/mm2 and µ=0.286. | CO 5/ U | 10 |
| 23. |  | Derive the slope and deflection expression of a simply supported beam with an eccentric point load using Macaulay's Method. | CO5 / A | 12 |
|  |  | **Compulsory:** | | |
| 24. |  | A simply supported beam of length 4 metre is subjected to a uniformly distributed load of 30 kN/m over the whole span and deflects 15 mm at the centre. Determine the crippling load when this beam is used as a column with the following conditions.  (i) one end fixed and other end hinged  (ii) both the ends pin jointed | CO6/ An | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand stress and strain relations in simple solids. |
| CO2 | Estimate stress and strain values in simple solids subjected thermal loads. |
| CO3 | Analyze the different types of loading and the consequent deflection. |
| CO4 | Determine maximum stress and angular deflection of solid and hollow shafts. |
| CO5 | Evaluate stress and strain using Mohr’s circle. |
| CO6 | Apply concepts of failure theories to determine safe design. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 |  | 12 |  |  |  | 16 |
| CO2 | 1 | 4 |  |  |  |  | 5 |
| CO3 | 4 | 1 |  |  | 12 |  | 17 |
| CO4 | 4 | 1 | 12 | 12 |  |  | 29 |
| CO5 | 6 | 11 | 13 | 12 |  |  | 42 |
| CO6 | 3 |  |  | 12 |  |  | 15 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **18ME2015** | **Duration** | **3hrs** |
| **Course Name** | **KINEMATICS AND THEORY OF MACHINES** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | List the classifications of kinematic chains. | | CO1 | U | 1 |
| 2. | A ball and a socket joint forms a -----------. | | CO1 | A | 1 |
| 3. | The size of a cam depends upon ----. | | CO2 | U | 1 |
| 4. | The radial distance of a tooth from the pitch circle to the bottom of the tooth, is called ------. | | CO2 | U | 1 |
| 5. | State D'Alembert’s principle. | | CO3 | R | 1 |
| 6. | The maximum fluctuation of energy in a flywheel is equal to -------. | | CO3 | A | 1 |
| 7. | The balancing of rotating and reciprocating parts of an engine is necessary when it runs at ------. | | CO4 | A | 1 |
| 8. | The tractive force is maximum or minimum when the angle of inclination of the crank to the line of stroke (Ɵ) is equal to -----. | | CO4 | U | 1 |
| 9. | Longitudinal vibrations are said to occur when the particles of a body moves ---------. | | CO5 | A | 1 |
| 10. | Write the expression for the natural frequency (in Hz) of free longitudinal vibrations. | | CO5 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain the term kinematic link. Give the classification of kinematic link. | | CO1 | U | 3 |
| 12. | Explain the terms: Module, Pressure angle, and Addendum. | | CO2 | U | 3 |
| 13. | Explain the dynamic force analysis process. | | CO3 | A | 3 |
| 14. | Explain why only a part of the unbalanced force due to reciprocating masses is balanced by revolving mass. | | CO4 | A | 3 |
| 15. | Discuss briefly with neat sketches the longitudinal, transverse and torsional free vibrations. | | CO5 | A | 3 |
| 16. | Explain the application of gyroscopic principles to aircrafts. | | 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. | Sketch and explain the various inversions of a slider crank chain. | CO1 | A | 6 |
|  | b. | Explain different kinds of kinematic pairs giving example for each one of them. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | A cam is to give the following motion to a knife-edged follower : 1. Outstroke during 60° of cam rotation ; 2. Dwell for the next 30° of cam rotation ; 3. Return stroke during next 60° of cam rotation, and 4. Dwell for the remaining 210° of cam rotation. The stroke of the follower is 40 mm and the minimum radius of the cam is 50 mm. The follower moves with uniform velocity during both the outstroke and return strokes. Draw the profile of the cam when the axis of the follower passes through the axis of the cam shaft. | CO2 | C | 12 |
|  |  |  |  |  |  |
| 19. | a. | The flywheel of a steam engine has a radius of gyration of 1 m and mass 2500 kg. The starting torque of the steam engine is 1500 N-m and may be assumed constant. Determine: 1. the angular acceleration of the flywheel, and 2. the kinetic energy of the flywheel after 10 seconds from the start. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | A single cylinder reciprocating engine has speed 240 r.p.m., stroke 300 mm, mass of reciprocating parts 50 kg, mass of revolving parts at 150 mm radius 37 kg. If two-third of the reciprocating parts and all the revolving parts are to be balanced, find: 1. The balance mass required at a radius of 400 mm, and 2. The residual unbalanced force when the crank has rotated 60° from top dead centre. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | A flywheel is mounted on a vertical shaft as shown in Fig 1. The both ends of the shaft are fixed and its diameter is 50 mm. The flywheel has a mass of 500 kg. Find the natural frequencies of longitudinal and transverse vibrations. Take E = 200 GN/m2.    Fig 1 | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | In a four bar chain ABCD, AD is fixed and is 150 mm long. The crank AB is 40 mm long and rotates at 120 r.p.m. clockwise, while the link CD = 80 mm oscillates about D., BC and AD are of equal length. Find the angular velocity of link CD when angle BAD = 60°. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 23. | a. | In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 r.p.m. in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 r.p.m. in the clockwise direction, what will be the speed of gear B ? | CO2 | C | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | A Porter governor has equal arms each 250 mm long and pivoted on the axis of rotation. Each ball has a mass of 5 kg and the mass of the central load on the sleeve is 25 kg. The radius of rotation of the ball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the minimum and maximum speeds and range of speed of the governor. | CO6 | An | 12 |
|  |  |  |  |  |  |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Determine mobility, position, velocity and acceleration of links in mechanism. |
| CO2 | Design cam profiles to meet the motion requirements in mechanisms. |
| CO3 | Determination of forces on parts of slider-crank mechanism and design of flywheel. |
| CO4 | Predict balancing mass requirement in rotary and reciprocating unbalanced systems. |
| CO5 | Determine frequency of translational and longitudinal vibration. |
| CO6 | Apply the use of governors to control speed and gyroscopes to navigate. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 4 | 13 | - | 12 | - | 29 |
| CO2 | - | 5 | - | - | - | 24 | 29 |
| CO3 | 1 | - | 4 | 12 | - | - | 17 |
| CO4 | - | 1 | 4 | 12 | - | - | 17 |
| CO5 | - | 1 | 4 | 12 | - | - | 17 |
| CO6 | - | - | 3 | 12 | - | - | 15 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18ME2022** | **Duration** | **3hrs** |
| **Course Name** | **MANUFACTURING TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | | **CO / BL** | | | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | | |
| 1. | The process of removing unwanted material from a work piece in the form of chips is called as \_\_\_\_\_\_\_. | | CO1 / R | | | | | 1 |
| 2. | The type of cutting tools widely used on lathes machine is \_\_\_\_\_\_\_. | | CO1 / U | | | | | 1 |
| 3. | A notch or groove in the face of a tool parallel to the cutting edge, to avoid the formation of continuous chips is called \_\_\_\_\_. | | CO2 / R | | | | | 1 |
| 4. | The chip space between the back of one tooth and the face of the next tooth in a plain milling cutter is named as \_\_\_\_\_\_\_. | | CO2 / U | | | | | 1 |
| 5. | \_\_\_\_\_\_\_ is the standard point angle of a drill bit. | | CO3 / R | | | | | 1 |
| 6. | The taper generally provided on drill spindles is known as \_\_\_\_\_\_\_\_\_\_\_. | | CO3 / U | | | | | 1 |
| 7. | The cutting tool material composed of nonferrous cast material with cobalt, chromium and tungsten is called\_\_\_\_\_\_\_\_\_\_\_. | | CO4 / R | | | | | 1 |
| 8. | \_\_\_\_\_\_\_\_ is widely used in tool steels to maintain its hardness even at red heat. | | CO4 / U | | | | | 1 |
| 9. | The \_\_\_\_\_\_\_\_\_\_ wear is formed due to chemical reaction between the tool surface and atmospheric oxygen at high temperature, also forms a layer of oxides on the surface. | | CO5/ R | | | | | 1 |
| 10. | \_\_\_\_\_\_\_\_\_\_\_ is used as binding material in cemented carbide tools. | | CO5/ U | | | | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | | |
| 11. | Define back rake angle. | | | | | CO1/ R | 3 | |
| 12. | List the factors affecting tool life. | | | | | CO2/ U | 3 | |
| 13. | Difference between shaper and planer with sketch. | | | | | CO3/ R | 3 | |
| 14. | Outline simple indexing. | | | | | CO4/ U | 3 | |
| 15. | Express wheel balancing. | | | | | CO5/ R | 3 | |
| 16. | Clarify on wheel dressing and truing. | | | | | 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. |  | Draw the comparison table and explain the different types of chips during metal cutting with neat sketch. | | | CO1 / A | | 12 | |
|  | |  | | |  | |  | |
| 18. |  | Draw and explain the nomenclature of single point cutting tool with neat sketch. | | | CO2 / R | | 12 | |
|  | |  | | |  | |  | |
| 19. |  | With mandatory sketch explain the nomenclature of milling cutter. | | | CO3 / U | | 12 | |
|  | |  | | |  | |  | |
| 20. | a. | Give the various details that need to be specified for a shaping machine. | | | CO4/An | | 6 | |
| b. | Explain a quick return mechanism used in shaper with neat sketch. | | | CO4 / A | | 6 | |
|  | |  | | |  | |  | |
| 21. |  | Explain with neat sketch, the working principle of radial drilling machine. | | | CO 5 / R | | 12 | |
|  | |  | | |  | |  | |
| 22. |  | Describe the Secondary finishing operations with neat sketch. | | | CO4 / U | | 12 | |
|  | |  | | |  | |  | |
| 23. | a. | Enlighten the types of grinding wheels with neat sketch. | | | CO5 / R | | 6 | |
| b. | Explicate the gear hobbing operation with neat sketch. | | | CO5 / U | | 6 | |
|  | | **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Define rapid prototyping. Explain the different types of rapid prototyping. | | | CO6 / A | | 12 | |

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|  | **COURSE OUTCOMES** |
| CO1 | Select the machining processes suitable for machining a component. |
| CO2 | Generate the process sequences for machining in machine tools to reduce the lead time. |
| CO3 | Analyze and choose the optimized machining parameters. |
| CO4 | Select cutting tools for the identified machining sequences. |
| CO5 | Appraise the abrasive machining process based on the surface finish requirements. |
| CO6 | Implement the non-conventional machining processes for machining hard materials. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 1 | 12 | - | - | - | 17 |
| CO2 | 13 | 4 | - | - | - | - | 17 |
| CO3 | 4 | 13 | - | - | - | - | 17 |
| CO4 | 1 | 16 | 6 | 6 | - | - | 29 |
| CO5 | 22 | 7 | - | - | - | - | 29 |
| CO6 | - | 3 | 12 | - | - | - | 15 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18ME2025** | **Duration** | **3hrs** |
| **Course Name** | **MATERIALS ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **CO/BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | |
| 1. | Define unit cell. | CO1 / U | 1 |
| 2. | What is line defects in materials? | CO1/ R | 1 |
| 3. | State Hooke’s Law. | CO2/ R | 1 |
| 4. | Name the property of metal by which it can be drawn in to wire form is called\_\_\_\_. | CO2/ A | 1 |
| 5. | Define hardness of a metal. | CO3 / R | 1 |
| 6. | What is ductile to brittle transmission in metals? | CO3 / R | 1 |
| 7. | What kind of solid solution is found in a Cu-Ni crystal? | CO4 / A | 1 |
| 8. | What temperature the Eutectic Reaction takes place in Iron Carbon diagram? | CO5 / U | 1 |
| 9. | Why quenching process is carried out during the heat treatment process? | CO5 / R | 1 |
| 10. | List any two applications of titanium alloys in Industries. | CO6 / A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | |
| 11. | Draw the crystal cell diagram and classify the crystal system. | CO1 / U | 3 |
| 12. | With neat sketch explain the principle of edge dislocation. | CO2 / R | 3 |
| 13. | Explain any two metal properties with an example. | CO3 / R | 3 |
| 14. | What is austenite structure in Iron carbon phase diagram? | CO4 / U | 3 |
| 15. | Explain Mar tempering process in metals with examples. | CO5 / A | 3 |
| 16. | State the applications of cupro-nickel and its chemical composition. | CO6 / A | 3 |

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| **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 atomic packing factor and coordination number for a BCC crystal structure. Enumerate the atomic packing factor for FCC and HCP structures. | CO1 / An | 12 |
|  |  |  |  |  |
| 18. |  | With a neat sketch, describe the construction, working principle, advantages, limitations and applications of TEM. | CO2 / R | 12 |
|  |  |  |  |  |
| 19. |  | With neat sketch explain the various modes in engineering stress-strain curve for ductile materials. | CO2 / R | 12 |
|  |  |  |  |  |
| 20. |  | Explain S-N curve and interpret the type of fracture associated with S-N curve with neat sketch. | CO3 / U | 12 |
|  |  |  |  |  |
| 21. |  | Describe the various phases present Fe-C equilibrium diagram with neat sketch. | CO4 / R | 12 |
|  |  |  |  |  |
| 22. |  | Draw the phase diagram for Ni-Cu alloy and describe the procedure to estimate the phase composition using it. | CO4 / A | 12 |
|  |  |  |  |  |
| 23. |  | In detail Explain the various heat treatment processes with neat sketch and its limitations.  a) Carbo nitriding b) Induction hardening c) Flame hardening | CO5 / R | 12 |
|  |  | **COMPULSORY QUESTION** | | |
| 24. |  | Discuss the fabrication procedure and applications of  a) Nickel based super alloys b) Managing steel | CO6 / A | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Identify crystal structures of common engineering materials. |
| CO2 | Understand the principle of various microscopes. |
| CO3 | Identify the various behaviors of materials and defects. |
| CO4 | Analyze failures and predict service behavior of materials for various applications. |
| CO5 | Interpret and determine the right compositions of metals. |
| CO6 | Select the heat treatment process based on the metals |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / BL | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 4 | - | 12 | - | - | 17 |
| CO2 | 16 | - | 1 | - | - | - | 17 |
| CO3 | 5 | 12 | - | - | - | - | 17 |
| CO4 | 12 | 3 | 13 | - | - | - | 28 |
| CO5 | 13 | 1 | 3 | - | - | - | 27 |
| CO6 | - | - | 16 | - | - | - | 16 |
|  | | | | | | | **125** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18ME2028** | **Duration** | **3hrs** |
| **Course Name** | **HYDRAULICS AND PNEUMATICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Enumerate the primary categories of fluid power control systems. | | CO1 | U | 1 |
| 2. | Provide the rationale behind the effectiveness of hydraulic power in heavy-duty applications. | | CO1 | U | 1 |
| 3. | Draw the graphical symbol of sequence valve. | | CO2 | R | 1 |
| 4. | Identify the three important things that are controlled in a hydraulic system. | | CO2 | A | 1 |
| 5. | State the purpose of accumulators in hydraulic system. | | CO3 | U | 1 |
| 6. | List the factors contributing to overheating in hydraulic systems. | | CO3 | A | 1 |
| 7. | Draw the graphical symbol of FRL unit. | | CO4 | U | 1 |
| 8. | Explain the purpose of shuttle valve in pneumatic system. | | CO4 | U | 1 |
| 9. | Write the advantages of closed loop control system. | | CO5 | U | 1 |
| 10. | Draw the graphical symbol of five way and two position direction control valve. | | CO5 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | List few fields of application of fluid power. | | CO1 | U | 3 |
| 12. | Write the main elements of hydraulic system with basic sketch. | | CO2 | U | 3 |
| 13. | Design and explain spring loaded type accumulator. | | CO3 | An | 3 |
| 14. | Develop a basic pneumatic speed control circuit by using flow control valve. | | CO4 | A | 3 |
| 15. | Draw the symbol of OR element and its truth table. | | CO5 | A | 3 |
| 16. | Create symbols for normally open and normally closed pneumatic and electrical switching contacts. | | 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. | Compare the use of fluid power to a mechanical system listing the advantages and disadvantages of each. | CO1 | A | 6 |
|  | b. | A 50 mm diameter cylinder is connected to another cylinder of 120 mm diameter and the system is filled with oil. A force of 100 N is applied to the smaller cylinder piston. Calculate the output force at larger cylinder. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Mention the types of the piston pumps, with neat sketch explain construction and working principle of any type of piston pump. | CO2 | A | 10 |
|  | b. | Draw graphical symbol of pressure relief and counterbalance valves. | CO2 | A | 2 |
|  |  |  |  |  |  |
| 19. | a. | Design a hydraulic sequence circuit for a drilling machine consisting of two cylinders one for operating the power vice jaw and the other for controlling the drill spindle travel. | CO3 | C | 10 |
|  | b. | Identify the purpose of fail-safe circuit. | CO3 | U | 2 |
|  |  |  |  |  |  |
| 20. | a. | Name the varieties of pneumatic linear and rotary actuators. | CO4 | U | 4 |
|  | b. | Explain the working principle of air filter with suitable neat sketch. | CO4 | A | 8 |
|  |  |  |  |  |  |
| 21. |  | Create a pneumatic circuit by classic method to enable the forward motion of a single acting cylinder, with the flexibility for operation from either of the two locations. | CO5 | C | 12 |
|  |  |  |  |  |  |
| 22. | a. | Find the actual delivery of the gear pump with following specifications: Outside diameter of the gear = 80 mm, inside diameter of the gear = 60 mm, gear width = 20 mm, speed of the pump = 1600 rpm, and volumetric efficiency = 88%. | CO2 | An | 6 |
|  | b. | Explain the working of balanced vane type hydraulic motor with neat sketch. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Design and describe a hydraulic circuit for shaping machine. | CO3 | An | 6 |
|  | b. | Create a meter-out circuit for hydraulic system and give an example. | CO3 | C | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Discuss the ladder diagram connections for a dual cylinder sequencing circuit for the following sequence of operations: A+B+B-A-. | CO6 | C | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand the salient features and constructional details of both hydraulic and Pneumatic systems. |
| CO2 | Understand the various types of actuation modes and control system design procedures for design of circuits and to control them. |
| CO3 | Understand the concepts of servo and proportional valves. |
| CO4 | Analyze various application circuits. |
| CO5 | Apply the above outcomes to design pneumatic and hydraulic circuits. |
| CO6 | Build a PLC programme for a particular application. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 5 | 6 | 6 |  |  | 17 |
| CO2 | 1 | 3 | 19 | 6 |  |  | 29 |
| CO3 |  | 3 | 1 | 9 |  | 16 | 29 |
| CO4 |  | 6 | 11 |  |  |  | 17 |
| CO5 |  | 2 | 3 |  |  | 12 | 17 |
| CO6 |  |  | 3 |  |  | 12 | 15 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18ME2034** | **Duration** | **3hrs** |
| **Course Name** | **OPERATIONS RESEARCH** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the limitation of graphical method in solving LPP | | CO1 | U | 1 |
| 2. | Compare ‘decision variable’ with ‘slack variable’ | | CO1 | A | 1 |
| 3. | Cite the method to balance a transportation problem | | CO2 | R | 1 |
| 4. | Balance the following assignment table (Sales Managers I,II and III and sales areas A and B   |  |  |  | | --- | --- | --- | |  | A | B | | I | 0 | 1 | | II | 5 | 0 | | III | 7 | 8 | | | CO2 | A | 1 |
| 5. | Draw network for the following activities and find the critical path   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Activities | 1-2 | 1-3 | 2-4 | 3-4 | | Duration  (Weeks) | 4 | 6 | 5 | 2 | | | CO3 | U | 1 |
| 6. | Identify the significance of the dummy activity(3-4) in the following network | | CO3 | A | 1 |
| 7. | Infer the application of Reorder point in inventory control | | CO4 | A | 1 |
| 8. | Interpret the concept of Economic Ordering Quantity (EOQ) | | CO4 | An | 1 |
| 9. | Differentiate ‘infinite queue size ’ and ‘finite queue size’ | | CO5 | An | 1 |
| 10. | Name one example for finite population queue | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List the advantages and limitations of LPP | | CO1 | R | 3 |
| 12. | There are 6 jobs each of which must go through the two machines A and B in the order A-B ,Processing time in hours are given in the table, Determine the optimal sequence of jobs and idle time of each machine   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Jobs | 1 | 2 | 3 | 4 | 5 | 6 | | Processing Time of  Machine A (Hours) | 3 | 6 | 4 | 7 | 5 | 8 | | Processing Time of  Machine B(Hours) | 2 | 5 | 6 | 3 | 2 | 8 | | | CO2 | A | 3 |
| 13. | Compare ‘Assignment model’ with ‘Transportation model’ | | CO3 | An | 3 |
| 14. | Normal duration and normal cost crash cost and crash duration of the activities 1-2 and 1-3 are given below Interpret the cost slope (Delta cost) and Delta time (Time available for crashing) of these activities   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Activities | Normal Cost  (Rupees) | Normal  Duration  (Weeks) | Crash  Cost  (Rupees) | Crash  Duration  (Weeks) | | 1-2 | 7,000 | 6 | 14,500 | 3 | | 1-3 | 4,000 | 8 | 8,500 | 5 | | | CO4 | A | 3 |
| 15. | In a mechanical workshop, it takes 10 days to get the stock of coolant oil after placing an order. The daily requirement of coolant oil in the workshop is 50 litres. Based on the past experience it is determined that the safety is 5 days stock. Infer the re-order point | | CO5 | An | 3 |
| 16. | Compare FCFS with LCFS in queuing model. | | 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. | Solve the following LPP by using **Graphical Method**  Maximize Z = 3X1+2X2  Subjected to  X1-X2 ≥ 1  X1+X2 ≥ 3  With non-negative restrictions X1, X2 ≥ 0. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | A machine shop has one shearing, one punching and one de-burring machine. Time in minutes for shearing, punching and de-burring operations is given for each job. Determine the optimal order (**sequence)** in which the jobs are to be processed to minimize the total time. Find 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 | | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | There are three factories located at places P,Q and R. .These factories supply products to whole sale agents located at places S, T and W. The weekly capacities of factories P,Q and R are 76,82 and 72 units respectively. Weekly requirements of agents S, T and W are 72,102 and 41 units respectively. the unit transportation cost in rupees from P to S, T and W are5,8 and 8 respectively, from Q to S,T and W are16,25 and 15 respectively and R to S,T and W are 9,16 and 25 respectively. **use least cost method to arrive initial solution** | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | The demand for a computer monitor cable is 1050 cables per month and shortages are allowed; if the cost per cable is Rupees 125, cost of making one purchase is Rupees 700, the holding cost of one cable is Rupees 3 per year and cost of one shortage is Rs 50/year Determine   1. EOQ 2. Optimal number of orders per year 3. Annual total inventory cost | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | The activities of a project with their respective time estimates (in weeks) are given in the following table.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Activities | 1-2 | 1-6 | 2-3 | 2-4 | 3-5 | 4-5 | 6-7 | 5-8 | 7-8 | | Optimistic  time | 3 | 2 | 6 | 2 | 5 | 3 | 3 | 1 | 4 | | Most  Probable  Time | 6 | 5 | 12 | 5 | 11 | 6 | 9 | 4 | 9 | | Pessimistic  time | 15 | 14 | 30 | 8 | 17 | 15 | 27 | 7 | 28 |   i)Draw the network of this project and compute duration, variance and standard deviation of the project (6)  ii) what is the probability of completing the project within 42 weeks and also for completing the project within 44 weeks(4)  iii) what is the probability of NOT completing the project within 40 weeks (2) | CO3 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | There are 5 Jobs and 5 machines; the associated cost (In Rupees) of allocating a job to the machines is given in the table .Find the optimal allocation and optimal allocation (assignment cost)  **Machines**   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | M1 | M2 | M3 | M4 | M5 | | J1 | 11 | 17 | 8 | 16 | 20 | | J2 | 9 | 7 | 12 | 6 | 15 | | J3 | 13 | 16 | 15 | 12 | 16 | | J4 | 21 | 24 | 17 | 28 | 26 | | J5 | 14 | 10 | 12 | 11 | 15 | | CO5 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Items | 1 | 2 | 3 | 4 | 5 | | Annual  Usage(units) | 200 | 3000 | 25 | 1100 | 60 | | Unit Cost(Rs) | 11 | 14 | 9 | 6 | 5 |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Items | 6 | 7 | 8 | 9 | 10 | | Annual  Usage(units) | 250 | 140 | 850 | 550 | 80 | | Unit Cost(Rs) | 90 | 6 | 6 | 15 | 9 |   Above tables show the annual usage and unit cost of 10 items in a store. Grade the value of these 10 items using ABC analysis | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Arrivals at a public telephone booth with an average of 8 minutes between one arrival and the next. The length of the telephone calls is assumed with a mean value of 2 minutes, Appraise the following  i) Utilization factor  ii) Average queue length  iii) Find the arrival rate assuming average waiting time in queue as 5 minutes | CO6 | An | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Correlate this subject knowledge with engineering problems |
| **CO2** | Construct flexible appropriate mathematical model to represent physical problem |
| **CO3** | Schedule the engineering projects by using network analysis |
| **CO4** | Analyze the transportation problem and optimize the resources and output |
| **CO5** | Apply knowledge in solving their engineering queuing problem |
| **CO6** | Develop their skills in decision making analysis by allocating resources |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 3 | 1 | 13 | - | - | - | 17 |
| **CO2** | 1 | - | 4 | 12 | - | - | 17 |
| **CO3** | 1 | - | 13 | 15 | - | - | 29 |
| **CO4** | - | - | 4 | 13 | - | - | 17 |
| **CO5** | - | - | 12 | 16 | - | - | 28 |
| **CO6** | 1 | - | - | 15 | - | - | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18ME2040** | **Duration** | **3hrs** |
| **Course Name** | **COMPUTATIONAL FLUID DYNAMICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Classify the forces that exert influence on a fluid particle. | | CO1 | U | 1 |
| 2. | Indicate the three main elements of CFD code. | | CO1 | R | 1 |
| 3. | Write the basic properties of discretization schemes. | | CO2 | R | 1 |
| 4. | Write the advantages of grid independence study. | | CO2 | R | 1 |
| 5. | The flow in which property which is varying with time is called----- | | CO3 | U | 1 |
| 6. | Define diffusion. | | CO3 | R | 1 |
| 7. | Define convective mass flux. | | CO4 | U | 1 |
| 8. | Write the advantage of upwind scheme. | | CO4 | R | 1 |
| 9. | Write the condition to use continuity equation as transport equation for density. | | CO5 | U | 1 |
| 10. | Define ‘no-slip condition’. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Write the differential form of general transport equation. | | CO1 | An | 3 |
| 12. | Define divergence and write the significance. | | CO2 | U | 3 |
| 13. | Write the differential form of 2D steady diffusion. | | CO3 | An | 3 |
| 14. | Explain explicit scheme of discretization. | | CO4 | A | 3 |
| 15. | Compare SIMPLER and PISO algorithms. | | CO5 | An | 3 |
| 16. | What are characteristics of free turbulent flows? | | 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. | a. | Derive the three-dimensional mass conservation equation for compressible fluids. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain different types of grids used in CFD. Also explain the advantages and applications of structured grids over unstructured grids. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Derive the discretized form of equation for 3D steady diffusion problem. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Consider the problem of source free heat conduction in an insulated rod whose ends are maintained at constant temperatures of 100 C and 500 C respectively. Consider this as 1D problem, divide the length into five equal control volumes, Calculate steady state temperature distribution in the rod. Thermal conductivity k is 1000W/mK, cross-sectional area A is 10Χ10 -3 m2 . The length of the rod is 0.5m. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain SIMPLE algorithm and derive the discretized equation for pressure. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain the discretized equation for 1D steady convection- diffusion problem and derive the expression using upwind differencing scheme. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | Derive the momentum equation for 3D flows. | CO1 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the different regions of boundary layer for flow over a flat plate and for flow inside a pipe. | CO6 | A | 8 |
|  | b. | Explain Two Equation Turbulence Model. | CO6 | A | 4 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Formulate the required governing equations for flow and heat transfer problems. |
| **CO2** | Discretize the governing equations of flow and heat transfer problems. |
| **CO3** | Solve the diffusion equations |
| **CO4** | Solve the diffusion-convection equations |
| **CO5** | Use appropriate algorithms to solve the discretized equations. |
| **CO6** | Apply turbulence models to accurately predict the variables based on the flow characteristics. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 1 | - | 27 | - | - | 29 |
| **CO2** | 2 | 3 | 12 | - | - | - | 17 |
| **CO3** | 1 | 1 | - | 15 | - | - | 17 |
| **CO4** | 1 | 1 | 3 | 24 | - | - | 29 |
| **CO5** | - | 1 | - | 15 | - | - | 16 |
| **CO6** | - | 4 | 12 | - | - | - | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18ME2044** | **Duration** | **3hrs** |
| **Course Name** | **REFRIGERATION AND AIR CONDITIONING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Mention the Bell-Coleman cycle's alternate name. | | CO1 | R | 1 |
| 2. | Name the cooling system suitable for low flight speed. | | CO1 | R | 1 |
| 3. | Define compression efficiency. | | CO2 | U | 1 |
| 4. | In a refrigeration system, what is the component that connects the compressor and condenser? | | CO2 | U | 1 |
| 5. | How many vapour-compression cycles with different refrigerants are used in a cascade refrigeration system? | | CO3 | R | 1 |
| 6. | Multiple refrigerants can be used in the cascade refrigeration system. True or false? | | CO3 | U | 1 |
| 7. | The investigation of the air-water mixture is known as? | | CO4 | U | 1 |
| 8. | Adiabatic cooling lines which are the same (for water vapour only) as the wet bulb or psychrometric line. True or False? | | CO4 | U | 1 |
| 9. | Rapid heating and cooling of milk is called as …………… | | CO5 | U | 1 |
| 10. | Name a refrigerant is used in Ice plant? | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Define air refrigeration. | | CO1 | U | 3 |
| 12. | What are absorbers in vapour absorption refrigeration systems? | | CO2 | R | 3 |
| 13. | Describe the advantages of a cascade refrigeration system. | | CO3 | An | 3 |
| 14. | State bypass factor. | | CO4 | U | 3 |
| 15. | Write short notes on infiltration. | | CO5 | U | 3 |
| 16. | Draw the layout of the Ice plant. | | 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. | Discuss in detail Bell-Coleman refrigeration cycle with T-S and P-V diagrams. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | With a neat sketch explain the Cascade refrigeration system and also represent the processes on the T-S diagram. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain the types of condensers installed in refrigeration systems with a neat sketch. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain water – ammonia vapour absorption refrigeration system and discuss its advantages over the vapour compression system. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | The atmospheric air at 30 °C dry bulb temperature and 75 % RH enters a cooling coil at the rate of 200 m3/min. The coil dew point temperature is 14 °C and the bypass factor of the coil is 0.1. Determine i) the temperature of the air leaving the cooling coil. ii) the capacity of cooling coil in tons of refrigeration and in kW. iii) the amount of water vapour removed per minute, and iv) the sensible heat factor for the process. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 22. | a. | In air conditioning system the inside and outside conditions are: dry bulb temperature 25 °C, RH 50 % and dry bulb temperature 40 °C, wet bulb temperature 27 °C respectively. The room sensible heat factor is 0.8. 50 % of room air is rejected to atmosphere and then equal quantity of fresh air added before air enters the air conditioning apparatus. If the fresh air is added is 100 m3/min., determine: i) Room sensible and latent heat load ii) sensible and latent heat load due to fresh air iii) apparatus dew point temperature iv) humidity ratio and dry bulb temperature of air entering air conditioning apparatus. Assume bypass factor zero, density of air is 1.2 kg/m3 at a total pressure of 1.01325 bar. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 23. | a. | Discuss about the summer air conditioning system for hot and dry conditions and also mark the processes on a Psychrometric chart. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain i) refrigeration system for food storage plants ii) Train air conditioning system. | CO6 | U | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Understand various refrigeration systems |
| **CO2** | Demonstrate the working of refrigeration equipment. |
| **CO3** | Understand various psychrometric processes |
| **CO4** | Estimate the space cooling load |
| **CO5** | Design the air-conditioning equipments |
| **CO6** | Select suitable refrigeration and air-conditioning systems for various applications |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 3 | 12 | - | - | - | 17 |
| **CO2** | 3 | 2 | - | - | 12 | - | 17 |
| **CO3** | 1 | 1 | - | 3 | 12 | - | 17 |
| **CO4** | - | 5 | 12 | - | 12 | - | 29 |
| **CO5** | - | 4 | 12 | - | 12 | - | 28 |
| **CO6** | 1 | 12 | 3 | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18ME2050** | **Duration** | **3hrs** |
| **Course Name** | **FINITE ELEMENT ANALYSIS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | The higher order elements are also called \_\_\_\_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 2. | On gathering stiffness and loads, the system of equations is given by \_\_\_\_\_\_\_. | | CO2 | R | 1 |
| 3. | Finite element analysis deals with \_\_\_\_\_\_\_\_\_\_. | | CO2 | U | 1 |
| 4. | For 1-D bar elements if the structure is having 3 nodes then the stiffness matrix formed is having an order of\_\_\_\_\_\_\_\_\_\_. | | CO3 | R | 1 |
| 5. | \_\_\_\_\_\_\_\_\_\_are used to find the nodal displacements in all parts of the element. | | CO3 | U | 1 |
| 6. | At fixed support, the displacements are equal to \_\_\_\_\_\_\_\_\_\_. | | CO4 | U | 1 |
| 7. | The point in the entire structure is defined using a coordinates system known as \_\_\_\_\_\_\_\_\_\_. | | CO4 | R | 1 |
| 8. | The displacement function for 1-D, two node linear element in terms of shape function will be \_\_\_\_\_\_\_\_\_\_\_. | | CO5 | R | 1 |
| 9. | For two-dimensional plane stress problems, normal and shear stress are\_\_\_\_\_\_\_\_\_\_. | | CO5 | U | 1 |
| 10. | Each node in heat transfer problem has \_\_\_\_\_\_\_\_\_ degrees of freedom. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Distinguish natural & essential boundary conditions with examples. | | CO1 | An | 3 |
| 12. | Define shape function. | | CO2 | U | 3 |
| 13. | What is the QST (Quadratic Strain Triangle) element? | | CO3 | R | 3 |
| 14. | What is meant by plane stress analysis? | | CO4 | U | 3 |
| 15. | Specify the shape functions of a four-node quadrilateral element. | | CO5 | An | 3 |
| 16. | Write the governing differential equation for two-dimensional heat 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. |  | A beam AB of span ‘L’ simply supported at ends and carrying a concentrated load W at the centre ‘C’ as shown in the figure. Determine the deflection at mid span by using Rayleigh–Ritz method.  C:\Users\Sunny\Downloads\IMG_20200316_154513.jpg | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | For a tapered bar of uniform thickness t=10mm as shown in the figure. Find the displacements at the nodes by forming into two element model. The bar has a mass density of G = 7800 Kg/m3, and young’s modulus E = 2x105 MN/m2. In addition to self-weight, the bar is subjected to a point load P= 1 KN at its centre. Also, determine the reaction forces at the support. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 19. |  | Consider a rectangular plate of length of 3500 mm and width of 2500 mm having a thickness of 300 mm. It is subjected to a uniform heat source of 200 W/ m3 acting over the whole body. The temperature of the top side of the body is maintained at 1300C. The body is insulated on the other edges. Take the thermal conductivity of the material as 35 W /m 0C. Determine the temperature distribution using triangular elements. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. |  | Determine the stiffness matrix for the CST Element shown in figure. The coordinates are given in mm. Assume plane stress conditions E = 210GPa, v=0.25 and t=10mm. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. |  | Derive the shape function for Eight Noded Rectangular Element. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Consider a three bar truss as shown in figure. It is given that E = 2 X 105 N/mm2. Calculate the following.   1. Nodal displacements. 2. Stress in each member.   Take A1 = 2000 mm2, A2 = 2500 mm2 and A3 = 2500 mm2  C:\Users\Sunny\Downloads\IMG_20200316_160933.jpg | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Evaluate the shape function for one corner node and one mid-side node of a nine-node quadrilateral element. For the four noded elements shown in fig. Determine the Jacobin and evaluate its value at the point (1/3,1/3) | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | A composite slab consists of three materials with thermal conductivities of 20 W/moK, 30 W/moK, 50 W/moK, and thicknesses 0.3 m, 0.15 m, and 0.15 m respectively. The outer surface is at 20oC and the inner surface is exposed to the convective heat transfer coefficient of 25 W/moK and a medium at 800oC. Determine the temperature distribution within the wall. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Outline the various FE techniques used for different applications and problems. |
| CO2 | Reproduce conservation of energy principle, variational principle and methods of weighted residual for developing finite element models. |
| CO3 | Develop the shape function, strain displacement-relation, stiffness matrix and consistent load vector for structural members. |
| CO4 | Analyze scalar and vector variable problems for 2-D elements. |
| CO5 | Formulate and construct the shape function for an Iso-parametric element. |
| CO6 | Choose appropriate GDE for the thermal and fluid flow problems and solve them. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO/BL | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | - | - | 15 | - | - | 16 |
| CO2 | 1 | 4 | - | - | 12 | - | 17 |
| CO3 | 4 | 1 | - | - | 12 | - | 17 |
| CO4 | 1 | 4 | 12 | - | 12 | - | 29 |
| CO5 | 1 | 13 | 12 | 3 | - | - | 29 |
| CO6 | - | 4 | - | 12 | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18ME2055** | **Duration** | **3hrs** |
| **Course Name** | **COMPUTER AIDED DESIGN** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Abbreviate CAPP\_\_\_\_\_\_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 2. | IGES and STEP are the two graphics standards used in the exchange of \_\_\_\_\_data. | | CO1 | R | 1 |
| 3. | State the use of random scan graphics. | | CO2 | R | 1 |
| 4. | State at least two advantages of line drawing algorithms that are implemented in graphics. | | CO3 | R | 1 |
| 5. | State the use of non-synthetic curves in surface modelling. | | CO3 | R | 1 |
| 6. | Changing the position of the control points can change the shape of the curve with greater\_\_\_\_\_\_\_\_\_\_\_. | | CO3 | R | 1 |
| 7. | List the important I/O devices for graphics design. | | CO4 | R | 1 |
| 8. | State the importance of the prototype. | | CO4 | R | 1 |
| 9. | List the softwares used for finite element analysis. | | CO5 | R | 1 |
| 10. | STL file is generally generated from a \_\_\_\_\_\_\_\_ model. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Articulate the need for implementing the CAD system. | | CO1 | U | 3 |
| 12. | Write short notes on the concatenation. | | CO2 | U | 3 |
| 13. | Distinguish between active and passive graphics displays. | | CO3 | U | 3 |
| 14. | How clipping line algorithm is useful in computer graphics? | | CO4 | U | 3 |
| 15. | Sketch neatly the product life cycle. | | CO5 | U | 3 |
| 16. | List out a few polymer and metal materials used in rapid prototyping. | | 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. | a. | Articulate the applications of the following graphics standards: (a) GKS, (b)PHIGS, (c) IGES and STEP. Mention their merits and demerits. | CO1 | A | 6 |
|  | b. | Illustrate the following transformation matrices with neat sketches:  (a) Translation, (b) Rotation, (c) Scaling, and (d) Reflection. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Discuss in detail the z-buffer algorithm for removing hidden lines. | CO2 | A | 6 |
|  | b. | Elaborate the painter’s algorithm with relevant sketches. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Illustrate the application of solid modelling. Differentiate between wireframe modelling and solid modelling? | CO3 | A | 6 |
|  | b. | Explain the significance of constructive solid geometry using neat sketches. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. |  | Explain in detail the B-spline curve with suitable sketches and examples. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | With neat sketches explain the following. (a) Sequential scanning and (b) Interlaced scanning with relevant sketches. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the following in detail. (a) Discretization (b) Element types and nodes (c) Element stiffness matrix. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Sketch a neat schematic diagram of reverse engineering and explain its advantages and disadvantages. | CO5 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Distinguish between FDM and SLA types of 3D printing technologies with neat sketches. Compare the advantages and limitations of the two technologies. | CO6 | E | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Demonstrate the basic structure and components of CAD. |
| CO2 | Outline the process of representing graphical entities in a CAD environment. |
| CO3 | Construct the geometric model using different techniques to represent a product. |
| CO4 | Illustrate various techniques and devices involved in CAD hardware. |
| CO5 | Analyze the models for design solutions using FEM. |
| CO6 | Discuss the various computer-aided tools implemented in various industrial applications. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 3 | 12 |  |  |  | 17 |
| CO2 | 2 | 3 | 12 |  |  |  | 17 |
| CO3 | 2 | 3 | 12 | 12 |  |  | 29 |
| CO4 | 2 | 3 |  | 12 |  |  | 17 |
| CO5 | 1 | 3 |  | 12 | 12 |  | 28 |
| CO6 | 1 | 3 |  |  | 12 |  | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **18ME2058** | **Duration** | **3hrs** |
| **Course Name** | **MECHATRONICS SYSTEM** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Restate an industrial automation. | | CO1 | U | 1 |
| 2. | Illustrate the working of a transducer. | | CO2 | U | 1 |
| 3. | Extend the following abbrivations: PLA and ABS. | | CO1 | U | 1 |
| 4. | Cite the term mechatronics. | | CO3 | U | 1 |
| 5. | Sketch circuit of DC series motor. | | CO2 | A | 1 |
| 6. | Construct the relay circuit. | | CO4 | U | 1 |
| 7. | Identify different types of electromechanical devices. | | CO4 | U | 1 |
| 8. | Discuss various merits of PLC controllers. | | CO6 | U | 1 |
| 9. | Sketch the pin diagram of 8086 microprocessor. | | CO5 | A | 1 |
| 10. | Illustrate the working principle of inductive proximity sensor. | | CO5 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Compare mechanization, computerization and automation. | | CO1 | An | 3 |
| 12. | Illustrate the working principle of hall effect sensor. | | CO2 | U | 3 |
| 13. | Examine the components of a hydraulic system. | | CO3 | A | 3 |
| 14. | Discuss briefly about SMA. | | CO4 | U | 3 |
| 15. | Establish the magneto stricture transducer’s behaviour. | | CO5 | A | 3 |
| 16. | Analyse the scanning instructions of the PLC controller. | | 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 different elements of a mechatronic system. | CO1 | U | 6 |
| b. | Establish the multidisciplinary nature of mechatronics system. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Organize various elements that might be present in a thermostatically controlled electric heater control system. | CO2 | An | 8 |
| b. | Interpret the components of washing machine with the general mechatronics system. | CO2 | A | 4 |
|  |  |  |  |  |  |
| 19. | a. | Describe the principle, application and the use of rotary and linear potentiometers with neat diagrams if any. | CO3 | U | 8 |
| b. | Describe the working of optical encoder with neat diagram. | CO3 | U | 4 |
|  |  |  |  |  |  |
| 20. | a. | Distinguish DC motor basics, types, uses and working principles with neat diagrams. | CO4 | E | 6 |
| b. | Assess the operation for PM stepper motor with neat diagrams. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 21. | a. | Evaluate the piezoelectric effect of material with neat diagrams. | CO5 | An | 6 |
| b. | Appraise the working of a capacitive sensor. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Sketch the Electro-hydraulic power steering system used in automobiles. | CO4 | A | 5 |
| b. | Interpret the I/O devices used in PLC. | CO6 | A | 7 |
|  |  |  |  |  |  |
| 23. | a. | Justify the Anti-lock Braking System used in automobiles. | CO5 | E | 6 |
| b. | Evaluate the LVDT with an example. | CO5 | E | 6 |
|  |  |  |  |  |  |
|  |  | **Compulsory** | | | |
| 24. | a. | Construct the PLC architecture and describe the function of elements. | CO6 | A | 8 |
| b. | Complete the definition of PLC as per National Electrical Manufacturing Association and compare it with computer. | CO6 | A | 4 |

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

|  |  |
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| **COURSE OUTCOMES** | |
| After completing the course, the student will be able to | |
| CO1 | Summarize and recall the overview of mechatronics applications. |
| CO2 | Demonstrate knowledge of electrical circuits and logic design. |
| CO3 | Develop and formulate engineering solutions and techniques to solve design problems. |
| CO4 | Design mechatronic components and systems. |
| CO5 | Classify and select various micro-sensors and microprocessors for a specific problem. |
| CO6 | Develop PLC programs for a given task. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | 8 | 6 | 3 | - | - | 17 |
| CO2 | - | 4 | 5 | 8 | - | - | 17 |
| CO3 | - | 13 | 3 | - | - | - | 16 |
| CO4 | - | 5 | 12 | - | 12 | - | 29 |
| CO5 | - | 1 | 4 | 12 | 12 | - | 29 |
| CO6 | - | 1 | 12 | 3 | - | - | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18ME2060** | **Duration** | **3hrs** |
| **Course Name** | **INDUSTRIAL SAFETY ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Cite few examples for products which are manufactured using fixed position layout. | | CO1 | U | 1 |
| 2. | Indicate any common cause of industrial accidents. | | CO1 | R | 1 |
| 3. | OSHA stands as an acronym for \_\_\_\_\_\_ | | CO2 | R | 1 |
| 4. | Identify the purpose of implementing Zero Mechanical State (ZMS) during machine maintenance. | | CO2 | R | 1 |
| 5. | Appraise the health issues faced by workers due to poor indoor air quality. | | CO3 | E | 1 |
| 6. | Give examples of machinery where nip-points are commonly found. | | CO3 | R | 1 |
| 7. | Differentiate between hazard and risk. | | CO4 | U | 1 |
| 8. | Identify the adverse effects of noise on human beings. | | CO4 | R | 1 |
| 9. | Indicate the negative effects of glare on humans. | | CO5 | R | 1 |
| 10. | Identify two benefits of effective workplace housekeeping. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate ‘Engineering control’ and ‘Administrative control’ in ensuring safety. | | CO1 | U | 3 |
| 12. | State the functions of safety trip control. | | CO2 | R | 3 |
| 13. | Discuss the significance of hazard control in the workplace. | | CO3 | U | 3 |
| 14. | Write down the necessary safety measures that should be followed when working with high pressure equipment. | | CO4 | A | 3 |
| 15. | Identify the important functions of machine guards. | | CO5 | U | 3 |
| 16. | Indicate any three ill effects of bad illumination on human body and mind. | | 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. |  | Analyze the various causes of industrial accidents. Explain in detail the methods to prevent them from occurring. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | Illustrate with suitable sketches explain the operation of any two types of safety guards suitable for industrial applications. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | Illustrate the biological hazards in workplace. Also discuss their effects and preventive measures. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain in detail, the various safety requirements recommended in a chemical industries. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Describe the factors influencing the entry of toxic materials in human body, in detail. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Classify and explain the different types of unsafe conditions in industry. | CO1 | U | 6 |
|  | b. | Supervisors and managers have significant effects on workplace safety. Justify. | CO1 | E | 6 |
| 23. |  | Summarize various methods used for safeguarding machines in an industry. | CO2 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Interpret the safety protocols to be followed and implemented in process industries. | CO6 | A | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understanding the importance of safety in process industries |
| **CO2** | Understanding the ethical issues that may arise from industrial processes |
| **CO3** | Communicate the difference between Hazard and Risk |
| **CO4** | Be able to express Safety in terms of Risk and to recognize unacceptable/inappropriate levels of Risk. |
| **CO5** | Be able to Assess & identify the potential hazards in process industries |
| **CO6** | Appreciation and applying safety procedures in a process industries. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 10 | - | 12 | 6 | - | 29 |
| **CO2** | 5 | - | - | 12 | 12 | - | 29 |
| **CO3** | 1 | 3 | - | 12 | 1 | - | 17 |
| **CO4** | 1 | 1 | 15 | - | - | - | 17 |
| **CO5** | 1 | 15 | - | - | - | - | 16 |
| **CO6** | 1 | 3 | 12 | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18ME2063** | **Duration** | **3hrs** |
| **Course Name** | **RAPID MANUFACTURING TECHNOLOGIES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Cite an application of rapid prototyping. | | CO1 | U | 1 |
| 2. | Expand STEP. | | CO1 | R | 1 |
| 3. | Name the software used for CAD modeling. | | CO2 | R | 1 |
| 4. | Select any two reverse engineered products in automobile industry. | | CO2 | R | 1 |
| 5. | Identify the basic principle of SLA. | | CO3 | U | 1 |
| 6. | State True or False: SGC is a solid based RP system. | | CO3 | R | 1 |
| 7. | Discover any one limitation of LOM. | | CO4 | U | 1 |
| 8. | List the process variables of FDM systems. | | CO4 | R | 1 |
| 9. | Differentiate: SLS and 3DP. | | CO5 | U | 1 |
| 10. | Recognize the expansion of LENS. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain the advantages of 3D printing. | | CO1 | An | 3 |
| 12. | State the use of digitization techniques in CAD. | | CO2 | U | 3 |
| 13. | Appraise the use of STL files during SLA operation. | | CO3 | An | 3 |
| 14. | Illustrate the construction of a FDM system with a neat sketch. | | CO4 | U | 3 |
| 15. | Estimate the strengths and weaknesses of 3DP systems. | | CO5 | An | 3 |
| 16. | Give examples for prototypes built using the Controlled Metal Build-up (CMB). | | 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. | a. | Compile the various types of RP processes used for aerospace applications. | CO1 | C | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain part orientation and support generation in RP systems. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Examine the concept of photo polymerization of SL resins. | CO3 | A | 6 |
|  | b. | Construct the strengths, weaknesses and applications of SGC. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Express the details of processes and materials used in LOM. | CO4 | C | 12 |
|  |  |  |  |  |  |
| 21. | a. | Estimate the strengths, weaknesses and applications of powder based 3DP systems. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 22. | a. | Determine the products developed using LOM systems. | CO4 | A | 6 |
|  | b. | Discover the different types of FDM systems. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Deduce the process involved in tool path generation for CAD modelling. | CO2 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Appraise the direct and indirect tooling methods with neat sketches. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Differentiate between conventional and rapid manufacturing approach |
| CO2 | Demonstrate the knowledge of Rapid Manufacturing technologies |
| CO3 | Understand the need and place for RP in an integrated manufacturing environment |
| CO4 | Get exposed to commercial Rapid Prototyping systems |
| CO5 | Possess knowledge on Rapid Prototyping software |
| CO6 | Model and manufacture RP components |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 1 | - | 3 | - | 12 | 17 |
| CO2 | 2 | 3 | - | 24 | - | - | 29 |
| CO3 | 1 | 1 | 12 | 3 | - | - | 17 |
| CO4 | 1 | 4 | 12 | - | - | 12 | 29 |
| CO5 | 1 | - | - | 3 | 12 | - | 16 |
| CO6 | - | 4 | - | 12 | - | - | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **18ME2067** | **Duration** | **3Hrs** |
| **Course Name** | **AUTOMOBILE ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify the function of piston rings in an IC engine. | | CO1 | U | 1 |
| 2. | Indicate the differences between sedans and coupes. | | CO1 | U | 1 |
| 3. | Identify the primary function of a transmission system in an automobile. | | CO2 | U | 1 |
| 4. | Indicate the purpose of slip joints in a propeller shaft assembly. | | CO2 | U | 1 |
| 5. | Identify the purpose of suspension system in an automobile. | | CO3 | U | 1 |
| 6. | Distinguish between dampers and springs in a vibrating system. | | CO3 | U | 1 |
| 7. | Indicate the main types of brakes used in vehicles. | | CO4 | U | 1 |
| 8. | Differentiate between wheel and tyre. | | CO4 | U | 1 |
| 9. | Identify the purpose of engine cooling system in an automobile. | | CO5 | U | 1 |
| 10. | Indicate any two alternative fuels commonly used in automobiles. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between hybrid and electric vehicles. | | CO1 | U | 3 |
| 12. | Describe the role of a differential in a vehicle's drivetrain. | | CO2 | U | 3 |
| 13. | Distinguish between coil springs and leaf springs in suspension systems. | | CO3 | U | 3 |
| 14. | Describe the role of Traction Control System (TCS) in automobiles. | | CO4 | U | 3 |
| 15. | Discuss the role of a catalytic converter in reducing engine emissions. | | CO5 | U | 3 |
| 16. | Explain the concept of using water as a fuel for automobiles. | | 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 advantages and disadvantages of front-wheel-drive vehicles. | CO1 | A | 6 |
|  | b. | Illustrate the essential components of an internal combustion engine and describe their functions. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Compare Hotchkiss drive and torque tube drive systems. | CO2 | An | 6 |
|  | b. | Explain the construction and working of a transfer box in four-wheel-drive vehicles. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the concept of independent suspension and its benefits over rigid axles. | CO3 | A | 6 |
|  | b. | Compare hydraulic power steering system with electronic power steering. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Compare disc brakes and drum brakes, discussing their relative merits in terms of performance and application. | CO4 | An | 6 |
|  | b. | Explain the role of electronic brake force distribution (EBD) in optimizing braking performance. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Analyze the advantages of capacitive discharge ignition (CDI) systems over conventional ignition systems in terms of performance and reliability. | CO5 | An | 6 |
|  | b. | Explain how a turbocharger works to increase engine power output. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain how VVT systems adjust valve timing based on engine speed and load conditions. | CO1 | A | 6 |
|  | b. | Explain the concept of a power brake and how it enhances braking efficiency. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain common causes of tire wear and how they can be prevented. | CO4 | A | 6 |
|  | b. | Compare the Euro and BS emission standards in terms of stringency and implementation. | CO5 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Analyze the potential of hydrogen fuel as an alternative to conventional fuels in automobiles. | CO6 | An | 6 |
|  | b. | Analyze the problems and challenges with electric vehicles. | CO6 | An | 6 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Understand different types of internal combustion engines. |
| **CO2** | Demonstrate the functions of clutch and gear box systems. |
| **CO3** | Describe the types of steering and suspension systems |
| **CO4** | Summarize the construction and operating principles of brakes and tyres |
| **CO5** | Express the functions and components of fuel injection and ignition systems. |
| **CO6** | Analyze the performance & emissions of alternate fuels. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | - | 5 | 18 | - | - | - | 23 |
| **CO2** | - | 5 | 6 | 6 | - | - | 17 |
| **CO3** | - | 5 | 6 | 6 | - | - | 17 |
| **CO4** | - | 5 | 12 | 12 | - | - | 29 |
| **CO5** | - | 4 | 6 | 12 | - | - | 22 |
| **CO6** | - | 1 | 3 | 12 | - | - | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18ME2073** | **Duration** | **3 Hrs** |
| **Course Name** | **MODERN MANUFACTURING TECHNIQUES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Give an example for subtractive manufacturing processes. | | CO1 | U | 1 |
| 2. | Indicate the various techniques used in polymer processing. | | CO1 | U | 1 |
| 3. | \_\_\_\_\_\_\_\_\_\_\_ is an unconventional machining process where material removal is accomplished through controlled anodic dissolution of work piece. | | CO2 | U | 1 |
| 4. | Differentiate amplifying and non-amplifying type of tool holders in USM. | | CO2 | U | 1 |
| 5. | Hot working is carried out above its \_\_\_\_\_\_\_ temperature. | | CO3 | U | 1 |
| 6. | Indicate the role of capacitor banks in an Electro Magnetic Forming system. | | CO3 | U | 1 |
| 7. | Identify the primary components of a gating system. | | CO4 | U | 1 |
| 8. | \_\_\_\_\_\_\_ casting process is used for making billets. | | CO4 | U | 1 |
| 9. | Indicate the methods used for initiating an arc in welding processes. | | CO5 | U | 1 |
| 10. | Identify the primary benefits of automating the manufacturing processes. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Describe the advantages of composite materials over traditional materials. | | CO1 | U | 3 |
| 12. | Distinguish between orthogonal and oblique metal cutting. | | CO2 | U | 3 |
| 13. | Differentiate between plastic and elastic deformation. | | CO3 | U | 3 |
| 14. | Distinguish between runner and riser in metal casting. | | CO4 | U | 3 |
| 15. | Write the measures that can be taken to minimize arc blow in welding and its effects. | | CO5 | A | 3 |
| 16. | Compare open loop and closed loop NC systems. | | 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. | a. | Classify manufacturing processes based on their principles, materials and applications. | CO1 | An | 6 |
|  | b. | Explain the important properties of metals that make them suitable for manufacturing applications. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the working principle and equipment used in Abrasive Jet Machining. | CO2 | A | 6 |
|  | b. | Illustrate the effect of process parameters on material removal rate and surface finish in EDM process. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Illustrate the working principle, applications and limitations of Explosive forming. | CO3 | A | 6 |
|  | b. | Explain the key components of Electro-hydraulic Forming (EMF) and their respective functions. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain shell casting with suitable sketches. | CO4 | A | 6 |
|  | b. | Write about evaporative pattern casting technique, its process, and its applications in modern manufacturing. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Illustrate the primary forces affecting metal transfer during welding, and how do they influence the weld pool dynamics. | CO5 | An | 6 |
|  | b. | Explain the working principle and equipment used in Laser Beam Welding process. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the equipment setup used in Ultrasonic Machining. Analyze the effect of abrasive particle size in Ultrasonic Machining. | CO2 | An | 6 |
|  | b. | Illustrate the working principle of Electron Beam Machining (EBM) and its key components. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Illustrate the purpose of a riser in metal casting, and how does it prevent defects like shrinkage and porosity in the final product. | CO4 | An | 6 |
|  | b. | Explain the equipment, process and applications of continuous casting in metal manufacturing processes. | CO4 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the applications of industrial robots in modern manufacturing for tasks such as assembly, welding, and material handling. | CO6 | A | 6 |
|  | b. | Analyze the role of adaptive control in manufacturing, and how does it enable real-time adjustments to optimize process parameters and performance. | CO6 | An | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand different manufacturing processes and the economic considerations |
| **CO2** | Understand the theory of metal cutting and the sciences of advanced machining processes |
| **CO3** | Learn the theories of advanced metal forming. |
| **CO4** | Know about the process of metal casting in detail |
| **CO5** | Understand the physics of arc welding and theory of advanced welding techniques |
| **CO6** | Demonstrate an understanding of competitive manufacturing environment |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | - | 5 | 6 | 6 | - | - | 17 |
| **CO2** | - | 5 | 18 | 6 | - | - | 29 |
| **CO3** | - | 5 | 12 | - | - | - | 17 |
| **CO4** | - | 5 | 18 | 6 | - | - | 29 |
| **CO5** | - | 1 | 9 | 6 | - | - | 16 |
| **CO6** | - | 4 | 6 | 6 | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18ME2074** | **Duration** | **3hrs** |
| **Course Name** | **RENEWABLE ENERGY TECHNOLOGIES** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Write the two bands of solar radiation majority in the total solar radiation reaching the earth. | | CO1 | U | 1 |
| 2. | Infer why world energy need rises. | | CO1 | U | 1 |
| 3. | Recall the application of the pyrheliometer. | | CO2 | R | 1 |
| 4. | Why is a transparent cover used in a flat plate collector? | | CO2 | R | 1 |
| 5. | What are the four main types of thermo-chemical processes? | | CO3 | R | 1 |
| 6. | What are anaerobic bacterias? | | CO3 | R | 1 |
| 7. | Give an example of a vertical-axis wind turbine. | | CO4 | U | 1 |
| 8. | What is the main disadvantage of a horizontal-axis wind turbine? | | CO4 | R | 1 |
| 9. | Summarise the high-temperature geothermal resources. | | CO5 | U | 1 |
| 10. | Outline the production of hydrogen using electrolysis. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | How can renewable energy benefit the environment? | | CO1 | U | 3 |
| 12. | Distinguish beam radiation and diffused radiation. | | CO2 | An | 3 |
| 13. | List a few Solar PV applications. | | CO3 | An | 3 |
| 14. | Explain how the wind is generated. | | CO4 | E | 3 |
| 15. | Define wave energy devices. | | CO5 | R | 3 |
| 16. | Write short notes on micro hydro systems. | | 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 various renewable energy resources and their availability in India. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 18. | a. | List the advantages and disadvantages of Solar PV systems over conventional power systems. | CO2 | An | 6 |
|  | b. | Distinguish between Solar Cell, module and an Array. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the process of gasification of solid biofuels. | CO3 | E | 4 |
|  | b. | List and explain the factors affecting the performance of biogas digester. | CO3 | An | 8 |
|  |  |  |  |  |  |
| 20. | a. | Derive the expression for maximum axial thrust experienced by a wind turbine and also find the condition for such operation. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | List and explain the various tidal energy conversion schemes. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain the various energy extraction technologies used with hydrothermal resources. | CO6 | E | 8 |
|  | b. | What are the merits and demerits of geothermal energy? | CO6 | R | 4 |
|  |  |  |  |  |  |
| 23. | a. | Explain the following terms w.r.t Solar Energy:  (i) Beam radiation  (ii) Diffuse radiation  (iii) Global radiation | CO2 | E | 6 |
|  | b. | Explain the salient points of the Solar radiation data. | CO2 | E | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Discuss the operation of Phosphoric Acid Fuel cell with a neat diagram. | CO6 | C | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Identify the various renewable energy sources. |
| CO2 | Summarize the application of solar energy systems. |
| CO3 | Develop technology to convert waste biomass into useful energy. |
| CO4 | Evaluate the performance of wind energy systems. |
| CO5 | Estimate power production from tidal and ocean energy systems |
| CO6 | Understand the energy conversion from geothermal and hydrogen sources |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 5 | - | - | 12 | - | 17 |
| CO2 | 2 | - | - | 15 | 12 | - | 29 |
| CO3 | 2 | - | - | 11 | 4 | - | 17 |
| CO4 | 1 | 1 | 12 | - | 3 | - | 17 |
| CO5 | 3 | 1 | - | 12 | - | - | 16 |
| CO6 | 4 | 1 | 3 | - | 8 | 12 | 28 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18ME3062** | **Duration** | **3 Hrs** |
| **Course Name** | **COMPOSITE MATERIALS** | **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. | Explain the key defining characteristics that differentiate composite materials from traditional materials. | CO1 | A | 10 |
|  | b. | Illustrate the most promising and innovative applications of composite materials in aerospace, automotive and construction industries. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the contribution of smart materials to the development of self-healing, shape-changing, and sensing capabilities in composite structures. | CO2 | A | 10 |
|  | b. | Graphite has poor strength but carbon fibres exhibit very high strength. Justify | CO2 | E | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain the characteristics of fiber-reinforced lamina. Discuss the significance of fiber orientation in determining mechanical properties. | CO2 | A | 10 |
|  | b. | Analyze the types of interlaminar stresses that occur in fiber-reinforced composite laminates. Discuss the factors affecting the magnitude and distribution of interlaminar stresses. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Analyze the environmental effects on fiber-reinforced composites. Discuss the degradation mechanisms induced by exposure to moisture, temperature, and chemicals. Devise strategies to enhance the environmental durability of composites. | CO2 | An | 10 |
|  | b. | Explain the hand lay-up process for manufacturing fiber-reinforced plastics (FRP). Discuss the materials, equipment, and steps involved in hand lay-up. | CO4 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the compression molding process for manufacturing fiber-reinforced composites. Discuss the key parameters influencing the quality and properties of compression-molded parts. | CO3 | A | 10 |
|  | b. | Compare fiber-reinforced plastics (FRP) and glass fiber-reinforced plastics (GRP) in terms of their manufacturing processes, properties, and applications. | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the differences between alloys and metal matrix composites (MMCs), focusing on their composition, properties, and applications. Give examples of each. | CO2 | A | 10 |
|  | b. | Explain any two processing techniques for manufacturing metal matrix composites (MMCs). | CO2 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Analyze the effect of reinforcement volume fraction on the properties of metal matrix composites (MMCs). Discuss the relationship between volume fraction and mechanical properties. | CO3 | An | 10 |
|  | b. | Illustrate the application of finite element analysis (FEA) in predicting the behavior of composite materials under different loading conditions. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Evaluate the reliability of composite materials in engineering applications. Discuss factors affecting the reliability of composites and methods for improving reliability. | CO5 | E | 10 |
|  | b. | Explain the vibration analysis of laminated composite beams. | CO5 | A | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Illustrate the characterization techniques used in the evaluation of composite products. | CO6 | An | 10 |
|  | b. | Explain the techniques, and applications of non-destructive testing (NDT) methods in the evaluation of composite structures. | CO6 | A | 10 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Predict elastic properties of composites |
| CO2 | Predict mechanical properties of fiber reinforced composite materials. |
| CO3 | Design a composite laminate for a given load condition. |
| CO4 | Describe fundamental fabrication processes for polymer matrix composites. |
| CO5 | Analyze the stresses using laminated plate theories. |
| CO6 | Compare and contrast different processes of manufacture of polymer composites. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | 10 | 10 | - | - | 20 |
| CO2 | - | - | 40 | 10 | 10 | - | 60 |
| CO3 | - | - | 10 | 10 | - | - | 20 |
| CO4 | - | - | 10 | 10 | - | - | 20 |
| CO5 | - | - | 10 | 20 | 10 | - | 40 |
| CO6 | - | - | 10 | 10 | - | - | 20 |
|  | | | | | | | **180** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **19ME1003** | **Duration** | **3hrs** |
| **Course Name** | **ENGINEERING MECHANICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Discuss parallelogram law of forces. | | CO1 | U | 1 |
| 2. | Define Lami’s theorem. | | CO1 | R | 1 |
| 3. | Describe moment of a force about a point. | | CO2 | U | 1 |
| 4. | Illustrate the reaction components of a roller support. | | CO2 | U | 1 |
| 5. | The moment of inertia (Ixx) of a hollow rectangle of width (B and b) and height (H and h) 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. | Name the principle used to analyze the motion a lift. | | CO4 | R | 1 |
| 9. | State the Impulse-Momentum principle. | | CO5 | R | 1 |
| 10. | Define angle of repose. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate coplanar and collinear force system. | | CO1 | U | 3 |
| 12. | Discuss Varignon’s theorem. | | CO2 | U | 3 |
| 13. | Describe the perpendicular axis theorem. | | CO3 | U | 3 |
| 14. | A car is moving with a velocity of 20 m/s. The car is brought to rest in 6 seconds, by applying brakes. Determine the retardation. | | CO4 | A | 3 |
| 15. | Two bodies, one of mass 30 kg, moving with a velocity of 9 m/s impinges centrally on another body of mass 15 kg, moving in the opposite direction with a velocity of 9 m/s. Compute the velocity of each body after impact, if the co-efficient of restitution is 0.8. | | CO5 | A | 3 |
| 16. | Discuss Coulomb’s laws of dry friction. | | 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. |  | The following forces act at a point as shown in the figure. Determine the magnitude and direction of the resultant force. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Two rollers, each of weight 50 N and of radius 10 cm rest in a horizontal channel of width 36 cm, as shown in figure below. Calculate the reaction at the point of contacts A, B and C.  21_0 | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | Calculate the moment of inertia of the section shown in the figure about its horizontal centroidal axis.  82_0 | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | The equation of motion of a particle moving in a straight line is given by :  s = 15t + 3t2 – t3, where (s) is in metres and (t) in seconds. Compute the velocity and acceleration at the start and the time at which the particle attains maximum velocity. | 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 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. Determine the acceleration of weights and the tension in the rope using Work-Energy method. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Calculate the reactions at the supports of the overhanging beam shown in the figure. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Two blocks of weight 150 N and 50 N are connected by a rope passing over a frictionless pulley as shown in the fugure. Estimate the acceleration of blocks A and B and the tension in the rope using Newton’s law of motion. | CO4 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | A uniform ladder of weight 1000 N and of length 4 m rests on a horizontal ground and leans against a smooth vertical wall. The ladder makes an angle of 60° with the horizontal. When a man of weight 750 N stands on the ladder at a distance 3 m from the top of the ladder, the ladder is at the point of sliding. Calculate the coefficient of friction between the ladder and the floor. | CO6 | A | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Determine the resultant force and moment for a given system of forces |
| **CO2** | Understand basics of equilibrium of rigid bodies |
| **CO3** | Determine the centroid and second moment of area of simple solids |
| **CO4** | Apply fundamental concepts of kinematics and kinetics to the analysis of simple / practical problems |
| **CO5** | Understand basic kinematics concepts – displacement, velocity and acceleration |
| **CO6** | Determine friction and its effects as per the laws of friction |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 4 | 12 | - | - | - | 17 |
| **CO2** | - | 5 | - | 24 | - | - | 29 |
| **CO3** | 2 | 3 |  | 12 | - | - | 17 |
| **CO4** | 2 | - | 15 | 12 | - | - | 29 |
| **CO5** | 1 | - | 3 | 12 | - | - | 16 |
| **CO6** | 1 | 3 | 12 |  | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **19ME2025** | **Duration** | **3hrs** |
| **Course Name** | **THERMODYNAMICS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Pressure is a \_\_\_\_\_\_\_\_\_\_\_\_ property. | | CO1 | U | 1 |
| 2. | Indicate extensive property. | | CO1 | R | 1 |
| 3. | The heat transfer and internal energy are equal for a constant volume process (True / False). | | CO2 | U | 1 |
| 4. | Which are the quantities are fixed for an isolated system. | | CO2 | U | 1 |
| 5. | Define zeroth law of thermodynamics. | | CO3 | R | 1 |
| 6. | COP of heat pump is equal to COP of refrigerator plus one (True/False). | | CO3 | A | 1 |
| 7. | Dryness fraction of steam along the saturation vapor line is \_\_\_\_\_\_ | | CO4 | U | 1 |
| 8. | Relative humidity is 100 % at the dew point temperature. (True/False). | | CO4 | U | 1 |
| 9. | Define specific humidity. | | CO5 | R | 1 |
| 10. | Express the air-standard efficiency relation for Diesel cycle. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Derive the pdv work for a constant temperature process. | | CO1 | A | 3 |
| 12. | Define Classius statement of second law of thermodynamics with source and sink diagram. | | CO2 | R | 3 |
| 13. | Dry saturated steam has an entropy of 6.76 kJ/kgK. Find its pressure, temperature, specific volume and enthalpy. | | CO3 | An | 3 |
| 14. | Indicate the ideal gas equation in mass and molar basis and prove that Cp – Cv = R. | | CO4 | A | 3 |
| 15. | Estimate the average molecular weight of the atmospheric air, if the air consist of 21% of O2, 78% of N2 and 1% of CO2 and other gases by weight. | | CO5 | An | 3 |
| 16. | Draw the P-V and T-S diagram for Diesel Cycle. | | 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 Joule’s experiment to predict the first law of thermodynamics applied to a cyclic process and prove that energy is a property of the system. | CO1 | A | 06 |
|  | b. | A perfect gas for which the ratio of specific heat is 1.4, occupies a volume of 0.3m3 at 100 kPa and 27o C. The gas undergoes a compression to 0.06m3. Find the heat transfer during compression process when (i) Pv = C, (ii) Pvγ = C. | CO1 | E | 06 |
|  |  |  |  |  |  |
| 18. | a. | In a steam power plant, steam flows steadily from the steam generator to the turbine. The steam passes through a horizontal nozzle having an inlet area of 0.1m2. Steam at a pressure of 1000 kPa, enthalpy of 3263.9 kJ/kg, specific volume of 0.292 m3/kg and temperature 400oC enters the nozzle with a velocity of 70m/s. The steam leaves the nozzle at a pressure of 300 kPa, enthalpy of 3069.3 kJ/kg, specific volume of 0.875 m3/kg and a temperature of 300oC.There is a heat loss of 30 kW while the steam is passing through the nozzle. Determine the mass flow rate and the exit velocity of the steam from the nozzle. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 19. | a. | A vessel of volume 0.04m3 contains a mixture of saturated water and saturated steam at a temperature of 250oC. The mass of the liquid present is 9 kg. Find the pressure, the mass, the specific volume, the enthalpy, the entropy and the internal energy. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. | a. | A gas has a Cp of 1.968 kJ/kgK and Cv of 1.507 kJ/kgK. Find the molecular weight and characteristic gas constant. A constant volume chamber of 0.3m3 capacity contains 2 kg of this gas at 5oC. Heat is transferred to the gas until the temperature is 100oC. Find the work done, heat transfer, change in internal energy, change in enthalpy and change in entropy. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. | a. | Express the Dalton’s law of partial pressure and prove that the sum of the mole fractions of a gas mixture will always be one. | CO4 | An | 06 |
|  | b. | Air at 200 kPa and 300oC has a volume of 0.8m3. In a frictionless process at constant volume the pressure changes to 100kPa. Find the final temperature and heat transferred. Take the value of Cv of air as 0.718 kJ/kgK. | CO4 | E | 06 |
|  |  |  |  |  |  |
| 22. | a. | Explain the working of the heat engine cycle with a neat sketch and derive the cycle efficiency. | CO2 | A | 06 |
|  | b. | Derive the equation for the change in entropy for a constant pressure and constant volume processes. | CO2 | An | 06 |
|  |  |  |  |  |  |
| 23. | a. | An air conditioning system is designed under the following conditions. The outdoor conditions are 30oC DBT and 75% RH and the indoor conditions are 22oC DBT and 70% RH. The amount of free air circulated is 3.33 m3/s and the coil dew point temperature is 14oC. The desired conditions is achieved first by cooling and dehumidification and then by heating. Calculate the following.  (i) Capacity of the cooling coil in Tonnes of Refrigeration  (ii) Capacity of the heating coil in kW  (iii) Amount of water vapor removed kg/s | CO5 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | An engine working on the Otto cycle is supplied with air at 0.1 MPa, 35oC. The compression ratio is 8. Heat supplied is 2100 kJ/kg. Calculate the maximum pressure and temperature of the cycle, the cycle efficiency and the mean effective pressure. (For air Cp=1.005 kJ/kgK, Cv=0.718 kJ/kg K and R=0.287 kJ/kgK). | CO6 | E | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the basic concepts in thermodynamics and energy balance to systems and control volumes, in situations involving heat and work interactions. |
| CO2 | Differentiate between high grade and low grade energies. |
| CO3 | Evaluate changes in thermodynamic properties of pure substances |
| CO4 | Apply gas laws to solve problems related to gas mixtures. |
| CO5 | Create psychrometric chart to perform moist air process calculations |
| CO6 | Recognize the significance of I law for reacting systems and heating value of fuels. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 01 | 01 | 09 | -- | 06 | -- | 17 |
| CO2 | 03 | 02 | 06 | 06 | 12 | -- | 29 |
| CO3 | 01 | -- | 01 | 03 | 12 | -- | 17 |
| CO4 | -- | 02 | 03 | 06 | 18 | -- | 29 |
| CO5 | 01 | -- | -- | 03 | 12 | -- | 16 |
| CO6 | 01 | -- | 03 | -- | 12 | -- | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **19ME2026** | **Duration** | **3hrs** |
| **Course Name** | **APPLIED THERMODYNAMICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define boiler efficiency. | | CO1 | R | 1 |
| 2. | State equivalent of evaporation. | | CO1 | U | 1 |
| 3. | Describe the processes in a Rankine cycle. | | CO2 | U | 1 |
| 4. | The heat energy of steam is converted into kinetic energy in a nozzle (True / False). | | CO3 | A | 1 |
| 5. | Dryness fraction of dry saturated steam is \_\_\_\_\_\_\_\_\_\_\_\_ | | CO3 | A | 1 |
| 6. | Express the relation for the blade velocity coefficient in an impulse turbine. | | CO4 | R | 1 |
| 7. | Difference between the total and swept volume in an air compressor is known as\_\_. | | CO5 | U | 1 |
| 8. | Define volumetric efficiency of the air compressor. | | CO5 | R | 1 |
| 9. | Write the COP relation for the vapour compression refirigeration cycle. | | CO6 | U | 1 |
| 10. | One metric ton of refrigeration is equal to­­­­­­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_ | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Describe evaporative capacity, boiler trail and factor of evaporation. | | CO1 | A | 3 |
| 12. | Derive the efficiency relation for Rankine cycle. | | CO2 | A | 3 |
| 13. | Derive the relation to find the exit velocity of the steam nozzle. | | CO3 | A | 3 |
| 14. | Write any three differences between the impulse and reaction turbine. | | CO4 | U | 3 |
| 15. | A single stage single acting compressor has to compress air isentropically from 1 bar and 303K to 5 bar. Find the work of compression required for unit mass of air. | | CO5 | An | 3 |
| 16. | List any three differences between vapour compression and vapour absorption refrigeration systems. | | 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. | a. | Sketch the schematic layout of the boiler plant and discuss the various types of losses in a boiler plant with the help of a heat balance sheet. | CO1 | A | 6 |
|  | b. | A boiler evaporates 3.6 kg of water per kg of coal into dry saturated steam at 10 bar. The temperature of feed water is 32oC. Find the equivalent of evaporation and the factor of evaporation. | CO1 | E | 6 |
|  |  |  |  |  |  |
| 18. | a. | In a steam power cycle, the steam supply is at 15 bar and dry saturated. The condenser pressure is 0.4 bar. Calculate the Rankine cycle efficiency. Neglect the pump work. | CO2 | An | 6 |
|  | b. | Explain the working of a reheat Rankine cycle with a neat sketch and derive the cycle efficiency. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Steam expands isentropically in a nozzle from 1 MPa and 250oC to 10 kPa. The flow rate of the steam is 1 kg/s. Find the following when the inlet velocity is neglected. (i) Quality of steam, (ii) Velocity of steam at the exit of the nozzle, (iii) Exit area of the nozzle. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | In a De Laval turbine, steam is supplied from the nozzle with the velocity of 1200 m/s. The nozzle angle is 20o and the mean blade velocity is 400 m/s. The inlet and outlet angles of the blades are equal and the mass of the steam leaving the turbine is 1000 kg/hr. Calculate (i) Blade angles, (ii) relative velocities, (iii) Tangential force on blades, (iv) power developed, (v) Blade efficiency. Take the blade velocity coefficient as 0.8 | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. | a. | Derive the relation to find the work done on a single stage, single acting reciprocating air compressor without the clearance volume. | CO5 | A | 6 |
|  | b. | Derive the relation for the volumetric efficiency of the single stage reciprocating air compressor with clearance volume | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | A single acting single cylinder reciprocating air compressor has a cylinder diameter of 200 mm and a stroke of 300 mm. Air enters the cylinder at 1 bar and 27oC. It is then compressed to 8 bar by following the process pV1.3 = constant. If N=250 rpm, Calculate (i) Mass of air compressed per minute, (ii) Temperature at the end of compression, and the (iii) Power developed in kW. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 23. | a. | A single stage reciprocating air compressor takes in 1m3 of air per minute at 1.013 bar and 15oC and delivers at 7 bar. Assuming that the law of compression is Pv1.25 = constant and the clearance volume is negligible, Calculate the indicated power. If the compressor is driven at 300 rpm and is single acting and single cylinder machine, Calculate the cylinder bore required, assuming that a stroke to bore ratio of 1.5:1. | CO5 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the working principle of a vapour compression refrigeration system with a neat sketch | CO6 | A | 6 |
|  | b. | Draw T-s and p-H diagrams illustrating a vapor compression refrigeration cycle, and express the corresponding equations to determine the following. (i) work of compression; (ii) heat rejected in condenser; (iii) heat added to evaporator and the Coefficient of performance | CO6 | An | 6 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Estimate the performance of a steam generator. |
| **CO2** | Carry out analysis of vapour power cycles. |
| **CO3** | Conduct analysis of steam nozzles and turbines. |
| **CO4** | Evaluate performance of reciprocating compressors. |
| **CO5** | Apply principles of refrigeration and air conditioning for analysis and performance evaluation. |
| **CO6** | Design turbine and nozzles and compressors. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 1 | 9 | - | 6 | - | 17 |
| **CO2** | - | 1 | 9 | 6 | - | - | 16 |
| **CO3** | - | - | 5 | 12 | - | - | 17 |
| **CO4** | 1 | 3 | - | - | 12 | - | 16 |
| **CO5** | 1 | 1 | 12 | 3 | 24 | - | 41 |
| **CO6** | - | 4 | 7 | 6 |  |  | 17 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **19ME3004** | **Duration** | **3hrs** |
| **Course Name** | **SMART MATERIALS AND SHAPE MEMORY ALLOYS** | **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. | Classify the Smart Materials with its applications. Explain any two with suitable examples. | CO1 | A | 12 |
|  | b. | Explain with neat sketches the one-way & two-way shape memory effect. | CO1 | A | 8 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Compare and contrast piezoceramics and piezopolymers in terms of their properties and applications | CO2 | A | 20 |
|  |  |  |  |  |  |
| 3. | a. | Explain the different phases in shape memory alloys with suitable sketches. | CO3 | A | 14 |
|  | b. | Describe the functional properties of shape memory alloys. | CO3 | A | 6 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Infer the following  1. Thermochromism  2. Photochromism  3. Electrochromism  4. Solvatochromism | CO4 | An | 20 |
|  |  |  |  |  |  |
| 5. | a. | Explain the Electroactive polymers (EAPs) and microgels in the context of smart materials. Also, explain its synthesis with examples. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Compare and contrast binary and ternary alloy systems in shape memory alloys. Also, explain the variations in the alloy composition of SMAs. | CO3 | An | 20 |
|  |  |  |  |  |  |
| 7. | a. | Discuss with suitable examples the principles behind pH-responsive and photo-responsive polymers. | CO5 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain in detail the application of molecular engineering principles facilitates the advancement of sustainable materials and their processes. | CO6 | An | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Discuss the development and applications of self-healing materials. Also, explain the mechanisms of self-healing and its contribution to the sustainable medical field. | CO6 | U | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understanding of the physical principles underlying the behaviour of smart materials. |
| CO2 | The basic principles and mechanisms of the stimuli-response for the most important smart materials. |
| CO3 | Propose improvement on the design, analysis and manufacturing of Smart materials. |
| CO4 | Command on Shape memory materials fabrication and shape memory effects. |
| CO5 | Smart polymers usage in space applications |
| CO6 | Identifying the application issues involved in integrating smart materials to engineering smart structures and products. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | 20 | - | - | - | 20 |
| CO2 | - | - | 20 | - | - | - | 20 |
| CO3 | - | - | 20 | 20 | - | - | 40 |
| CO4 | - | - | - | 20 | - | - | 20 |
| CO5 | - | 20 | - | 20 | - | - | 40 |
| CO6 | - | 20 | - | 20 | - | - | 40 |
|  | | | | | | | **180** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20ME1006** | **Duration** | **3hrs** |
| **Course Name** | **PROFESSIONAL ETHICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define morality. | | CO1 | R | 1 |
| 2. | Distinguish scientists and engineers. | | CO1 | A | 1 |
| 3. | Give a few benefits of integrity. | | CO2 | R | 1 |
| 4. | List the different facets of integrity in the workplace. | | CO2 | U | 1 |
| 5. | What are the common types of Conflicts of Interest in business? | | CO3 | R | 1 |
| 6. | List a few social skills. | | CO3 | U | 1 |
| 7. | Expand the term “VUCA”. | | CO4 | R | 1 |
| 8. | The crime committed by someone during their employment is called as……. | | CO5 | U | 1 |
| 9. | Give some examples of unethical behaviour of professionals. | | CO5 | U | 1 |
| 10. | Define discrimination. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Differentiate morals and ethics. | | CO1 | A | 3 |
| 12. | Define professionalism. | | CO2 | U | 3 |
| 13. | List the general features of morally responsible engineers. | | CO3 | R | 3 |
| 14. | Brief the responsibility of an editor. | | CO4 | R | 3 |
| 15. | What is meant by risk? and state the causes of risk. | | CO5 | R | 3 |
| 16. | Define code of ethics. | | 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. | a. | Write shorts notes on   1. Work ethics 2. Respect for others 3. Expert willingness 4. Professionalism | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain in detail the baccalaureate experience and postdoctoral experience. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Discuss the ways to be socially active and its benefits. | CO3 | R | 12 |
|  |  |  |  |  |  |
| 20. | a. | Discuss in detail the peer review process and duties of peer review. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain in detail the professional rights and employees' rights. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Write notes on unethical behaviour among   1. Individuals 2. Business 3. Professionals | CO6 | R | 12 |
|  |  |  |  |  |  |
| 23. | a. | What is the meaning of academic freedom? And discuss the takeaways for students and faculties. | CO3 | R | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain in detail the code of ethics in business. | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand the ethical framework in professional life. |
| CO2 | Know the psychology and philosophy of ethics. |
| CO3 | Recognize the ethics in scientific and engineering society. |
| CO4 | Diagnose the code of ethics and ethical standards. |
| CO5 | Understand the integrity in research. |
| CO6 | Realize the Enforcement of Code of Ethics. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 12 | 4 | - | - | - | 17 |
| CO2 | 1 | 16 | - | - | - | - | 17 |
| CO3 | 28 | 1 | - | - | - | - | 29 |
| CO4 | 4 | 12 | - | - | - | - | 16 |
| CO5 | 3 | 14 | - | - | - | - | 17 |
| CO6 | 13 | 15 | - | - | - | - | 28 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20ME1007** | **Duration** | **3hrs** |
| **Course Name** | **3D PRINTING TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | 3D printing is used by \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_ departments in an industry. | | CO1 | R | 1 |
| 2. | Define Reverse Engineering. | | CO2 | R | 1 |
| 3. | Draw a flow chart classifying various 3D printing technologies based on type of materials used. | | CO3 | U | 1 |
| 4. | List the applications of support structure in 3D printing. | | CO2 | U | 1 |
| 5. | Mention any one major difference between Stereo Lithography Apparatus Process and Continuous Liquid Interface Production Process. | | CO4 | U | 1 |
| 6. | Why does an Electron Beam Melting process require a vacuum chamber while printing components? | | CO5 | An | 1 |
| 7. | Which of the 3D printing technologies replicate an arc welding process? | | CO5 | U | 1 |
| 8. | Differentiate between re-engineering and reverse engineering. | | CO6 | C | 1 |
| 9. | Justify and defend the use of .stl file format for 3D printing. | | CO6 | E | 1 |
| 10. | Name one application of Direct Metal Laser Sintering process in automobile. | | CO5 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Differentiate between Selective Laser Sintering and Fused Deposition Modelling. | | CO4 | U | 3 |
| 12. | Draw a neat diagram of Laminated Object Modelling Process and discuss the parts associated with the machine. | | CO3 | An | 3 |
| 13. | Illustrate the applications of Direct and Indirect tooling using additive manufacturing. | | CO6 | E | 3 |
| 14. | Enumerate the three main advantages of Z Corp’s 3D Printing Machine. | | CO5 | U | 3 |
| 15. | List the major applications of 3D printing with respect to Aeronautical Field. | | CO6 | A | 3 |
| 16. | Can you derive a possible solution to solve unemployment through 3D printing technology? | | CO1 | C | 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. | Describe the need for implementing 3D printing technology in industries. | CO1 | U | 6 |
|  | b. | Draw the flow chart explaining the Product Development Cycle (PDC). | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | List the digitization techniques available in the industries. Explain the process of digitize a product with a Coordinate Measuring Machine (CMM). | CO2 | U | 6 |
|  | b. | Explain the working principle of Stereo Lithography Apparatus (SLA). Mention the merits and demerits of the process. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the critical factors that influence the performance and functions of Selective Laser Sintering. Justify the answer with examples or case studies | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Which one of the 3D printing technologies can be hypothesized to be used in Construction Industry? Explain the design changes required to make a 3D printer to build houses. | CO4 | C | 12 |
|  |  |  |  |  |  |
| 21. | a. | Critically evaluate the use of Direct Metal Laser Sintering Process technology over Laser Engineered Net Shaping technology. Compare the merits and demerits. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 22. | a. | With an industrial or commercial case study, explain the application of 3D printing technology in Recreational Industry. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Classify the post processing techniques used for various 3D printing processes. Justify the importance of those post processing techniques with pictorial illustrations. | CO6 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain with a neat sketch the construction, working principle, advantages, disadvantages, applications and process variables of Solid Ground Curing (SGC) Process. | CO3 | R | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Conceptualize the product development cycle and identify the role of 3D Printing in industries. |
| CO2 | Illustrate appropriate 3D Printing techniques for developing products. |
| CO3 | Articulate the working principles of various 3D Printing Technologies. |
| CO4 | Identify suitable applications for every classification of 3D Printing Technology. |
| CO5 | Correlate the process variables with the quality of products built using 3D Printing Processes. |
| CO6 | Design materials for 3D Printing Process to solve real time industrial problems. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 6 | 6 |  |  | 3 | 16 |
| CO2 | 1 | 7 |  | 6 |  |  | 14 |
| CO3 | 12 | 1 |  | 15 |  |  | 28 |
| CO4 |  | 4 | 12 |  |  | 12 | 28 |
| CO5 |  | 4 | 1 | 1 | 12 |  | 18 |
| CO6 |  |  | 3 | 12 | 4 | 1 | 20 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **20ME2002** | **Duration** | **3hrs** |
| **Course Name** | **CNC PROGRAMMING** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | The punched tape reader in NC is \_\_\_\_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 2. | In an \_\_\_\_\_\_ positioning programming system, the next tool location must be defined with reference to the previous tool location. | | CO1 | R | 1 |
| 3. | Identify the control loop system which is more stable. | | CO2 | U | 1 |
| 4. | The \_\_\_\_\_\_ translates the part program into internal commands for moving tools and executing auxiliary functions in a CNC system. | | CO2 | R | 1 |
| 5. | \_\_\_\_\_\_\_ interpolation method, in which interpolation is carried out using a computer program. | | CO3 | R | 1 |
| 6. | Which software interpolation method requires high performance CPU? | | CO3 | R | 1 |
| 7. | Define Position error. | | CO5 | R | 1 |
| 8. | The fourth axis of a CNC machine refers to rotation about \_\_\_\_ axis | | CO5 | U | 1 |
| 9. | G – codes are used to specify \_\_\_\_\_\_\_\_\_ functions in the program. | | CO6 | R | 1 |
| 10. | Write the CNC codes for dwell and skip functions | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate sequential engineering and concurrent engineering. | | CO1 | U | 3 |
| 12. | Examine why the recirculating ball screw is used in the CNC Machine tools? | | CO2 | A | 3 |
| 13. | Draw and brief the concept of interpolator, if a tool should move from point *P*1 to *P*2 at feed rate *Vf* in the *XY* plane. | | CO3 | A | 3 |
| 14. | Restate the advantages of PLC. | | CO4 | U | 3 |
| 15. | Infer the limitations of cutter radius compensation. | | CO5 | U | 3 |
| 16. | Compare fixed cycle and canned cycle. | | 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. | a. | Explain the MMI and NCK functions in CNC Architecture. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | With a block diagram, explain the control systems used in CNC Machine tools. | CO2 | U | 8 |
|  | b. | Describe the importance of spindle design in CNC. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. | a. | Explain Hardware interpolation DDA. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain the functions of Programmable logic control and its architecture. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the function of G & M – code interpreter. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain the Look ahead, Feed forward and Skip functions used in CNC. | CO6 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Write the part program for the below component. The cutting speed to be 50 m/min and the feed rate is 0.08 mm/rev. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the servo control for positioning. | CO5 | U | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the control systems for CNC machine tool and select the components of CNC architecture |
| CO2 | Articulate the principles of motors, Feedback devices and hydraulic system |
| CO3 | Compare the interpolation methods in CNC control system |
| CO4 | Propose the PLC programming Languages. |
| CO5 | Recommend PID controllers, servo controller, Numerical control Kernel types |
| CO6 | Design and evaluate CNC programming techniques for various industrial applications. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 15 |  |  |  |  | 17 |
| CO2 | 1 | 13 | 3 |  |  |  | 17 |
| CO3 | 2 | 12 | 3 |  |  |  | 17 |
| CO4 |  | 3 | 12 |  |  |  | 15 |
| CO5 | 1 | 16 | 12 |  |  |  | 29 |
| CO6 | 1 | 16 | 12 |  |  |  | 29 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20ME2004** | **Duration** | **3hrs** |
| **Course Name** | **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. | Discuss the concurrent engineering. | | CO1 | U | 1 |
| 2. | State the purpose of design validation procedures. | | CO1 | R | 1 |
| 3. | Restate the term biomaterial. | | CO2 | U | 1 |
| 4. | Illustrate Baddeleyite. | | CO2 | U | 1 |
| 5. | Estimate the term BPAP. | | CO3 | A | 1 |
| 6. | Interpret two types of ventilator support in noninvasive ventilation (NIV). | | CO3 | E | 1 |
| 7. | Identify the Tribological properties of materials. | | CO4 | A | 1 |
| 8. | Infer the primary function of a bone screw. | | CO4 | A | 1 |
| 9. | Illustrate natural polymers. | | CO5 | U | 1 |
| 10. | Define FTA. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | According to Joseph Edward Shigley’s Engineering Design, estimate the requirements of product design. | | CO1 | An | 3 |
| 12. | Identify various properties for an ideal material. | | CO2 | U | 3 |
| 13. | Compare the merits and demerits of BPAP. | | CO3 | U | 3 |
| 14. | Construct the examples of the basic safety and essential performance characteristics with respect to medical devices. | | CO4 | A | 3 |
| 15. | List four major degradation mechanisms for polymers. | | CO5 | R | 3 |
| 16. | Summarize the gate symbols used in fault tree analysis. | | 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. | a. | Analyze the human needs according to Maslow. | CO1 | An | 6 |
|  | b. | Differentiate the design process versus design control. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate Biocompatibility. | CO2 | A | 8 |
|  | b. | Interpret the Implant material requirements in orthopedic applications. | CO2 | A | 4 |
|  |  |  |  |  |  |
| 19. | a. | Analyze the noninvasive ventilation (NIV). | CO3 | An | 6 |
|  | b. | Analyze the functioning of Pressure Swing Adsorption (PSA) of Air separation methods. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Classify various bone defects. | CO4 | An | 6 |
|  | b. | Summarize the working Heart Lung machine with a neat sketch. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 21. | a. | Estimate the various physical and mechanical properties that can be measured using Universal Testing Machine. | CO4 | E | 6 |
|  | b. | Debate the implant design paradigm. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 22. | a. | Compare and contrast four major degradation mechanisms for polymers. | CO5 | An | 6 |
|  | b. | Identify the differences between the natural polymers from synthetic polymers with their merits, demerits and applications in medical field. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 23. |  | Analyze various steps involved in writing own Failure Mode Effects Analysis (FMEA). | CO6 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the failure analysis of orthopedic implants, and justify the importance of risk in the manufacturing of the medical devices and the four different types of risk analysis. | CO6 | E | 12 |

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

|  |  |
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| **COURSE OUTCOMES** | |
| The student will be able to | |
| 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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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 7 | 6 | 3 | - | - | 17 |
| CO2 | - | 5 | 12 | - | - | - | 17 |
| CO3 | - | 3 | 1 | 12 | 1 | - | 17 |
| CO4 | - | - | 5 | 6 | 18 | - | 29 |
| CO5 | 3 | 1 | 6 | 6 | - | - | 16 |
| CO6 | - | 3 | 1 | 12 | 12 | - | 28 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20ME2006** | **Duration** | **3 hrs** |
| **Course Name** | **ENGINEERING ECONOMICS & OPEARATIONS RESEARCH** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | \_\_\_\_\_\_\_\_\_\_\_\_\_cost does not change with the level of production. | | CO1 | U | 1 |
| 2. | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the point where total revenue equals total variable costs. | | CO1 | R | 1 |
| 3. | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the primary goal of value engineering. | | CO2 | R | 1 |
| 4. | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ method calculates the average profit per period. | | CO2 | R | 1 |
| 5. | \_\_\_\_\_\_\_\_\_\_\_ algorithm is used to solve LPP problems more efficiently. | | CO3 | U | 1 |
| 6. | The graphical method is always preferable to the simplex method for solving Linear Programming Problems. (True / False) | | CO3 | R | 1 |
| 7. | The North-West corner method is used to find initial basic feasible solutions in transportation models. (True / False) | | CO4 | U | 1 |
| 8. | What technique is employed to move towards optimality in transportation problems? | | CO4 | R | 1 |
| 9. | In the assignment model, what term describes the objective of maximizing the total profit or benefit? | | CO5 | U | 1 |
| 10. | Identify the term which describes the technique in project management where activities are scheduled to start as late as possible. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | State the law of supply and demand quoting relevant examples. | | CO1 | An | 3 |
| 12. | How does the time value of money concept influence financial decisions? Provide an example. | | CO2 | U | 3 |
| 13. | When do you use artificial variable technique and the two-phase simplex method in solving LPPs? | | CO3 | An | 3 |
| 14. | Explain in simple terms Vogells’s approximation method. | | CO4 | U | 3 |
| 15. | Highlight the advantages of the Hungarian Algorithm over other methods in terms of efficiency and accuracy. | | CO5 | An | 3 |
| 16. | Differentiate between forward and backward scheduling techniques within the PERT/CPM methodology. | | 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. | a. | Explain the different elements of costs that contribute to the overall cost structure and influence decision-making processes within organizations. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the concept of value engineering in the context of project management. | CO2 | R | 6 |
|  | b. | Outline the value engineering procedure, including the key steps involved in value engineering. | CO2 | R | 6 |
|  |  |  |  |  |  |
| 19. | a. | Solve the following Linear programming problem by graphical method:  Maximize  Subject to the constraints ; and | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | A company has three production facilities S1, S2 and S3 with production capacity of 7, 9 and 18 units (in 100s) per week of a product, respectively. These units are to be shipped to four warehouses D1, D2, D3 and D4 with requirement of 5,6,7, and 14 units (in 100s) per week, respectively. The transportation costs (in rupees) per unit between factories to warehouses are given in the table below. Formulate this transportation problem and minimize the transportation cost using Least cost method.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | D1 | D2 | D3 | D4 | Supply (Availability) | | S1 | 19 | 30 | 50 | 10 | 7 | | S2 | 70 | 30 | 40 | 60 | 9 | | S3 | 40 | 8 | 70 | 20 | 18 | | Demand (Requirement) | 5 | 8 | 7 | 14 | 34 | | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | A department of a company has five employees with five jobs to be performed. The time (in hrs.) that each man takes to perform each job is given in the effectiveness matrix. How should the jobs be allocated, one per employee, so as to minimize the total man-hours?   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Employees | | | | | | | | Jobs |  | I | II | III | IV | V | | A | 10 | 5 | 13 | 15 | 16 | | B | 3 | 9 | 18 | 13 | 6 | | C | 10 | 7 | 2 | 2 | 2 | | D | 7 | 11 | 9 | 7 | 12 | | E | 7 | 9 | 10 | 4 | 12 | | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain the make or buy decision process in procurement and supply chain management. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 23. | a. | Define the Average Rate of Return (ARR) method and explain how it is used to assess the profitability of investment projects | CO2 | R | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Consider a construction project to build a new office building. The project consists of several activities with their durations and dependencies as follows:   |  |  |  |  | | --- | --- | --- | --- | | **Activity** | **Description** | **Duration (days)** | **Predecessor(s)** | | A | Site preparation | 5 | - | | B | Foundation work | 8 | A | | C | Framing | 10 | B | | D | Roofing | 6 | C | | E | Electrical and Plumbing work | 8 | C | | F | Interior finishing | 7 | D, E | | G | Exterior finishing | 5 | D | | H | Landscaping | 4 | D |   1. Draw the network diagram.  2. Calculate the earliest start time (ES), earliest finish time (EF), latest start time (LS), latest finish time (LF), and total float for each activity.  3. Determine the critical path(s) in the project network and the project duration. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Correlate this subject knowledge with the engineering problems |
| **CO2** | Construct flexible appropriate mathematical model to represent physical problem. |
| **CO3** | Schedule their engineering projects by using network analysis |
| **CO4** | Analyze the transportation problem and optimize the resources and output |
| **CO5** | Apply knowledge in solving their engineering queuing problems. |
| **CO6** | Develop their skills in decision making analysis by allocation of resources |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 25 | 1 |  | 3 |  |  | 29 |
| **CO2** | 26 | 3 |  |  |  |  | 29 |
| **CO3** | 1 | 1 |  | 15 |  |  | 17 |
| **CO4** | 1 | 4 |  | 12 |  |  | 17 |
| **CO5** |  | 1 |  | 15 |  |  | 16 |
| **CO6** |  | 4 |  | 12 |  |  | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20ME2007** | **Duration** | **3hrs** |
| **Course Name** | **AUTOMATION OF PRODUCT LIFE CYCLE MANAGEMENT** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the use of MES in automation systems | | CO1 | R | 1 |
| 2. | \_\_\_\_\_\_\_\_is a type of computer system that is meant to gather and quickly analyze real-time data. | | CO1 | R | 1 |
| 3. | Mention a few part design attributes used in GT. | | CO2 | R | 1 |
| 4. | List some of the part manufacturing attributes used in GT. | | CO2 | R | 1 |
| 5. | One of the primary reasons for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_is to reduce the worker fatigue or effort. | | CO3 | R | 1 |
| 6. | Preventing non-conformance components or parts from shipping saves a huge amount of \_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_. | | CO3 | R | 1 |
| 7. | A common strategy for solving any complex task is to decompose it into \_\_\_\_\_\_\_\_\_\_units that are easier to manage. | | CO4 | R | 1 |
| 8. | Sketch neatly the steps in functional decomposition. | | CO4 | R | 1 |
| 9. | List out the attributes considered in a successful design. | | CO5 | R | 1 |
| 10. | Depict a tree diagram for an IC engine using the first level of functional decomposition. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List out a few significant applications of the Industrial Internet of Things. | | CO1 | U | 3 |
| 12. | Sketch neatly the basic elements of the automation system and write their importance. | | CO2 | U | 3 |
| 13. | State the three unique structures used in classification and coding schemes. | | CO3 | U | 3 |
| 14. | List the important benefits of GT if implemented in the industry. | | CO4 | U | 3 |
| 15. | List any four important reasons for implementing automation in the industries. | | CO5 | U | 3 |
| 16. | Sketch a diagram depicting the three types of automation relative to production quantity and product variety | | 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. | a. | Tabulate the following: (1) Reasons for implementing manufacturing cells and (2) Important design considerations that should be taken into consideration during cell formation. | CO1 | A | 6 |
|  | b. | Explain the process adapted by Mitrofanov and Edwards on the concept of the composite part that is formed by merging the primitives of all the parts of a part family. | CO1 | A | 6 |
|  | | | | | |
| 18. | a. | Enumerate the features and benefits of the ERP systems in detail with a neat sketch. | CO2 | A | 6 |
|  | b. | Sketch a neat flowchart that depicts the automation of self-driving cars using various levels of the automation system and explain its functions, merits, and demerits. | CO2 | A | 6 |
|  | | | | | |
| 19. | a. | Tabulate the flow classes depicting the standard flow classes & member flow types and explain their significance in product design, | CO3 | A | 6 |
|  | b. | List and explain the seven important DFX methodologies used in concurrent engineering. | CO3 | A | 6 |
|  | | | | | |
| 20. | a. | Sketch neatly the reversed triangle of the ‘4R-1D’ waste management concept and write its significance. | CO4 | A | 6 |
|  | b. | Enumerate the benefits of the steps involved in a paper recycling plant using a neat sketch. | CO4 | A | 6 |
|  | | | | | |
| 21. | a. | Distinguish between sequential and concurrent engineering and suggest the best methodology to bring out a product in a shorter lead time. | CO5 | An | 6 |
|  | b. | Describe the steps and benefits involved in a glass recycling plant through a process cycle sketch. | CO5 | An | 6 |
|  | | | | | |
| 22. | a. | Depict a functional decomposition tree model for a bike fender /mudguard. | CO5 | An | 6 |
|  | b. | Describe the steps involved in a plastic recycling plant using a neat sketch. | CO5 | An | 6 |
|  | | | | | |
| 23. | a. | Explain in detail, the concept of FMEA and tabulate examples of the failures in mechanical engineering components. | CO6 | An | 6 |
|  | b. | How the FMEA methodology aims to accomplish the three important things. Describe the process and its uses. | CO6 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | List out five significant conceptual steps of the Product data specifications. Describe the implications involved in the following steps: (i) Social, political, and legal requirements (ii) Manufacturing Specifications. | CO6 | An | 6 |
|  | b. | Case Study: Explain the necessary steps involved in PDS for designing and manufacturing of a Compact Disc Jewel Case after the Problem Description and Need Identification is completed. | CO6 | An | 6 |

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **COURSE OUTCOMES** | | | | | | |
| CO1 | Explain various strategies and technologies adapted in industrial automation. | | | | | | |
| CO2 | Select appropriate evaluation methods used in the automation. | | | | | | |
| CO3 | Apply modern tools like AI, ANN and Fuzzy logic in the building of automation systems. | | | | | | |
| CO4 | Apply the concept of New Product Development and its structuring. | | | | | | |
| CO5 | Analyse the virtual product development. | | | | | | |
| CO6 | Develop new product development, product structure and supporting systems. | | | | | | |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / BL | | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | | **Total** |
| CO1 | | 2 | 3 | 12 |  |  |  | | 17 |
| CO2 | | 2 | 3 | 12 |  |  |  | | 17 |
| CO3 | | 2 | 3 | 12 |  |  |  | | 17 |
| CO4 | | 2 | 3 | 12 |  |  |  | | 17 |
| CO5 | | 1 | 3 |  | 24 |  |  | | 28 |
| CO6 | | 1 | 3 |  | 24 |  |  | | 28 |
|  | | 10 | 18 | 48 | 48 |  |  | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20ME2008** | **Duration** | **3 hrs** |
| **Course Name** | **APPLICATION OF MACHINE LEARNING FOR MECHANICAL ENGINEERING SYSTEMS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define Artificial Intelligence. | | CO1 | R | 1 |
| 2. | State the role of regression model. | | CO2 | R | 1 |
| 3. | Define regression. | | CO2 | R | 1 |
| 4. | Describe the term Linear regression. | | CO3 | U | 1 |
| 5. | Define the term splitting, used in decision tree. | | CO3 | R | 1 |
| 6. | Describe clustering. | | CO4 | U | 1 |
| 7. | Identify k in k-means algorithm. | | CO4 | U | 1 |
| 8. | Discuss on prediction with deep neural network. | | CO5 | U | 1 |
| 9. | Describe the importance of Long short-term memory. | | CO5 | U | 1 |
| 10. | Define prognostics. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Describe Data statistics. | | CO1 | R | 3 |
| 12. | Distinguish regression and classification. | | CO2 | U | 3 |
| 13. | Distinguish linear and logistic regression. | | CO3 | U | 3 |
| 14. | Discuss concept of K- Nearest Neighbours. | | CO4 | U | 3 |
| 15. | Distinguish AI and deep learning. | | CO5 | U | 3 |
| 16. | Discuss the types of maintenance carried out in machines. | | 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. | a. | Examine in detail on Problem Spaces and Search techniques. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain linear regression with an example. | CO2 | A | 6 |
|  | b. | Discuss the nearest neighbour with a neat sketch. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Examine logistic regression with suitable example. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain K mean clustering algorithm with an example. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Examine different types of deep neural networks. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Distinguish Classification and Regression. | CO2 | U | 6 |
|  | b. | Write short notes on Principal component analysis (PCA) | CO3 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Discuss K Nearest Neighbor algorithm. | CO4 | U | 6 |
|  | b. | Illustrate Convolutional Neural Network (CNN). | CO5 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the role of machine learning in prognostics and condition monitoring of rotary machines. | CO | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **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 analyze the models using unsupervised learning algorithms. |
| CO4 | Understand the basics of clustering and develop prediction model. |
| CO5 | Learn the fundamentals 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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 4 | - | 12 | - | - | - | 16 |
| CO2 | 2 | 15 | 6 | - | - | - | 23 |
| CO3 | 1 | 10 | 12 | - | - | - | 23 |
| CO4 | - | 11 | 12 | - | - | - | 23 |
| CO5 | - | 5 | 18 | - | - | - | 23 |
| CO6 | 1 | 3 | 12 | - | - | - | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20ME2009** | **Duration** | **3hrs** |
| **Course Name** | **INTELLIGENT ROBOTIC SYSTEM** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | "Robot" comes from the word called \_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO1 | U | 1 |
| 2. | Identify the part that is connected to the manipulator. | | CO1 | A | 1 |
| 3. | The Robot manipulator is designed to perform a task in\_\_\_\_\_\_\_\_ space. | | CO2 | A | 1 |
| 4. | Define SHAKEY. | | CO2 | R | 1 |
| 5. | The function of Navigation is to move the robot to a \_\_\_\_\_\_ location. | | CO3 | An | 1 |
| 6. | Agents interact with other agents via some kind of agent communication language known as \_\_\_\_\_\_\_\_. | | CO3 | A | 1 |
| 7. | Identify the number of principles involved in the hybrid architecture for the interfacing strategy. | | CO4 | A | 1 |
| 8. | List the few applications of the forward model. | | CO4 | An | 1 |
| 9. | The first computer orientation method to reduce the dimension of the unconstrained dynamic equation is\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO5 | U | 1 |
| 10. | Define the sizing of the DC motor. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Discuss any four robot components. | | CO1 | R | 3 |
| 12. | Illustrate the types of possible orientation angles for the Wrist motion. | | CO2 | U | 3 |
| 13. | Describe the Land-Based Navigation. | | CO3 | U | 3 |
| 14. | List some of the assumptions required in hybrid architecture. | | CO4 | R | 3 |
| 15. | Classify the types of model learning approaches. | | CO5 | U | 3 |
| 16. | List the robot kinematics with suitable examples. | | 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. |  | Illustrate Agent-Task Model with neat sketches and examples. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the robot manipulator kinematics with suitable sketches. | CO2 | R | 6 |
|  | b. | Outline "STRIPS" with suitable sketches. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain with neat sketches, the closed-loop feedback system for linear and non-linear control manipulators. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate the subsumption architecture with suitable examples. | CO4 | U | 6 |
|  | b. | Construct the detailed step-by-step procedural hybrid architecture for the Autonomous Robot Application. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. |  | List the model-based approaches and elaborate with neat sketches. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Construct the AVR Architecture in detail with suitable sketches. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Outline the Robot expressing behaviour with suitable sketches and examples. | CO4 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the following  1. Actuators.  2. Robot Locomotion.  3. Power supply.  4. Legged and Wheeled Locomotion. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Design, build and program simple autonomous robots. |
| **CO2** | Implement standard signal processing and control algorithms. |
| **CO3** | Describe and analyze robot processes using appropriate methods. |
| **CO4** | Solve simple control problems by hand using appropriate methods. |
| **CO5** | Write a detailed report on a robot project. |
| **CO6** | Carry out and write up investigation using appropriate experimental methods. |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 3 | 1 | 13 | 12 | - | - | 29 |
| **CO2** | 7 | 9 | 1 | - | - | - | 17 |
| **CO3** | - | 3 | 13 | 1 | - | - | 17 |
| **CO4** | 3 | 6 | 7 | 13 | - | - | 29 |
| **CO5** | - | 4 | - | 12 | - | - | 16 |
| **CO6** | 3 | 1 | - | 12 | - | - | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20ME2010** | **Duration** | **3hrs** |
| **Course Name** | **KINEMATICS AND DYNAMICS OF MACHINERY** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define inversion of a mechanism. | | CO1 | R | 1 |
| 2. | Indicate the number of degrees of freedom for a four bar mechanism. | | CO1 | U | 1 |
| 3. | The velocity at any point on a rigid link with respect to any other point on the same link is \_\_\_\_\_\_\_\_\_\_\_ to the link. | | CO2 | R | 1 |
| 4. | State an expression for length of the belt in case of cross belt drive. | | CO3 | R | 1 |
| 5. | Describe the phenomena of ‘creep’ in a belt drive. | | CO3 | U | 1 |
| 6. | Define the term dedendum in a gear. | | CO4 | R | 1 |
| 7. | Discuss about helical gear drives. | | CO4 | U | 1 |
| 8. | Describe the term ‘sensitiveness’ relating to a governor. | | CO5 | U | 1 |
| 9. | The engine of an aeroplane rotates in clockwise direction when seen from the tail end and the aeroplane takes a left turn. State the effect of the gyroscopic couple in the aeroplane. | | CO5 | R | 1 |
| 10. | Describe the term transverse vibration. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between completely constrained motion and incompletely constrained motion. | | CO1 | U | 3 |
| 12. | Illustrate how velocity of a slider is obtained in a slider crank mechanism. | | CO2 | U | 3 |
| 13. | List the advantages of fibre rope drives. | | CO3 | R | 3 |
| 14. | Discuss ‘epicyclic gear train’. | | CO4 | U | 3 |
| 15. | Compare radial and off-set follower. | | CO5 | U | 3 |
| 16. | A cantilever shaft 50 mm diameter and 300 mm long has a disc of mass  100 kg at its free end. The Young's modulus for the shaft material is 200 GN/m2. Determine the frequency of longitudinal vibrations of the shaft. | | 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. | Sketch and explain any two inversions of a double slider crank chain. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | The crank and connecting rod of a theoretical steam engine are 0.5 m and 2 m long respectively, as shown in the Fig. The crank makes 360 rpm. in the clockwise direction. When it has turned 45° from the inner dead centre position, evaluate: (i) velocity of piston, and (ii) angular velocity of connecting rod. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Two pulleys, one 450 mm diameter and the other 200 mm diameter are on parallel shafts 1.95 m apart and are connected by a crossed belt. Find the length of the belt required and the angle of contact between the belt and each pulley.  Calculate the power can be transmitted by the belt when the larger pulley rotates at 200 rev/min, if the maximum permissible tension in the belt is 1 kN, and the coefficient of friction between the belt and pulley is 0.25. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | The following data relate to a pair of 20° involute gears in mesh:  Module = 6 mm; Number of teeth on pinion = 17; Number of teeth on gear = 49; Addenda on pinion and gear wheel = 1 module.  Compute: (i) The number of pairs of teeth in contact; (ii) The angle turned through by the pinion when one pair of teeth is in contact. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | A ship propelled by a turbine rotor which has a mass of 5000 kg and a speed of 2100 r.p.m. The rotor has a radius of gyration of 0.5 m and rotates in a clockwise direction when viewed from the stern. Determine the gyroscopic couple and its effects in the following conditions:  (i) The ship sails at a speed of 30 km/h and steers to the left in a curve having 60 m radius.  (ii) The ship pitches 6 degree above and 6 degree below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | A Proell governor has equal arms of length 300 mm. The upper and lower ends of the arms are pivoted on the axis of the governor. The extension arms of the lower links are each 80 mm long and parallel to the axis when the radii of rotation of the balls are 150 mm and 200 mm. The mass of each ball is 10 kg and the mass of the central load is 100 kg. Evaluate the range of speed of the governor. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | An epicyclic gear train is arranged as shown in the fig. Estimate the number of  revolutions made by the arm, to which the pinions B and C are attached, when A makes one revolution clockwise and D makes half a revolution anticlockwise.  The number of teeth on gears A and D are 40 and 90 respectively. | CO4 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Four masses A, B, C and D as shown below are to be completely balanced.    The planes containing masses B and C are 300 mm apart. The angle between planes containing B and C is 90°. B and C make angles of 210° and 120° respectively with D in the same sense. Evaluate the magnitude and the angular position of mass A. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the basic concepts of Mechanisms, Machines and their relative motions, then apply it to appropriate environments. |
| **CO2** | Carry out kinematic analysis (Displacement, Velocity and Acceleration) of simple mechanisms (Single slider Crank Mechanism and four bar Mechanisms) by graphical and analytical method. |
| **CO3** | Construct & Design different CAM profiles for given conditions using graphical & Theoretical methods. |
| **CO4** | Apply the concept of balancing and use it for reducing the unbalanced forces in rotating masses and reciprocating engines under operating conditions exposure to IS standards. |
| **CO5** | Acquire knowledge on types of vibrations in different systems and damping methods to minimize vibrations. |
| **CO6** | Understand, apply and analyze the control mechanisms in Governors and Gyroscopes. |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 4 | 12 | - | - | - | 17 |
| **CO2** | 1 | 3 | - | 12 | - | - | 16 |
| **CO3** | 4 | 1 | 12 | - | - | - | 17 |
| **CO4** | 1 | 4 | 12 | 12 | - | - | 29 |
| **CO5** | 1 | 4 | 12 | 12 | - | - | 29 |
| **CO6** | 1 | - | 3 | 12 | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20ME2011** | **Duration** | **3hrs** |
| **Course Name** | **FINITE ELEMENT METHODS IN ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Discretization. | | CO1 | R | 1 |
| 2. | State the methods of engineering analysis. | | CO6 | R | 1 |
| 3. | Define aspect ratio. | | CO1 | R | 1 |
| 4. | List the functions of node. | | CO1 | R | 1 |
| 5. | Classify the types of boundary condition in FEA. | | CO3 | An | 1 |
| 6. | Write the application of FEA in nuclear engineering. | | CO6 | C | 1 |
| 7. | Write the purpose of Pascal’s Triangle. | | CO2 | A | 1 |
| 8. | What do you mean by scalar field problem? | | CO4 | A | 1 |
| 9. | Write the stages in finite element analysis according to computer implementations. | | CO6 | A | 1 |
| 10. | State the different modes of heat transfer. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Why are polynomial types of interpolation functions preferred over trigonometric functions? | | CO1 | U | 3 |
| 12. | Differentiate between r, p, and h versions of the finite element method. | | CO6 | An | 3 |
| 13. | Why linear triangular element is often called as constant strain triangular (CST) element? | | CO4 | U | 3 |
| 14. | Write the properties of shape function. | | CO2 | A | 3 |
| 15. | Differentiate between local, global, and natural coordinate systems. | | CO3 | An | 3 |
| 16. | Define plane strain analysis and specify an example for a plane strain problem. | | CO5 | 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. | a. | Explain the step-by-step procedure of finite element analysis. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | Evaluate the elongation, strain and stresses for the stepped bar shown in Figure 1. A1=2cm2; A2=1cm2 ; E1=E2=2x105N/mm2  (1)  (2)  100N  10cm  10cm  Figure 1 | CO5 | E | 12 |
|  |  |  |  |  |  |
| 19. | a. | The following differential equation is available for a physical phenomenon d2y /dx2 + 300 x2 = 0; 0 ≤ x ≤ 1;  Trial function is y = a(x – x4); Boundary conditions are y(0) = 0 and y(1)=0. Evaluate the value of parameter ‘a’ using the following methods:  a. Point collocation  b. Least square method  c. Subdomain method  d. Galerkin’s method | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. | a. | Determine three points on the 50oC contour line for the rectangular element shown in Figure 2. The nodal values are T1=42oC, T2= 54oC, T3= 56oC and T4= 46oC. Nodal coordinates are node1 (5,3), node2 (8,3), node 3(8,5) and node4 (5,5).    S  x  Y  2(8,3)  1(5,3)  3 (8,5)  4(5,5)  t                Figure. 2 | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. |  | For the smooth pipe of variable cross-section shown in Figure 3, determine the potential at the junctions, velocities in each section of the pipe and the volumetric flow rate. The potential at the left end is p1=10m and that at the right end is p4=2m. Permeability coefficient k=1m/s.  1 m  1 m  1 m  A1=3m2  A2=2m2  A3=1m2  1  2  3  4  Figure 3. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Develop the shape functions for 1D Quadratic element. | CO2 | C | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain serendipity element and establish the shape functions for any one serendipity family of element. | CO3 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Determine the temperature distribution in a one-dimensional fin of circular cross-section as shown in Figure 4. The fin is circular in shape, 8cm long and 1cm in diameter. Assume that convection heat loss occurs from the right end of the fin. (use 2 element idealization)  ;  L=8 cm  100°C  1 cm diameter      Figure 4. | CO5 | A | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Acquire the fundamental theory of finite element analysis and develop characteristic equation. |
| CO2 | Derive element matrix equation by applying basic laws in mechanics and integration by parts |
| CO3 | Apply suitable boundary conditions to a global equation for field problems |
| CO4 | Analyse scalar and vector variable problems |
| CO5 | Understand the application and use FE method for solving heat transfer, fluid mechanics and  structural problems |
| CO6 | Use professional level finite element software to solve engineering problems |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 3 | 3 | - | 12 | - | - | 18 |
| CO2 | - | - | 4 | - | - | 12 | 16 |
| CO3 | - | - | - | 16 | 12 | - | 28 |
| CO4 | 1 | 3 | - | - | 12 | - | 16 |
| CO5 | 4 | - | 24 | - | 12 | - | 40 |
| CO6 | 1 | - | 1 | 3 | - | 1 | 06 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **20ME2012** | **Duration** | **3hrs** |
| **Course Name** | **INTERNET OF THINGS FOR MECHANICAL SYSTEMS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | The ………….. consists of software, a big data engine, an application platform and a database. | | CO1 | U | 1 |
| 2. | After data is generated by sensors, it is transmitted between devices and to the cloud through -------------------- | | CO1 | R | 1 |
| 3. | Pooling of physical storage from multiple storage devices to appear as single device managed by single entity is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_ virtualization. | | CO2 | R | 1 |
| 4. | List four advantages of Industrial IoT. | | CO2 | R | 1 |
| 5. | Name any one-business application of predictive analysis. | | CO3 | U | 1 |
| 6. | ………….. is a piece of software that allows multiple VMs to run on a physical machine (PM). | | CO3 | R | 1 |
| 7. | Mention few challenges of IOT. | | CO4 | U | 1 |
| 8. | Define actuators and sensors. | | CO4 | R | 1 |
| 9. | Cite the need to have dynamic marketing. | | CO5 | U | 1 |
| 10. | Mention few Big Data Technologies. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | State virtualization. | | CO1 | An | 3 |
| 12. | Interpret the applications of ‘cloud’ in Internet of Things (IOT). | | CO2 | U | 3 |
| 13. | List the 4 types of visualization. | | CO3 | R | 3 |
| 14. | Cite the primary forms of value IoT 4 will generate in terms of manufacturing processes. | | CO4 | U | 3 |
| 15. | Enumerate the advantages of running on cloud rather than metal servers. | | CO5 | An | 3 |
| 16. | Assess few applications of Cyber Physical systems. | | 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. | a. | Illustrate the various processes involved in Internet of Things (IOT). | CO1 | An | 6 |
|  | b. | Justify the emergence of smart factories in the realm of industry 4.0. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. |  | Evaluate the predictive analysis and its evolution over the time. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 19. |  | Appraise the significance of ‘Additive Manufacturing’ in IOT enabled Manufacturing. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain the 5 V's of big data using real-world examples of big data technologies. Include examples for the four-domain big data classification as well. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Evaluate the applications of Robot in material handling in manufacturing and service industry. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Elaborate the Top 5 Most Popular IoT Devices in 2023. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | Discuss the various applications of Augmented Reality in Manufacturing. | CO3 | An | 6 |
|  | b. | Illustrate the four main abilities of a smart product. | CO2 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Elaborate on digital twin with suitable illustrations. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Interpret the Essentials of IoT for Modern Engineers. |
| **CO2** | Examine the importance of Smart and Digital Factories. |
| **CO3** | Make use of IoT in Manufacturing Process and Applications. |
| **CO4** | Model IoT for Cyber-Physical Systems, Virtual Reality and Data Analytics. |
| **CO5** | Interpret the IoT Challenges in Mechanical Systems. |
| **CO6** | Apply IoT concepts in various applications. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** |  | 1 |  | 15 |  |  | 16 |
| **CO2** |  | 3 |  | 12 |  |  | 15 |
| **CO3** | 4 | 1 |  | 18 | 12 |  | 35 |
| **CO4** |  |  | 4 | 12 |  |  | 16 |
| **CO5** |  |  | 15 | 12 |  |  | 27 |
| **CO6** |  | 3 |  | 12 |  |  | 15 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Identify the application of passive type sensor in various industrial applications. | | CO1 | An | 1 |
| 2. | Indicate the significance True Value in the sensor measurement system. | | CO1 | A | 1 |
| 3. | Define Magnetism. | | CO2 | U | 1 |
| 4. | Indicate the effect of attenuation in ultrasonic sensor. | | CO3 | A | 1 |
| 5. | Write any two velocity sensors used in automobiles. | | CO3 | R | 1 |
| 6. | Identify the mobile phone sensor that turns off the display when a user is holding the phone close to his face during a call to save battery life. | | CO6 | An | 1 |
| 7. | Define the term ‘Segmentation’ in machine vision system. | | CO4 | R | 1 |
| 8. | Indicate the materials used for the fabrication of Diaphragm using in pressure sensors. | | CO5 | A | 1 |
| 9. | Indicate the use of bellows in bellow pressure sensor. | | CO5 | U | 1 |
| 10. | List out any two advantages of SCADA in food industry. | | CO2 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Distinguish between Passive sensor and Active sensor with examples. | | CO1 | An | 3 |
| 12. | Articulate the principle of solenoid switch with neat sketch. | | CO2 | A | 3 |
| 13. | State the working principle of the magnetic proximity sensor and its applications. | | CO3 | R | 3 |
| 14. | Indicate the significance of Debye temperature in selection of sensor materials for high temperature applications. | | CO5 | A | 3 |
| 15. | Articulate the important functions of machine vision system in industrial robots. | | CO4 | U | 3 |
| 16. | List out the basic components of an automated sensor system. | | CO2 | 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. | a. | Illustrate the important characteristics of sensors used in mechanical systems. | CO1 | A | 8 |
|  | b. | Articulate the importance’s of Nano-electromechanical system (NEMS) and its applications. | CO1 | A | 4 |
|  |  |  |  |  |  |
| 18. | a. | Indicate the principle of ‘Inductance’ with neat sketch. | CO3 | U | 6 |
|  | b. | Illustrate the working procedure of Capacitance sensors with a neat sketch. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Describe the working principle of Ultrasonic sensor with neat sketch and its industrial applications. | CO6 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate the function of sensor used for detecting breathing rate of a sleeping child with neat line sketch. | CO6 | A | 8 |
|  | b. | Explain the working principle of capacitive touch sensor with neat sketch. | CO4 | A | 4 |
|  |  |  |  |  |  |
| 21. | a. | Describe the operating procedure of Hall effect sensor with neat sketch and its commercial applications. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Illustrate the operational procedure of charged-coupled device (CCD) with a neat sketch and highlights its commercial applications. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain the working principle of Thermocouples with a neat sketch and its applications in mechanical instrumentation. | CO5 | U | 8 |
|  | b. | Illustrate the principle of Piezoelectric sensor used for temperature measurement. | CO5 | A | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Articulate the various process control system used in modern food processing industries. | CO2 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **Course Outcomes** |
| CO1 | Recognize the concept of sensors and their characteristics. |
| CO2 | Summarize the practical approach in the 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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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | 19 | 4 | - | - | 23 |
| CO2 | 3 | 1 | 13 | - | - | - | 17 |
| CO3 | 4 | 18 | 2 | - | - | - | 24 |
| CO4 | 1 | 3 | 16 | - | - | - | 20 |
| CO5 | - | 9 | 10 | - | - | - | 19 |
| CO6 | - | 12 | 8 | 1 | - | - | 21 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **20ME2014** | **Duration** | **3hrs** |
| **Course Name** | **INDUSTRIAL SAFETY AND QUALITY STANDARDS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | OSHA stands as an acronym for------------------- | | CO1 | U | 1 |
| 2. | G Helmet are provided to safeguard from……… | | CO1 | R | 1 |
| 3. | In a 1-10, scale a hazard has severity 5, probability of occurrence 6, probability of detection or easiness to detect is 7. Find Risk Priority Number (RPN) | | CO2 | R | 1 |
| 4. | As per J.M.Juran, quality is------------ for use. | | CO2 | R | 1 |
| 5. | Range,------------- and--------------- are the measures of scatterness in a frequency distribution. | | CO3 | U | 1 |
| 6. | UCL stands for------------------- and LCL stands---------------- in quality control charts. | | CO3 | R | 1 |
| 7. | Infer the application of ‘Pullback devices’. | | CO4 | U | 1 |
| 8. | Define Precision. | | CO4 | R | 1 |
| 9. | Justify Process capability ratio for manufacturing industry. | | CO5 | U | 1 |
| 10. | …………………. is a systematic method by which organizations can measure themselves against the best industry practices | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Mention the fundamental purpose of National policy on safety. | | CO1 | R | 3 |
| 12. | List the three basic Areas to be safeguarded in an industrial layout. | | CO2 | U | 3 |
| 13. | Enumerate any three safety measures in electroplating industry. | | CO3 | An | 3 |
| 14. | Cite the various dimensions of service quality. | | CO4 | U | 3 |
| 15. | Summarize the objective and methodology of Six sigma quality control. | | CO5 | An | 3 |
| 16. | Infer statistical process control. | | 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. |  | Outline the objectives of safety management and the roles of different members in an organization. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | Analyze the various types of Guarding techniques in machining industries and list their advantages and limitations. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Classify Safety precautions to be adopted during arc welding and gas welding. | CO3 | A | 6 |
|  | b. | Examine the standard operating procedure to store and use the hazardous metals. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. |  | Analyze the various quality costs with respect to quality control. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Interpret the application of ‘Fault Tree Analysis’ in failure analysis. | CO5 | U | 6 |
|  | b. | Elaborate on the stages of risk priority assessment. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. |  | Evaluate the significance and application of ‘seven traditional tools of quality’ in quality control. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain Personnel protective equipment (PPE) with neat sketches. | CO3 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Appraise the role of ‘Quality Function Deployment (QFD)’ in quality assurance process. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Apply safety principles, protocols and Personnel protective equipments (PPE) to engineering processes |
| **CO2** | Assess risk in manufacturing processes in term of Risk Priority Number (RPN) ,manage and mitigate them |
| **CO3** | Apply quality principles and control charts to maintain quality of the processes and products |
| **CO4** | Appraise quality costs in products and minimize failure and reworks |
| **CO5** | Experimenting failure analysis thereby improve the production process and develop fool proof Manufacturing processes |
| **CO6** | Adapting Total Quality Management tools such as Quality function deployment, Benchmarking and Business process reengineering to realize quality standards |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 1 |  | 15 |  |  | 17 |
| **CO2** | 2 |  |  | 15 |  |  | 17 |
| **CO3** | 1 | 16 | 6 | 6 |  |  | 29 |
| **CO4** | 1 | 4 |  | 12 |  |  | 17 |
| **CO5** |  | 19 | 6 | 3 |  |  | 28 |
| **CO6** |  | 4 |  | 12 |  |  | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20ME2016** | **Duration** | **3hrs** |
| **Course Name** | **FLUID MECHANICS AND FLUID MACHINES** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define specific gravity of fluid. | | CO1 | R | 1 |
| 2. | Distinguish Real fluid and Ideal fluid. | | CO1 | U | 1 |
| 3. | Describe velocity potential function. | | CO2 | R | 1 |
| 4. | When fluid is at rest, the shear stress is equal to \_\_\_\_\_\_\_\_\_. | | CO2 | U | 1 |
| 5. | Discern free and forced vortex flow. | | CO3 | U | 1 |
| 6. | The application of pitot tube is to measure the ………………. | | CO3 | R | 1 |
| 7. | Name two assumptions made for deriving Bernoulli’s equation. | | CO4 | R | 1 |
| 8. | Give any two examples of fundamental dimensions. | | CO4 | U | 1 |
| 9. | Define Mach number. | | CO5 | U | 1 |
| 10. | Provide an example for reaction turbine. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Determine the surface tension in a soap bubble of 4cm diameter when the inside pressure is 2.5N/m2 above atmospheric pressure. | | CO1 | A | 3 |
| 12. | A pipe contains an oil of sp. gr 0.9. A differential manometer connected at the two points A and B shows a difference in mercury level as 15cm. Evaluate the pressure difference at the two points. | | CO2 | An | 3 |
| 13. | Sketch the stream lines represented by the stream function . Also find out the velocity and its direction at point (1, 2). | | CO3 | A | 3 |
| 14. | Draw the development of boundary layer over a flat plate. | | CO4 | U | 3 |
| 15. | Find the force exerted by a jet of water of diameter 75 mm on a stationary flat plate, when the jet strikes the plate normally with velocity of 20 m/s. | | CO5 | An | 3 |
| 16. | Define the terms: Hydraulic Machines, Turbines and Pumps. | | 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. | a. | A U-Tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limp of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limp. Determine the pressure of water in the main line, if the difference in the levels of mercury in the limps of U-tube is 10cm and the free surface of mercury is in level with the centre of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m2, calculate the new difference in the level of mercury. Sketch the arrangements in both cases. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | Derive the three dimensional continuity equation for steady flow using Eulerian approach. | CO2 | C | 6 |
|  | b. | An orifice meter with orifice diameter 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 co-efficient of discharge of the orifice meter is 0.64. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | A resisting force R of a supersonic plane during flight can be considered as depend upon the length of the aircraft l, velocity V, air viscosity µ, air density ρ and bulk modulus of air K. Express the functional relationship between these variables and the resisting force. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | The three differences in water surface level in two tanks, which are connected by three pipes in series of lengths 300m, 170 m and 210 m and of diameters 300 mm, 200 mm and 400 mm respectively, is 12 m. Determine the rate of flow of water if coefficient of friction are 0.005, 0.0052 and 0.0048 respectively, considering: (i) minor losses (ii) neglecting minor losses. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. | a. | Elucidate the working principle, operation of Pelton wheel in detail with neat sketch. | CO5 | A | 6 |
|  | b. | Estimate the forces exerted in x and y direction of plate by the jet strikes at one end tangentially when the plate is symmetrical. | CO5 | C | 6 |
|  |  |  |  |  |  |
| 22. | a. | A jet of water of diameter 7.5 cm strikes a curved plate at its centre with a velocity of 20 m/s. The curved plate is moving with a velocity of 8 m/s in the direction of jet. The jet is deflected through an angle of 165o. Assuming the plate smooth find.   1. Force exerted on the plate in the direction of jet 2. Power of the jet, and 3. Efficiency of the jet | CO5 | E | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain in detail about Pelton wheel with neat sketch. | CO6 | A | 6 |
|  | b. | Write short summary on Gross head, Net head and hydraulic efficiency | CO6 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Write short notes on Jet pump, Gear oil pump and Submersible pump. | CO6 | A | 12 |

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Recognize the important fluid properties and determine forces acting on immersed bodies. |
| CO2 | Solve fluid flow problems using Conservation principles. |
| CO3 | Analyze the characteristics of boundary layer and relationship between different physical quantities of fluid flow. |
| CO4 | Determine rate of flow and calculate flow losses through pipes. |
| CO5 | Evaluate the performance of pumps |
| CO6 | Evaluate the performance of turbines |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / BL | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 1 | 3 | 12 | - |  | 17 |
| CO2 | 1 | 1 | - | 9 | - | 6 | 17 |
| CO3 | 1 | 1 | 3 | 12 | - |  | 17 |
| CO4 | 1 | 4 | - | - | 12 |  | 17 |
| CO5 | - | 1 | 6 | 3 | 12 | 6 | 28 |
| CO6 | - | 4 | 24 | - | - |  | 28 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20ME2017** | **Duration** | **3hrs** |
| **Course Name** | **AUTOMOTIVE MATERIALS AND ELECTRONICS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | What are the primary forces driving change in materials selection and design? | | CO1 | R | 1 |
| 2. | How does the selection of materials impact marine applications? | | CO1 | U | 1 |
| 3. | What is the purpose of selection strategy in materials engineering? | | CO2 | U | 1 |
| 4. | How do manufacturing processes influence material selections choices? | | CO2 | U | 1 |
| 5. | Name the material typically used for piston rings in IC engines. | | CO3 | R | 1 |
| 6. | Name the primary material used for manufacturing gearbox casings in IC engines. | | CO3 | R | 1 |
| 7. | Define multiplexed wiring systems and their significance in modern vehicles. | | CO4 | R | 1 |
| 8. | How do electronic ignition systems differ from conventional ignition systems? | | CO4 | U | 1 |
| 9. | What is the purpose of vehicle condition monitoring? | | CO5 | R | 1 |
| 10. | Name one digital control technique used in engine management systems. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Discuss the advantages of using Ashby charts in the materials selection process and provide examples of their practical applications. | | CO1 | A | 3 |
| 12. | Analyze the importance of considering environmental factors in materials selection for automotive, aerospace, marine, and defense applications. | | CO2 | An | 3 |
| 13. | Explain why aluminum alloys are commonly used for pistons and describe the advantages they offer over other materials. | | CO3 | U | 3 |
| 14. | Describe the fundamental principles of ignition systems in internal combustion engines. | | CO4 | U | 3 |
| 15. | Differentiate between analog and digital visual displays, giving examples of each type. | | CO5 | U | 3 |
| 16. | How is artificial intelligence utilized in engine management? | | 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. | a. | Define the major classes of engineering materials and classify the different materials under each class. | CO1 | U | 6 |
|  | b. | Provide examples of materials from each class and discuss their key properties and typical applications. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Define materials properties and explain their significance in engineering applications. | CO1 | R | 6 |
|  | b. | Discuss the importance of understanding material properties for materials selection, design, and performance optimization. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain how material availability, recyclability, and environmental considerations impact material and process selection decisions. | CO2 | E | 6 |
|  | b. | Describe the role of materials selection in designing engine blocks and connecting rods for internal combustion engines, consider the factors such as strength, stiffness, and thermal stability. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Evaluate the impact of material selection on the performance, reliability, and service life of gears in internal combustion engines. | CO3 | E | 6 |
|  | b. | Explain how circuit diagrams and symbols are used to represent electrical components and connections in automotive systems, providing examples of commonly used symbols. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Compare and contrast petrol fuel injection and diesel fuel injection systems, highlighting their respective operating principles, fuel delivery methods, and control strategies. | CO4 | A | 6 |
|  | b. | Provide an overview of the types of sensors utilized in vehicles for monitoring parameters such as temperature, pressure, speed, and position. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Describe the function and operation of electric power steering systems in modern vehicles. Discuss the advantages of electric power steering over traditional hydraulic systems, including energy efficiency, responsiveness, and adaptability. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explore the role of digital control techniques in engine management systems, including electronic fuel injection, ignition timing control, and throttle-by-wire systems. | CO6 | C | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the operation of airbag and seat belt tensioner systems in vehicles, focusing on their role in occupant protection during collisions. Discuss advancements in airbag technology and the importance of seat belt pre-tensioners in reducing injury risk. | CO6 | A | 12 |
|  |  |  |  |  |  |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Familiar with different materials used for automotive component manufacturing. |
| **CO2** | Select proper material for Automobile applications. |
| **CO3** | Choose a suitable material for selected part of the engine components. |
| **CO4** | Know the working of electronic starting and ignition systems. |
| **CO5** | Use the instrumentations and electronic controls. |
| **CO6** | Understand the engine managements system, lighting and security systems. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 7 | 13 | 3 | 6 |  |  | 29 |
| **CO2** |  | 2 |  | 3 | 6 |  | 11 |
| **CO3** | 2 | 3 | 6 |  | 6 |  | 17 |
| **CO4** | 1 | 4 | 12 | 6 |  |  | 23 |
| **CO5** | 1 | 3 |  |  | 12 |  | 16 |
| **CO6** | 1 | 3 | 12 |  |  | 12 | 28 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20ME3001** | **Duration** | **3hrs** |
| **Course Name** | **ADDITIVE MANUFACTURING TECHNOLOGIES** | **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. | Define the term "Additive Manufacturing (AM)" and explain in detail about the basic AM systems. | CO1 | U | 12 |
|  | b. | Describe in detail about the Digital Prototyping. | CO1 | U | 8 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Illustrate the step-by-step process involved in preparing and executing SLA fabrication. | CO2 | A | 12 |
|  | b. | Contrast key strengths of SGC technology in terms of part quality, build speed, and material versatility, and infer advantages of SGC with other AM methods. | CO2 | An | 8 |
|  |  |  |  |  |  |
| 3. |  | Explain the core processes of Laser Engineered Net Shaping (LENS). Distinguish the LENS from other additive manufacturing techniques such as SLS or FDM. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Explain in detail about the different tooling methods and compare their manufacturing capabilities. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 5. |  | Compare the Building Valid and Invalid Tessellated Models with suitable examples. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Describe the Microfabrication. Illustrate with suitable figures any one Microfabrication Technique in detail. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 7. |  | Infer the following.   1. SLS 2. 3DP 3. LENS 4. 4. EBM | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Explain in detail the role of Rapid Prototyping in Finite Element Analysis (FEA), Computational Fluid Dynamics (CFD), and other engineering simulations for design validation and optimization. | CO6 | An | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Explain the steps involved in Customized Implants & Prosthesis fabrication using AM Process. | CO6 | C | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Describe the significance and importance of Additive manufacturing (AM) for product development and innovation. |
| CO2 | Demonstrate comprehensive knowledge of the broad range of AM processes, devices, capabilities and materials. |
| CO3 | Articulate the various trade-offs in selecting advanced/additive manufacturing processes, devices and materials to suit particular product requirements. |
| CO4 | Design a product and employ suitable AM process for value addition and reproduction of complex parts. |
| CO5 | Select a RP tool for multi-component object using advanced/additive manufacturing devices and processes. |
| CO6 | Apply the principles of Rapid tooling and develop a tool for various applications. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 20 | - | - | - | - | 20 |
| CO2 | - | - | 12 | 28 | - | - | 40 |
| CO3 | - | - | - | 40 | - | - | 40 |
| CO4 | - | - | - | 20 | - | - | 20 |
| CO5 | - | - | - | 20 | - | - | 20 |
| CO6 | - | - | - | 20 | - | 20 | 40 |
|  | | | | | | | **180** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20ME3009** | **Duration** | **3hrs** |
| **Course Name** | **NEW-AGE MATERIALS** | **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. | Explain the concept of smart materials and their role in engineering innovation. Also, differentiate between smart materials and traditional materials. | CO1 | A | 10 |
|  | b. | Analyze the application areas of smart materials in diverse industries such as aerospace, automotive, healthcare, and construction. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Classify smart materials based on their stimulus-response mechanisms. Explain each classification with relevant examples. | CO1 | An | 10 |
|  | b. | Explain the crystallographic arrangement of atoms within the Perovskite structure and its relevance to piezoelectric properties. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Analyze the utilization of piezoelectric materials in actuators. Describe the working principles of piezoelectric actuators and indicate their advantages, limitations, and applications in various fields | CO2 | An | 10 |
|  | b. | Evaluate the role of piezoelectric materials in energy-harvesting applications. | CO2 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the principles and mechanisms underlying the Shape Memory Effect and Superelastic Effect in Shape Memory Alloys. | CO4 | A | 10 |
|  | b. | Illustrate the industrial and medical applications of shape memory alloys. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the fabrication techniques for shape memory alloy foams. Indicate their major applications. | CO4 | A | 10 |
|  | b. | Compare the structural and electronic properties of carbon nanotubes (CNTs) and graphene. Indicate the unique characteristics of each material and their potential applications | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the underlying principles of MR effect and how the rheological properties of these materials can be controlled using magnetic fields. | CO3 | A | 10 |
|  | b. | Explain the thermochromic behavior of materials. Describe their applications in smart windows, temperature indicators, and clothing. | CO3 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Write about protein-based smart polymers and their applications in biotechnology and biomedicine. | CO5 | A | 10 |
|  | b. | Evaluate the use of smart polymers in drug delivery systems. Discuss how smart polymers can respond to external stimuli to release drugs in a controlled manner. | CO5 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Illustrate the importance of biocompatible materials in biomedical applications. Also, explain the criteria for determining the biocompatibility of materials and provide examples of biocompatible polymers used in medical implants. | CO5 | A | 10 |
|  | b. | Explain the principle of operation of Spark Plasma Sintering (SPS) process. Discuss the advantages of SPS over conventional sintering techniques. | CO3 | A | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the concept of self-healing materials and the mechanisms involved in their self-repairing capabilities. | CO6 | A | 10 |
|  | b. | Explain the principles behind smart corrosion protection coatings. Discuss the mechanisms employed by these coatings to detect and prevent corrosion. | CO6 | A | 10 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understanding of the physical principles underlying the behaviour of advanced and new-age materials. |
| CO2 | The basic principles and mechanisms of the stimuli-response for the most important smart materials. |
| CO3 | Propose improvement on the design, analysis and manufacturing of advanced and new-age materials. |
| CO4 | Command on Shape memory materials fabrication and shape memory effects. |
| CO5 | Smart polymers and new-age materials usage in space applications. |
| CO6 | Identifying the application issues involved in integrating advanced and new-age materials to engineering smart structures and products. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | 10 | 20 | - | - | 30 |
| CO2 | - | - | 10 | 10 | 10 | - | 30 |
| CO3 | - | - | 30 | 10 | - | - | 40 |
| CO4 | - | - | 20 | 10 | - | - | 30 |
| CO5 | - | - | 20 | - | 10 | - | 30 |
| CO6 | - | - | 20 | - | - | - | 20 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20ME3011** | **Duration** | **3hrs** |
| **Course Name** | **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 key components and operational principles of melting furnaces commonly employed in foundries in detail and describe the specific considerations that must be taken into account when melting non-ferrous metals like aluminum, copper, and zinc alloys. | CO1 | U | 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 | A | 20 |
|  |  |  |  |  |  |
| 3. |  | Explain various casting processes used for the manufacturing of alloys. | CO2 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the common casting defects that arises during casting of alloys and describe their causes and remedies. | CO2 | A | 10 |
|  | b. | Describe the inspection, and heat treatment methods applied in foundries to optimize the quality and performance of castings | CO2 | U | 10 |
|  |  |  |  |  |  |
| 5. |  | Explain the working principles of various rapid prototyping systems used in additive manufacturing. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the concept of resolution in light microscopy, including Airy rings, numerical aperture, magnification, and depth of field. | CO4 | An | 10 |
|  | b. | Describe the principles and applications of phase contrast microscopy, encompassing both bright-field and dark-field contrast techniques. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 7. |  | Describe the various applications of X-ray diffraction in materials science, including the estimation of grain size, particle size, macro texture, and residual stress in crystalline materials. | CO5 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Explain the principles, construction and operation of scanning electron microscopy (SEM). | CO6 | A | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Describe the principles, construction, and operation of transmission electron microscopy (TEM) and explain the significance of TEM in revealing microstructural details to define the properties of materials at the Nanoscale. | CO6 | U | 20 |

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

|  |  |
| --- | --- |
|  | **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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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 20 | 20 | - | - | - | 40 |
| CO2 |  | 30 | 10 |  |  |  | 40 |
| CO3 |  |  | 20 |  |  |  | 20 |
| CO4 |  | 10 |  | 10 |  |  | 20 |
| CO5 |  | 20 |  |  |  |  | 20 |
| CO6 |  | 20 | 20 |  |  |  | 40 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20ME3012** | **Duration** | **3hrs** |
| **Course Name** | **MATERIALS FRACTURE AND FAILURE ANALYSIS** | **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. | Explain the J integral quantifies the energy release rate at the crack tip and its influence on crack propagation behavior. | CO1 | An | 10 |
| b. | Estimate Griffith’s Crack Propagation theory. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Compare and contrast the crack-tip models by Irwin and Dugdale. | CO1 | E | 8 |
| b. | Summarize the derivation of an Irwin’s model. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 3. | a. | Apply the principle of Elastic-Plastic fracture Mechanics (EPFM) With suitable example. | CO2 | A | 14 |
| b. | Examine the critical strain energy release rate (G1C) in Linear Elastic Fracture Mechanics (LEFM). | CO2 | A | 6 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Employ the ASTM E399 standard test method used for fracture toughness evaluation in LEFM testing. | CO2 | A | 10 |
|  | b. | Illustrate LEFM and EPFM. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Estimate the role of microstructure in failure and the application of quantitative metallography. | CO3 | An | 14 |
|  | b. | Explain the temper and hydrogen embrittlement with suitable examples. | CO3 | An | 6 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Assess the interrelation between mechanical properties and metallurgical properties of materials, focusing on how variations in metallurgical composition affect mechanical behavior. | CO3 | E | 14 |
|  | b. | Estimate the role of grain size, secondary phase particles, grain boundary and segregation on the hardness and strength of a material. | CO3 | E | 6 |
|  |  |  |  |  |  |
| 7. | a. | Devise different types of fractures and discuss the models of nucleation and growth of cracks. | CO4 | C | 12 |
| b. | Express the deformation and the general approach for analysis of failure and describe fractography. | CO4 | C | 8 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Debate the different types of corrosion in materials and discuss the common corrosive environments in which materials are being used in day-to-day applications. | CO5 | E | 12 |
| b. | Evaluate the stress corrosion cracking (SCC) using time-to-failure (TTF) technique. Derive the SCC for crack growth. | CO5 | E | 8 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Deduce an empirical relation describing crack growth by fatigue and explain the life calculations for a given load amplitude. | CO6 | An | 12 |
| b. | Illustrate the fatigue failure analysis with suitable case study. | CO6 | An | 8 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
|  | After completing the course the student will be able to |
| CO1 | Understand the mechanics of failure under static loading. |
| CO2 | Apply the techniques of testing of LEFM and EPFM. |
| CO3 | Analyze the microstructural aspects of failure. |
| CO4 | Know the general approach to analysis of failure. |
| CO5 | Examine the environment assisted failures |
| CO6 | Evaluate the failure **analysis of fatigue fracture** |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | - | 20 | 20 | - | 40 |
| CO2 | - | - | 40 | - | - | - | 40 |
| CO3 | - | - | - | 20 | 20 | - | 40 |
| CO4 | - | - | - | - | - | 20 | 20 |
| CO5 | - | - | - | - | 20 | - | 20 |
| CO6 | - | - | - | 20 | - | - | 20 |
| Total | | | | | | | **180** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **21ME2002** | **Duration** | **3 hrs** |
| **Course Name** | **STRENGTH OF MATERIALS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define the term Young’s Modulus. | | CO1 | R | 1 |
| 2. | Define Bulk modulus. | | CO1 | R | 1 |
| 3. | Describe the sign convention for bending moment in beam. | | CO2 | U | 1 |
| 4. | Describe an overhanging beam. | | CO2 | U | 1 |
| 5. | Write the bending equation. | | CO3 | U | 1 |
| 6. | Define the term resilience. | | CO4 | R | 1 |
| 7. | Define the term polar modulus. | | CO4 | U | 1 |
| 8. | Name the stress acting on thin spherical shell. | | CO5 | U | 1 |
| 9. | Discuss about Macaulay’s method. | | CO5 | U | 1 |
| 10. | Define the term strut. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Define the terms Principal planes and principal stresses. | | CO1 | U | 3 |
| 12. | Sketch the shear force and bending moment diagrams for a cantilever beam of length L carrying a point load of W at the free end. | | CO2 | A | 3 |
| 13. | Discuss about section modulus for a hollow circular section. (Assume the parameters). | | CO3 | U | 3 |
| 14. | List the assumptions made in the theory of torsion. | | CO4 | R | 3 |
| 15. | A thin cylindrical shell of diameter 1.5 m is provided with hemispherical ends. It is subjected to an internal pressure of 2 N/mm2. Determine the thickness of the hemispherical part, if the permissible stress is 100 N/mm2. | | CO5 | A | 3 |
| 16. | Name the assumptions made in Euler’s column theory. | | 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. | a. | The following data refer to a tensile test conducted on a mild steel bar: (i) Diameter of the steel bar = 30 mm; (ii) Gauge length = 200 mm; (iii) Extension at a load of 100 kN = 0.139 mm; (iv) Load at elastic limit = 230 kN; (v) Maximum Load = 360 kN; (vi) Total extension = 56 mm; (vii) Diameter of rod at failure = 22.25 mm.  Determine: (a) Young’s Modulus; (b) Stress at elastic limit; and (c) Percentage elongation. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | A simply supported beam of span 4 m carries uniformly distributed load and point load as shown in the Fig. Draw the shear force and bending moment diagram of the beam. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Calculate the maximum stress induced in a cast iron pipe of external diameter 40 mm and internal diameter 20 mm and of length 4 m, when the pipe is supported at its ends and carries a point load of 80 N at its centre. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | A steel shaft transmits 105 kW at 160 rpm. If the shaft is 100 mm in diameter, find the torque on the shaft and the maximum shearing stress induced. Determine also the twist of the shaft in a length of 6 m. Take Modulus of Rigidity C = 8 x 104 N/mm2. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | A beam of length 6 m is simply supported at its ends and carries two point loads as shown in the Fig. Estimate the deflection of the beam under the 48 kN load (point C), using Macaulay’s method. Take E = 2 x 105 N/mm2 and I = 85 x 106 mm4. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | A 1.5 m long column has a circular cross-section of 50 mm diameter. One of the ends of the column is fixed and the other end is free. Taking factor of safety as 3, estimate the safe load using:   1. Rankine’s formula; take yield stress σc = 560 N/mm2 and α = for pinned ends. 2. Euler’s formula; Young’s modulus for CI = 1.2 x 105 N/mm2. | CO6 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | A tensile load of 60 kN is gradually applied to a circular bar of diameter 40 mm and length 5000 mm. If E = 2 x 105 N/mm2, determine: (i) stress in the rod, and; (ii) strain energy absorbed by the rod. | CO4 | A | 6 |
|  | b. | A vessel in the shape of a spherical shell of 1.2 m internal diameter and 12 mm shell thickness is subjected to an internal fluid pressure of 1.6 N/mm2. Determine the stress developed in the material of the vessel. | CO5 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Summarize and derive an expression for the Euler’s crippling load for a long column when both ends are hinged. | CO6 | An | 8 |
|  | b. | Calculate the safe compressive load on a hollow cast iron column (one end fixed and the other end is hinged) of 150 mm external diameter and 100 mm internal diameter and 10 m in length. Use Euler’s formula with a factor of safety of 5 and E = 95 kN/mm2. | CO6 | A | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Demonstrate fundamental knowledge about various types of loading and stresses induced. |
| CO2 | Draw the SFD and BMD for different types of loads and support conditions. |
| CO3 | Analyze the stresses induced in basic mechanical components. |
| CO4 | Estimate the strain energy in mechanical elements. |
| CO5 | Analyze the deflection in beams. |
| CO6 | Evaluate buckling and bending phenomenon in columns, struts and beams. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 3 | 12 | - | - | - | 17 |
| CO2 | - | 2 | 3 | 12 | - | - | 17 |
| CO3 | - | 4 | 12 | - | - | - | 16 |
| CO4 | 4 | 1 | 18 | - | - | - | 23 |
| CO5 | - | 2 | 9 | 12 | - | - | 23 |
| CO6 | 4 | - | 4 | 20 | - | - | 28 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **21ME2003** | **Duration** | **3hrs** |
| **Course Name** | **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. | Name the theory of failure suitable for the design of brittle materials. | | CO2 | R | 1 |
| 3. | Define eccentric load. | | CO1 | R | 1 |
| 4. | List the type of stresses induced in shafts. | | CO2 | R | 1 |
| 5. | Write the different type of loads that can act on machine components. | | CO2 | U | 1 |
| 6. | Define factor of safety. | | CO1 | R | 1 |
| 7. | Justify the reason for using flange coupling. | | CO3 | E | 1 |
| 8. | Define Soderberg line. | | CO4 | R | 1 |
| 9. | Write the difference between coupling and a clutch. | | CO3 | U | 1 |
| 10. | Name the possible modes of failure in riveted joint. | | CO3 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List the factors affecting endurance strength. | | CO2 | R | 3 |
| 12. | Distinguish between brittle fracture and ductile fracture. | | CO2 | U | 3 |
| 13. | Distinguish clearly, giving examples between axle and shaft. | | CO3 | U | 3 |
| 14. | List the methods used to reduce stress concentration. | | CO4 | R | 3 |
| 15. | Write the factors to be considered in the selection of materials for a machine element. | | CO1 | U | 3 |
| 16. | Write the function of rebound clips in a leaf spring. | | CO5 | 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. |  | Figure1  A mild steel bracket as shown in Figure1 is subjected to a pull of 6000N acting at 45˚ to its horizontal axis. The bracket has a rectangular section whose depth is twice the thickness. Estimate the cross-sectional dimensions of the bracket, if the permissible stress in the materials of the bracket is limited to 60 MPa. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | A mild steel shaft is subjected to 3500 N-m of bending moment at its critical point and transmits a torque of 2500 N-m. The shaft is made of steel having yield strength of 231 MPa. Estimate the size of the shaft based on various theories of failure and specify the final size. Take factor of safety as 2 and Poisson's ratio as 0.3. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | A bar of circular cross-section is subjected to alternating tensile forces varying from a minimum of 200 kN to a maximum of 500 kN. It is to be manufactured of a material with an ultimate tensile strength of 900 MPa and an endurance limit of 700 MPa. Determine the diameter of bar using safety factors of 3.5 related to ultimate tensile strength and 4 related to endurance limit and a stress concentration factor of 1.65 for fatigue load. Use Goodman straight line as basis for design. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | A hollow shaft of 0.5m outside diameter and 0.3m inside diameter is used to drive a propeller of a marine vessel. The shaft is mounted on bearings 6m apart and it transmits 5600 kW at 150 rpm. The maximum axial propeller thrust is 500 kN and the shaft weighs 70 kN. Evaluate   1. The maximum shear stress developed in the shaft. 2. Angular twist between the bearings. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. |  | Design a helical compression spring to sustain an axial load of 3 KN. The deflection is 60 mm. Spring index is 6. The shear stress is not to exceed 300 MPa. Modulus of rigidity for spring material is 81 GPa. | CO5 | C | 12 |
|  |  |  |  |  |  |
| 22. |  | Design a muff coupling which is used to connect two steel shafts transmitting 40 kW at 350 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. | CO4 | C | 12 |
|  |  |  |  |  |  |
| 23. |  | A semi-elliptical spring has an overall length of 1.1 m and sustains a load of 70 kN at its centre. The spring has 3 extra full length leaves and 13 graduated leaves with a central band of 100 mm wide. All the leaves are to be stressed equally without exceeding 420 N/mm2 when fully loaded. The total depth of the spring is twice the width. If the young’s modulus is 2.1x105 N/mm2 , determine the following   1. The thickness and width of leaves 2. The nip to be provided for pre-stressing 3. The load exerted on the clipping bolts after the spring is assembled. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Design a knuckle joint for transmitting an axial load of 30 kN. The allowable stresses are 80 N/mm2 in tension, 120 N/mm2 in crushing and 60 N/mm2 in shear. | CO6 | C | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the standard design procedure for design of machine elements |
| **CO2** | Analyze stresses acting on components and determine the size based on theories of failure |
| **CO3** | Design machine components for a given load condition using design data hand book |
| **CO4** | Decide specifications as per standards given in design data and select standard components to improve interchangeability. |
| **CO5** | Design and develop non- standard machine components |
| **CO6** | Prepare a detail design layout, drawing and computer coding of machine elements |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 4 | 12 |  |  |  | 18 |
| **CO2** | 5 | 4 |  | 12 |  |  | 21 |
| **CO3** | 1 | 4 | 12 |  | 1 |  | 18 |
| **CO4** | 4 |  |  |  | 12 | 12 | 28 |
| **CO5** |  | 3 | 12 |  |  | 12 | 27 |
| **CO6** |  |  |  |  |  | 12 | 12 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **21ME2006** | **Duration** | **3hrs** |
| **Course Name** | **HEAT AND MASS TRANSFER** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Lumped system analysis of transient heat conduction is applicable when Biot number is \_\_\_\_\_\_\_\_\_\_. | | CO1 | U | 1 |
| 2. | Fin effectiveness is generally \_\_\_\_\_\_\_\_\_\_\_\_ than one. | | CO1 | U | 1 |
| 3. | In a flow over a flat plate the Reynolds Number is 25000 and Prandtl number is 0.75. Calculate the average Nusselt number. | | CO2 | A | 1 |
| 4. | Rayleigh number is a product of \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_ . | | CO2 | R | 1 |
| 5. | Write the expression for emissive power. | | CO3 | R | 1 |
| 6. | Radiation shield should have \_\_\_\_\_\_\_\_\_\_\_\_ reflectivity. | | CO3 | U | 1 |
| 7. | LMTD in case of condenser will \_\_\_\_\_\_\_ for counter and parallel flow heat exchanger. | | CO4 | U | 1 |
| 8. | Effectiveness of a heat exchanger is \_\_\_\_\_\_\_\_\_\_\_. | | CO4 | R | 1 |
| 9. | In pool boiling, as soon as the temperature of heating surface reaches the boiling point of the liquid, heat transfer takes place by \_\_\_\_\_\_\_\_ mode. | | CO5 | U | 1 |
| 10. | List the various modes of mass transfer. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | List the different modes of heat transfer. | | CO1 | R | 3 |
| 12. | Air at 200C blows over a hot plate of 50 x 60 cm made of carbon steel maintained at 2200C. The convective heat transfer coefficient is 25 W/m2K. Determine the heat loss from the plate. | | CO2 | A | 3 |
| 13. | Calculate the view factor F1-2 and F2-1 for the sphere of diameter D inside a cubical box of length D. | | CO3 | A | 3 |
| 14. | Write the relation for overall heat transfer coefficient in heat exchanger with fouling factor. | | CO4 | R | 3 |
| 15. | Distinguish pool boiling and forced convection boiling. | | CO5 | U | 3 |
| 16. | State Fick’s law of diffusion. | | 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. |  | A steam pipe, 10cm I.D and 11cm O.D., is covered with an insulating substance (k=1 W/mK). The steam temperature and the ambient temperatures are 2000C and 200C, respectively. If the convective heat transfer coefficient between the insulation surface and air is 8 W/m2K, find the critical radius of insulation. For this value of r0, calculate the heat loss per metre of pipe and the outer surface temperature. Neglect resistance of the pipe material | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | An aluminium sphere weighing 5.5 kg and initially at a temperature of 2900C is suddenly immersed in a fluid at 150C. The convective heat transfer coefficient is 58 W/m2K. Estimate the time required to cool the aluminium to 950C, Using the lumped capacity method of analysis. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Air stream at 270C moving at 0.3 m/s across 100 W incandescent bulb, glowing at 1230C. If the bulb is approximated by a 60 mm diameter sphere, estimate the heat transfer rate. | CO2 | A | 6 |
|  | b. | Water at 500 C enters a 1.5 cm diameter and 3 m long tube with a velocity of 1 m/s. The tube wall is maintained at a constant temperature of 900C. Calculate the heat transfer coefficient and the total amount of heat transferred if the exit water temperature is 640C. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 20. |  | State Buckingham’s π theorem. Explain the various parameters used in natural convection. Using dimensional analysis show that Nu=φ(Gr,Pr). | CO2 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Two large parallel plates at temperature 1000 K and 600 K have emissivity of 0.5 and 0.8 respectively. A radiation shield having emissivity 0.1 on one side and 0.05 on the other side is placed between the plates. Calculate the heat transfer rate by radiation per square metre with and without radiation shield. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | A chemical having specific heat of 3.5 kJ/kgK flowing at the rate of 15000 kg/h enters a parallel flow heat exchanger at 120oC. The flow rate of cooling water is 40000 kg/h with an inlet temperature of 20oC. The heat transfer area is 12m2 and the overall heat transfer coefficient is 1000 W/m2 K. Find (a) the effectiveness of the heat exchanger (b) the outlet temperature of water and chemical. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain the various regimes in pool boiling heat transfer with neat sketches. | CO5 | R | 6 |
|  | b. | Saturated steam at 900C and 70 kPa is condensed on outer surface of a 1.5 m long 2.5 m diameter vertical tube maintained at uniform temperature of 700C. Assuming film wise condensation, calculate the heat transfer rate on the tube surface. | CO5 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Define mass concentration, molar concentration and mass fraction. | CO6 | R | 4 |
|  | b. | Pressurized hydrogen gas is stored at 358 K in a 4.8 m outer diameter spherical container made of nickel. The shell of the container is 6 cm thick. The molar concentration of hydrogen in the nickel at the inner surface is determined to be 0.087 kmol/m3. The concentration of hydrogen in the nickel at the outer surface is negligible. Determine the mass flow rate of hydrogen by diffusion through the nickel container. | CO6 | A | 8 |

**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 conduction heat transfer. |
| CO2 | Apply mathematical knowledge to predict the properties and characteristics of a fluid |
| CO3 | Evaluate radiation heat transfer between black, gray surfaces and the surroundings |
| CO4 | Design heat exchangers and also estimate the pressure drop and pumping power. |
| CO5 | Apply boiling and condensation correlations to two phase flow processes. |
| CO6 | Estimate the mass transfer by applying suitable correlations. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 3 | 2 | 12 | 12 | - | - | 29 |
| CO2 | 1 | - | 28 | - | - | - | 29 |
| CO3 | 1 | 1 | 15 | - | - | - | 17 |
| CO4 | 4 | 1 | 12 | - | - | - | 17 |
| CO5 | 6 | 4 | 6 | - | - | - | 16 |
| CO6 | 8 | - | 8 | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **21ME2007** | **Duration** | **3hrs** |
| **Course Name** | **COMPUTATIONAL FLUID DYNAMICS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define curl and write its significance. | | CO1 | U | 1 |
| 2. | Write the principle of conservation of mass. | | CO1 | A | 1 |
| 3. | Differentiate between uniform and non-uniform grids. | | CO2 | An | 1 |
| 4. | Write the importance of ‘Grid independence test’. | | CO2 | A | 1 |
| 5. | Define the term “Truncation error”? | | CO3 | R | 1 |
| 6. | Write the general discretized form of equation at node in 1 D diffusion problem. | | CO3 | A | 1 |
| 7. | Define ‘Peclet number’. | | CO4 | R | 1 |
| 8. | Differentiate between convection and diffusion process. | | CO4 | A | 1 |
| 9. | Identify the importance of choosing boundary conditions in CFD. | | CO5 | U | 1 |
| 10. | Write the condition to use continuity equation as transport equation for density. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain the two principal categories of physical behavior of flows. | | CO1 | A | 3 |
| 12. | Write the importance ‘adaptive mesh’. | | CO2 | A | 3 |
| 13. | Determine the expression for second derivative using the Taylor series. | | CO3 | A | 3 |
| 14. | Compare upwind and central differencing schemes. | | CO4 | An | 3 |
| 15. | Identify the common types of boundary conditions used in CFD. | | CO5 | A | 3 |
| 16. | Write the expression for pressure gradient for u-cell control volume in staggered grid? | | 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. | Explain the importance of energy equation and derive the equation for 3D flows. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain different types of grids used in CFD with a neat sketch. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Derive the discretized form of equation for 3D steady diffusion problem. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | A property φ is transported by means of convection and diffusion through a one-dimensional domain. Consider the case to be steady one-dimensional convection diffusion, with boundary conditions as φ0 = 1at x = 0 and φL = 0 at x = L. Using five equally spaced cells and the central difference scheme for convection and diffusion, calculate the distribution of φ as a function of x. Apply the following data: u=0.1 m/s, L= 1 m, Γ= 0.1 kg/m/s, ρ= 1 kg/m3 | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain how the following boundary conditions are implemented.  1. Inlet boundary condition  2. Symmetry boundary condition  3. Wall boundary conditions | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Derive the x-momentum equation from the fundamentals of thermodynamics. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Derive the discretized equation for convection diffusion using central difference scheme. | CO4 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain SIMPLE algorithm and derive the equation for pressure correction. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Formulate the required governing equations for flow and heat transfer problems. |
| CO2 | Identify suitable grids for computing |
| CO3 | Discretize the governing equations of flow and heat transfer problems |
| CO4 | Solve the diffusion equations |
| CO5 | Develop a suitable finite volume method for the convection diffusion problems |
| CO6 | Use appropriate algorithms to solve the discretized equations. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 1 | 16 | 12 |  |  | 29 |
| CO2 |  |  | 16 | 1 |  |  | 17 |
| CO3 | 1 |  | 4 | 12 |  |  | 17 |
| CO4 | 1 |  | 13 | 15 |  |  | 29 |
| CO5 |  | 1 | 3 | 12 |  |  | 16 |
| CO6 |  |  | 1 | 15 |  |  | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **21ME2008** | **Duration** | **3hrs** |
| **Course Name** | **BIOMECHANICS AND BIOMATERIALS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define the term Arthrokinematics. | | CO1 | R | 1 |
| 2. | Infer the purpose of studying biomechanics. | | CO1 | U | 1 |
| 3. | Review the functions of the Elbow. | | CO2 | U | 1 |
| 4. | Name the parts for the following pelvis and hip joint shown in Figure. B(2.b).    **Figure. B(2.b)** | | CO2 | R | 1 |
| 5. | State the Newton’s second law of motion. | | CO3 | R | 1 |
| 6. | Describe the work done by a constant force. | | CO3 | U | 1 |
| 7. | Define the biomaterials according to Clemson University advisory Board for Biomaterials. | | CO4 | R | 1 |
| 8. | Discuss Host response with respect to the foreign material in the human body. | | CO4 | U | 1 |
| 9. | Illustrate the surface modification. | | CO5 | U | 1 |
| 10. | Discuss briefly about the Biosensors. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Infer the impact and coefficient of restitution. | | CO1 | A | 3 |
| 12. | Two children sit on opposite sides of a playground seesaw as shown in Figure. B.1. If Joey, weighing 200 N, is 1.5 m from the seesaw’s axis of rotation, and Susie, weighing 190 N, is 1.6 m from the axis of rotation, predict the end of the seesaw that will drop.    Figure. B.1 | | CO2 | E | 3 |
| 13. | Devise the procedure for problem solving in kinetics, | | CO3 | An | 3 |
| 14. | Survey the evolution of biomaterial in science and technology. | | CO4 | An | 3 |
| 15. | Interpret the importance of Nano bio materials. | | CO5 | A | 3 |
| 16. | Examine the Cardiovascular Applications of biomaterials, | | 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. | Calculate the value of P in the system shown figure C.1, to cause the motion of 500N block to the right side. Assume the pulley is smooth and the coefficient of friction between either contact surfaces is 0.2.    **Figure. C.1.** | CO1 | An | 6 |
| b. | State the three laws of mechanics introduced by Sir Isaac Newton. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Appraise the numbering and labeling the human frame model. | CO2 | An | 4 |
| b. | During walking and running, we momentarily put all of our body weight on one leg (the right leg in Figure.C.2). The forces acting on the leg carrying the total body weight are also shown in the same figure for a single-leg stance. Estimate the force exerted by the hip abductor muscles and the joint reaction force at the hip to support the leg and the hip in the position shown. Let the weight of the leg are measured in terms of the person’s height h =173cm and total weight W = 600N as follows: a = 0:05h, b = 0:20h, c = 0:52 h, α = 45, β = 80, θ = 70; and W1 = 0:17W.    **Figure. C.2.** | CO2 | E | 8 |
|  |  |  |  |  |  |
| 19. | a. | As shown in figure.C.3, consider a 9 kg object initially rested at position (1), which is measured at distance h above the ground. The object falls with a constant gravitational acceleration of g = 9.8 m/s2 and after t2 = 2.5 s hits the ground at position (2). If the air resistance is negligible, determine:   1. The speed V2 of the object at position (2). 2. The vertical distance h between positions (1) and (2). 3. The potential energy EP1 of the object at position (1). 4. The kinetic energy EK2 of the object at position (2).     **Figure. C.3.** | CO3 | E | 6 |
| b. | Analyze the kinematics of spine with principal planes. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the impact of biomaterials. | CO4 | A | 6 |
| b. | Illustrate the few of construction materials with their merits and demerits. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Construct the Human Anatomy and discuss various parts. | CO3 | A | 6 |
| b. | Compare and contrast various polymer based biomaterials. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Classify various metallic biomaterials with their merits and demerits. | CO5 | An | 6 |
| b. | Categorize different ceramic biomaterials with their pros and cons. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the Dental Implants and their construction details. | CO6 | A | 6 |
| b. | Describe the relevance of Bio electrodes in biomedical instrumentation. | CO6 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Compute the implant and device failures. | CO6 | A | 6 |
| b. | Interpret the biomedical sensors. | CO6 | A | 6 |

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

|  |  |
| --- | --- |
| **COURSE OUTCOMES** | |
|  | The student will be able to |
| **CO1** | Understand the applicability of statics to biomechanics. |
| **CO2** | Apply the principles of kinematics dynamics to biomechanics. |
| **CO3** | Apprehend the mechanical properties of biological tissues. |
| **CO4** | Know different types of biomaterials available in the market. |
| **CO5** | Choose appropriate biocompatible materials for medical use. |
| **CO6** | Recognize the practical aspects of biomaterials for various implants |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 1 | 9 | 6 | - | - | 17 |
| **CO2** | 1 | 1 |  | 6 | 9 | - | 17 |
| **CO3** | 1 | 1 | 6 | 9 | 6 | - | 23 |
| **CO4** | 1 | 1 | 6 | 15 | - | - | 23 |
| **CO5** | - | 1 | 3 | 12 | - | - | 16 |
| **CO6** | - | 1 | 27 | - | - | - | 28 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **21ME3015** | **Duration** | **3 Hrs.** |
| **Course Name** | **ERGONOMICS IN BIO-MEDICAL INSTRUMENTATION** | **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. | Explain the significance of the skeletal system in human anatomy and its role in providing structural support and protection. Provide examples to illustrate its importance. | CO1 | A | 10 |
|  | b. | Assess the role of sensory abilities and motor skills in ergonomic design. Explain how understanding these capabilities influences the design of products. | CO1 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Analyze the importance of designing specialized products tailored to the anthropometric differences between men and women. | CO1 | An | 10 |
|  | b. | Analyze the challenges and innovations in the development of prosthetic devices for restoring mobility and function in individuals with joint disorders or injuries. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Analyze the biostatic mechanics of the musculoskeletal system, with a focus on the statics of the upper extremity and hand. | CO2 | An | 10 |
|  | b. | Explain the biomechanics of human body kinetics, emphasizing the forces, torques, and moments involved in movement production and control. | CO2 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the electrobiophysics of muscle fibers, including the mechanisms underlying muscle contraction and electrical activity. | CO3 | A | 10 |
|  | b. | Evaluate the role of stabilimeters and instrumented shoes in measuring foot force distribution and gait analysis. | CO3 | E | 10 |
|  |  |  |  |  |  |
| 5. | a. | Analyze the working principle and applications of Electrocardiography (ECG). | CO3 | An | 10 |
|  | b. | Illustrate the principles of biomagnetism and the generation of bio-magnetic fields in living organisms. Discuss the applications of induction coil measurements. | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Evaluate different types of microelectrodes and suction electrodes utilized in bioelectric signal recording. | CO4 | E | 10 |
|  | b. | Analyze the challenges posed by magnetic noise in biomagnetic measurements and the importance of shielding techniques. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain the principles behind direct pressure measurement methods, focusing on catheters and diaphragm-type pressure sensors. | CO5 | A | 10 |
|  | b. | Analyze the design considerations, materials, and biocompatibility issues associated with implantable pressure sensors, and their potential benefits in long-term monitoring. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the pressure measurements in small vessels, such as arteries and capillaries. Illustrate the challenges and techniques involved in measuring pressure in small vessels. | CO5 | A | 10 |
|  | b. | Explain pressure measurement techniques applicable to collapsible vessels and interstitial spaces. | CO5 | A | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the oscillometric method for measuring mean blood pressure. | CO6 | A | 10 |
|  | b. | Illustrate the working principle of Doppler ultrasound technique in indirect pressure measurements and its application in assessing blood flow velocity, and blood pressure. | CO6 | A | 10 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Apply the principles of anthropometry for designing for special population. |
| CO2 | Determine bio-static and bio-dynamics of human body. |
| CO3 | Measure bio-electrical and bio-electronic signals. |
| CO4 | Analyze of electrostatics of bio-magnetic signals. |
| CO5 | Evaluate direct muscle force measurements. |
| CO6 | Estimate indirect muscle force measurements. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | 10 | 10 | 10 | - | 30 |
| CO2 | - | - | 10 | 20 | - | - | 30 |
| CO3 | - | - | 10 | 10 | 10 | - | 30 |
| CO4 | - | - | - | 20 | 10 | - | 30 |
| CO5 | - | - | 30 | 10 | - | - | 40 |
| CO6 | - | - | 20 | - | - | - | 20 |
|  | | | | | | | **180** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **21ME3016** | **Duration** | **3hrs** |
| **Course Name** | **MICROCONTROLLERS FOR SENSOR CONTROL AND INTERFACES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A(4 X 20= 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Describe the functional details or modes of ADC and DACs. | CO1 | An | 10 |
|  | b. | Discuss in detail the generation of audio waves. | CO1 | C | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Illustrate the working of strain gauge with Wheatstone bridge with neat diagram. | CO2 | U | 10 |
|  | b. | Illustrate the sensor electronic interface with a block diagram. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Define the following: micro controller, PWM signal generator, white noise generation, single shot timer and continuous timers. | CO3 | R | 10 |
|  | b. | Describe the input capture mode and output compare modes. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Design UART communication using interrupt and DMA methods. | CO4 | E | 10 |
|  | b. | Discuss briefly on the sensor interfacing and signal conditioning. | CO4 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Illustrate the functions of architecture of PIC controller with a neat diagram. | CO5 | U | 10 |
|  | b. | Describe ARM 32 bit microcontroller with a neat diagram. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Discuss in detail the working principle of stepper motor and its control. | CO5 | C | 20 |
| 7. |  | Discuss briefly on the hardware interfacing techniques – Serial Communication, RTC and EEPROM interface. | CO6 | C | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Elaborate on the serial-port and timer programming modes. | CO6 | C | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Elaborate the working principle of the following with neat diagrams:   1. Relay 2. DC Motor | CO6 | E | 20 |

CO – COURSE OUTCOME BL – BLOOMS’ LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
|  | The student will be able to |
| CO1 | Analyze ADC and DAC modules. |
| CO2 | Familiarize the interfacing with instrument amplifiers. |
| CO3 | Know the micro controller I/O port and its peripherals. |
| CO4 | Knowledge on communication modes. |
| CO5 | Knowledge on latest micro controllers. |
| CO6 | Create an embedded system for a particular application. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | - | - | 10 | - | 10 | 20 |
| CO2 | - | 20 | - | - | - | - | 20 |
| CO3 | 10 | - | - | 10 | - | - | 20 |
| CO4 | - | - | 10 | - | 10 | - | 20 |
| CO5 | - | 10 | - | 10 | - | 20 | 40 |
| CO6 | - | - | - | - | 20 | 40 | 60 |
|  | | | | | | | **180** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **21ME3017** | **Duration** | **3hrs** |
| **Course Name** | **DIGITAL MANUFACTURING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Examine the role of digital manufacturing technologies in enhancing each stage of the product lifecycle management (PLM) process with neat sketch. | CO1 | An | 16 |
|  |  |  |  |  |  |
| 2. | a. | Inspect the architectural components of a Digital Manufacturing System (DMS) and their elements such as cyber-physical systems, Industrial Internet of Things (IIoT) devices, cloud computing infrastructure, and data analytics platforms collaborate to enable real-time monitoring, control, and optimization of manufacturing processes. | CO2 | An | 16 |
|  |  |  |  |  |  |
| 3. | a. | Explain the concept of virtual prototyping and its role in the product development process and also discuss how virtual prototyping facilitates design validation, optimization, and collaboration among cross-functional teams. | CO3 | U | 16 |
|  |  |  |  |  |  |
| 4. | a. | Discuss the concept of intelligent multi-information sensing and fusion in digital manufacturing systems with their benefits and challenges of multi-information sensing and fusion in improving manufacturing efficiency and quality. | CO4 | An | 16 |
|  |  |  |  |  |  |
| 5. | a. | Elucidate the technologies of Radio-Frequency Identification, QR codes, and barcode systems for product identification, tracking, and traceability throughout the manufacturing process with neat sketch. | CO5 | U | 16 |
|  |  |  |  |  |  |
| 6. | a. | Describe a comprehensive implementation strategy for integrating Digital Twin technology into an existing manufacturing facility. | CO1 | C | 16 |
|  |  |  |  |  |  |
| 7. | a. | Discuss the concept of 4D printing and its potential impact on digital manufacturing. Also explore applications of 4D printing in fields such as architecture, biomedical engineering, and consumer products. | CO6 | An | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Illuminate the fused deposition modeling technologies involved in direct digital manufacturing with neat sketch. Provide examples of products manufactured using DDM technology. | CO6 | U | 20 |

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Learn the Design processes and methods in product development. |
| CO2 | Get a basic knowledge on the importance of digital manufacturing. |
| CO3 | Understand the digital transformation in manufacturing. |
| CO4 | Implement decision knowledge in manufacturing. |
| CO5 | Integrate the digital technologies in product life cycle. |
| CO6 | Know the additive manufacturing technologies used in digital manufacturing. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | - | 16 | - | 16 | 32 |
| CO2 | - | - | - | 16 | - | - | 16 |
| CO3 | - | 16 | - | - | - | - | 16 |
| CO4 | - | - | - | 16 | - | - | 16 |
| CO5 | - | 16 | - | - | - | - | 16 |
| CO6 | - | 20 | - | 16 | - | - | 36 |
|  | | | | | | | **132** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **23ME1001** | **Duration** | **3hrs** |
| **Course Name** | **ENGINEERING MATERIALS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | With a neat sketch or a flowchart, visually show the classification of materials. | | CO1 | U | 1 |
| 2. | Enumerate the basic crystallographic structures in materials. | | CO1 | R | 1 |
| 3. | Compare the Vacancy defect and Interstitial defect in a crystal structure. | | CO2 | An | 1 |
| 4. | Indicate a Burger’s vector on a neat sketch of a line dislocation. | | CO2 | R | 1 |
| 5. | State Gibbs phase rule with the equation associated with it. | | CO3 | R | 1 |
| 6. | Solid solution strengthening is associated with metal \_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO3 | U | 1 |
| 7. | Differentiate between a paramagnetic material and a diamagnetic material. | | CO4 | U | 1 |
| 8. | Which properties, if found in a material, can be classified as a smart material? | | CO6 | U | 1 |
| 9. | Compare a ceramic with a glass and state any one difference between them. | | CO5 | An | 1 |
| 10. | List any two metals that are highly resistive to a corrosive environment. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Derive the atomic packing factor and coordination number for an FCC structure. | | CO1 | A | 3 |
| 12. | Explain the importance of Miller Indices. | | CO2 | E | 3 |
| 13. | List the three phases in Fe-C diagram and the associated temperature for each phase. | | CO3 | R | 3 |
| 14. | Differentiate between Creep Failure and Fatigue Failure. | | CO4 | U | 3 |
| 15. | Enumerate the most significant properties of a magnetostrictive material. | | CO5 | R | 3 |
| 16. | Categorize at least three materials based on their application in the Nuclear energy sector and space sector. | | CO6 | C | 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. | Elaborate briefly on body-centered cubic (BCC) and hexagonal close-packed (HCP) crystal structures using suitable sketches. | CO1 | U | 6 |
|  | b. | Articulate the differences between scanning electron microscopy (SEM) and a transmission electron microscope (TEM). | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Summarize the dislocation present in metals with respect to a point defect and an impurity defect. | CO2 | E | 6 |
|  | b. | With neat sketches, explain the theory of Edge dislocation and screw dislocation. | CO2 | E | 6 |
|  |  |  |  |  |  |
| 19. | a. | List the step by step procedure to derive the miller indices of a crystallographic plane. | CO2 | R | 6 |
|  | b. | Enumerate the conditions required for making an alloy combination. | CO2 | R | 6 |
|  |  |  |  |  |  |
| 20. | a. | Describe the equilibrium diagrams having intermediate phases or compounds. | CO3 | U | 6 |
|  | b. | Interpret the iron-iron carbide phase diagram using suitable sketch. | CO3 | E | 6 |
|  |  |  |  |  |  |
| 21. | a. | Formulate a composition to convert a diamagnetic material in to a ferromagnetic material. | CO5 | C | 6 |
|  | b. | Explain any one of the manufacturing processes for converting the magnetic property of a material. | CO5 | C | 6 |
|  |  |  |  |  |  |
| 22. | a. | Summarize briefly on the effect of interstitial atoms on the microstructure with a neat sketch. | CO4 | E | 6 |
|  | b. | Describe the requirement of a burgers vector to represent the defects in crystal structures. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 23. | a. | Discuss the plastic deformation in metallic materials by twinning. | CO4 | U | 6 |
|  | b. | Compare an alloy with a composite and critically evaluate the similarities and differences. | CO5 | E | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | With a flow diagram classify the materials and list the engineering applications associated with each category. | CO6 | U | 6 |
|  | b. | List and explain the properties that are required for a material to be used in automobile sector. | CO6 | E | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Identify materials structures to ascertain properties of the materials |
| CO2 | Test the mechanical properties of metals and analyze the metal failure |
| CO3 | Predict the behavior of materials through phase diagrams |
| CO4 | Choose appropriate fabrication techniques by following engineering standards |
| CO5 | Select suitable polymers and composites for advanced applications |
| CO6 | Develop products through smart materials |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 13 | 3 |  |  |  | 17 |
| CO2 | 13 |  |  | 1 | 15 |  | 29 |
| CO3 | 4 | 7 |  |  | 6 |  | 17 |
| CO4 |  | 10 |  |  | 12 |  | 22 |
| CO5 | 3 |  |  | 1 | 6 | 12 | 22 |
| CO6 | 1 | 7 |  |  | 6 | 3 | 17 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **23ME1002** | **Duration** | **3hrs** |
| **Course Name** | **DRONE TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | The Aerosonde is a small UAV designed to collect \_\_\_\_\_\_\_\_data over oceans and remote areas. | | CO1 | R | 1 |
| 2. | Give a reason why some roles are dangerous to unmanned air vehicles. | | CO1 | R | 1 |
| 3. | \_\_\_\_\_\_\_\_\_\_ is the UAV that flies over 15,000 m altitude and has an endurance of more than 24 hours. | | CO2 | R | 1 |
| 4. | The lower pressure on the upper surface and the higher pressure on the lower surface of a wing is merely the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_for the reaction force. | | CO2 | R | 1 |
| 5. | The horizontal component of the reaction force is a drag known as the\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the propulsion system of the aircraft must overcome that if it is to maintain airspeed. | | CO3 | R | 1 |
| 6. | If the aircraft travelling with forward velocity (V) and deflected air velocity (u), then the lift-to-drag ratio is obtained for small airstream deflection angles ϕ is given as\_\_\_\_\_\_\_\_\_\_. | | CO3 | R | 1 |
| 7. | Identification of the engine by sounds that are produced by drones/aircraft is known as\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_signature. | | CO4 | R | 1 |
| 8. | A Wide-area search to look (principally with Radar) for an early sign of enemy movements is done by\_\_\_\_\_\_\_\_\_\_\_\_\_early warning system. | | CO4 | R | 1 |
| 9. | Several UAVs, possibly in swarms, could be sent ahead of a manned strike force to attract the attention of air defence systems so that their positions are disclosed is done by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_counter system. | | CO5 | R | 1 |
| 10. | The monitoring of traffic in narrow sea lanes is a \_\_\_\_\_\_\_\_\_\_\_activity required to ensure that traffic proceeds in allocated lanes. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Write the history of the development of the Pioneer drone developed by the nation of Israel. | | CO1 | U | 3 |
| 12. | Explain how the conceptual phase plays an important role in the development of drones. | | CO2 | U | 3 |
| 13. | Describe the principle of lift-induced drag and its significance in drones. | | CO3 | U | 3 |
| 14. | Differentiate between dispensable and non-dispensable payloads. | | CO4 | U | 3 |
| 15. | How mid-air collision system work to avoid the collision of drones? | | CO5 | U | 3 |
| 16. | Explain the commercial roles carried out by drones in the present world. | | 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. | a. | Describe the advanced features and specifications of the RQ-4 Global Hawk. | CO1 | A | 6 |
|  | b. | Explain the dull and dangerous roles of drones. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe in detail the economic reasons and factors for designing, developing and deployment of the drones. | CO1 | A | 6 |
|  | b. | Describe how drones play vital roles in environmentally critical conditions. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the functions and applications of the Firebee 1241 drone and Scout drone developed by the nation of Israel. | CO2 | A | 6 |
|  | b. | Distinguish between the Pathfinder and the Helios (US) | CO2 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Sketch neat schematics of the navigation and position systems of a drone. Explain the challenges in the design aspects. | CO3 | A | 6 |
|  | b. | Explain the significance of autonomous flight path techniques that are widely used globally. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Describe the techniques used by drones for precision farming with neat sketches. | CO4 | An | 6 |
|  | b. | Enumerate the techniques and applications of drones in crop health monitoring. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the significance of the following parameters involved with the air vehicle:  1. Air Vehicle – Payload (Capacity) 2. Air Vehicle – Endurance (Time) | CO5 | An | 6 |
|  | b. | Explain the significance of the following parameters involved with the air vehicle:   1. Air Vehicle – Radius of Action (Operating Distance) 2. Air Vehicle – Speed Range (Travel) | CO5 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | How the thermal signature and the radio/radar signature are applied in the drones. Give a case study on both. | CO5 | An | 6 |
|  | b. | Sketch neatly and explain the different types of antennas and their uses. | CO5 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe significant applications of drones in the medical field. | CO6 | An | 6 |
|  | b. | Describe the roles of drones in the Indian Army and Paramilitary | CO6 | An | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Design unmanned aerial vehicle systems (UAS). |
| CO2 | Optimize design parameters, aerodynamics and airframe configurations of Unmanned Aerial Vehicles |
| CO3 | Apply the principles of flight control dynamics, avionics and various sensors in UAVs. |
| CO4 | Analyze crop monitoring, land surveying and mapping using drones. |
| CO5 | Create professional/high-quality photos and videos for various applications. |
| CO6 | Categorize future trends and develop new technology in line with government regulations. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 3 | 24 |  |  |  | 29 |
| CO2 | 2 | 3 | 12 |  |  |  | 17 |
| CO3 | 2 | 3 | 12 |  |  |  | 17 |
| CO4 | 2 | 3 |  | 12 |  |  | 17 |
| CO5 | 1 | 3 |  | 24 |  |  | 28 |
| CO6 | 1 | 3 |  | 12 |  |  | 16 |
|  | 10 | 18 | 48 | 48 |  |  | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **23ME1003** | **Duration** | **3hrs** |
| **Course Name** | **INNOVATION AND CREATIVITY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Express the definition of Innovation. | | CO1 | R | 1 |
| 2. | Name any one of the innovative tools for academic assignments. | | CO1 | U | 1 |
| 3. | Define Empathizing. | | CO2 | R | 1 |
| 4. | Give any one example of open innovation. | | CO2 | U | 1 |
| 5. | Define Ideation. | | CO3 | R | 1 |
| 6. | Distinguish mind mapping and brain writing. | | CO3 | U | 1 |
| 7. | How is the success of open innovation measured? | | CO4 | U | 1 |
| 8. | List a few government schemes that promote entrepreneurship in India. | | CO4 | R | 1 |
| 9. | Name a few social entrepreneurs. | | CO5 | R | 1 |
| 10. | Summarize two elements of entrepreneurial ventures. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Provide a few techniques that stimulate innovation. | | CO1 | A | 3 |
| 12. | Summarize the steps in the creative problem-solving process. | | CO2 | U | 3 |
| 13. | Outline the methodology for measuring the success of open innovation. | | CO3 | An | 3 |
| 14. | Distinguish traditional and design thinking process. | | CO4 | U | 3 |
| 15. | Classify the intellectual property rights. | | CO5 | U | 3 |
| 16. | List three successful women entrepreneurs and their ventures. | | 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. | a. | Discuss the various steps in the problem-solving process. | CO1 | U | 8 |
|  | b. | List out the barriers to innovation and creativity | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Explain in detail the techniques for Idea Generation and Solutions. | CO2 | U | 8 |
|  | b. | Discuss the benefits of open innovations. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. |  | Describe the various tools used for creativity. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Illustrate how the best solutions are identified with suitable examples. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Examine the role of entrepreneurship in the economic development of India. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Write short notes on   1. Women Entrepreneurship, 2. Rural Entrepreneurship 3. Social Entrepreneurship. | CO4 | R | 12 |
|  |  |  |  |  |  |
| 23. |  | Discuss a few success and failure stories of entrepreneurs. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain in detail the role of new technology in entrepreneurship. | CO6 | E | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Design innovative systems with enhanced performance. |
| **CO2** | Devise innovative techniques for optimizing the system's performance. |
| **CO3** | Develop new products for industrial applications. |
| **CO4** | Collaborate with external partners and stakeholders to develop new products. |
| **CO5** | Design new processes and methodologies to improve system performance. |
| **CO6** | Evolve creative technology for innovative entrepreneurial ventures |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 1 | 3 | 4 | 8 | - | 17 |
| **CO2** | 1 | 4 | - | - | 12 | - | 17 |
| **CO3** | 1 | 1 | 12 | 3 | E | - | 17 |
| **CO4** | 13 | 1 | - | 15 | - | - | 29 |
| **CO5** | 1 | 12 | 15 | - | - | - | 28 |
| **CO6** | 3 | 1 | - | - | 12 | - | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **23ME1004** | **Duration** | **3hrs** |
| **Course Title** | **INDUSTRIAL ROBOTICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Josef Capek, cubist painter and writer introduced the term ‘robota’ which gives the meaning\_\_\_\_\_\_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 2. | In the year 1950,\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_developed the first industrial robot ‘Unimate’ in the United States. | | CO1 | R | 1 |
| 3. | Kinematics is the study of motion that will not consider the \_\_\_\_\_\_\_\_\_that affects the motion. | | CO2 | R | 1 |
| 4. | Define the important function of an industrial robot Manipulator. | | CO2 | R | 1 |
| 5. | The \_\_\_\_\_\_\_\_\_\_\_\_\_ programming method requires the operator/programmer to move the manipulator manually through the desired motion path. | | CO3 | R | 1 |
| 6. | The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_leadthrough method makes use of a teach pendant to control the various joint motors and to power drive the robot arm and wrist through a series of points in space. | | CO3 | R | 1 |
| 7. | The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_and perception enable robots to navigate, manipulate objects, and interact with their environment effectively. | | CO4 | R | 1 |
| 8. | Expand LiDAR and write its application. | | CO4 | R | 1 |
| 9. | Which sensor measures distance by transmitting and analyzing sound waves? | | CO5 | R | 1 |
| 10. | \_\_\_\_\_\_is a semi-autonomous robot (cobot) capable of working alongside humans that was first developed by Victor Scheinman at Stanford University. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List the applications of Cartesian, Spherical and Polar configurations robots. | | CO1 | U | 3 |
| 12. | Sketch the Articulated and SCARA configuration robots and indicate their nomenclature. | | CO2 | U | 3 |
| 13. | Illustrate the notations of linear, rotational, twisting and revolving joints of a robot with sketches. | | CO3 | U | 3 |
| 14. | Sketch any three lighting techniques used in machine vision inspection systems. | | CO4 | U | 3 |
| 15. | Write three functional differences between a sensor and a transducer. | | CO5 | U | 3 |
| 16. | Summarize the development of collaborative robots over the period. | | 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. |  | Elaborate on the safety precautions to be followed while working with the industrial robots. | CO1 | A | 12 |
|  | | | | | |
| 18. |  | Explain the significant aspects/features of drives implemented in industrial robots. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain the following robot motion planning factors in detail: (a) Path planning, (b) Configuration space, (c) Collision avoidance, (d) Optimization. | CO2 | A | 6 |
|  | b. | Articulate the following robot trajectory generation methods: (a) Velocity profile (b) Acceleration profile, (c) Jerk control, (d) Interpolation and (e) Dynamic control. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Tabulate any six important methods of robot programming and describe their functions. | CO3 | A | 6 |
|  | b. | Describe any six essential factors of robot programming methods in a tabular column. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Classify the types of robot control systems in a tabular column, explain the working principles and list their advantages. | CO3 | AN | 12 |
|  |  |  |  |  |  |
| 22. | a. | Tabulate any eight types of sensors and their applications in the automation industries. | CO4 | AN | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain ten prominent transducers with their working principles and major applications in the automation industries. | CO5 | AN | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Enumerate the components and features of the mobile robots. | CO6 | AN | 6 |
|  | b. | Summarize the industrial applications of mobile robots. | CO6 | AN | 6 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Design industrial robots for specific applications. |
| **CO2** | Implement robot dynamics and control algorithms. |
| **CO3** | Develop robot programming for various applications. |
| **CO4** | Design robot vision system for image processing and object tracking. |
| **CO5** | Adopt different control algorithms for optimizing the performance of robots. |
| **CO6** | Create collaborative robots for industrial applications |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 3 | 12 | - | - | - | 17 |
| **CO2** | 2 | 3 | 24 | - | - | - | 29 |
| **CO3** | 2 | 3 | 24 | - | - | - | 29 |
| **CO4** | 2 | 3 | - | 12 | - | - | 17 |
| **CO5** | 1 | 3 | - | 12 | - | - | 16 |
| **CO6** | 1 | 3 | - | 12 | - | - | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **23ME1005** | **Duration** | **3hrs** |
| **Course Name** | **INTRODUCTION TO MECHANICAL SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Lines of action of all forces pass through the single point is \_\_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 2. | A body is said to be in equilibrium, the resultant of the force system act on it is \_\_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 3. | A heat engine operates between two reservoirs one at 600 K and the other at 300 K. Then the efficiency of the heat engine is \_\_\_\_. | | CO2 | A | 1 |
| 4. | Any change from one state to another is called \_\_\_\_\_\_\_\_\_\_\_\_. | | CO2 | R | 1 |
| 5. | Continuity equation deals with the law of conservation of \_\_\_\_\_\_. | | CO3 | U | 1 |
| 6. | Venturimeter is used to measure \_\_\_\_\_\_. | | CO3 | U | 1 |
| 7. | The physical property of a solid to bend or be hammered into another shape without breaking is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO4 | R | 1 |
| 8. | \_\_\_\_\_\_\_ material is having high strength to weight ratio. | | CO4 | R | 1 |
| 9. | Thermal conductivity of solid metals \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ with rise in temperature | | CO5 | U | 1 |
| 10. | The function of turbine is to convert heat energy into \_\_\_\_\_\_\_\_\_\_\_. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | State Parallelogram law of forces. | | CO1 | R | 3 |
| 12. | A system executes a cyclic process during which there are four transfers of heat Q12= 880 kJ, Q23= -100 kJ, Q34= -720 kJ, Q23= 200 kJ. The work transfers during the process are given as W12= 60 kJ , W23= -40 kJ ,W34= -80 kJ. Find the work done W41. | | CO2 | A | 3 |
| 13. | Calculate the density, specific weight and weight of one litre of Petrol of specific gravity 0.7. | | CO3 | A | 3 |
| 14. | Define composite materials and indicate some common composite materials that offer high stiffness and strength across a wide temperature range. | | CO4 | R | 3 |
| 15. | State the laws governing three basic modes of heat transfer. | | CO5 | R | 3 |
| 16. | Discuss the working principle of wind turbine generator. | | 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. |  | If five forces act on a particle as shown in figure.1, determine the magnitude and direction of the resultant force.    Figure. 1 | CO1 | A | 12 |
| 18. |  | Air flows steadily at the rate of 0.5 kg/s through an air compressor, entering at 7m/s velocity, 100 kPa and 0.95 m3/kg volume and leaving at 5 m/s, 700 kPa and 0.19 m3/kg . The internal energy of the air leaving is 90 KJ/Kg greater than that of air entering. Cooling water in the compressor jackets absorbs heat from the air at the rate of 58kW (a) compute the rate of shaft work input to the air in kW (b) find the ratio of the inlet pipe diameter to outlet pipe diameter. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | An oil of specific gravity 0.7 is flowing through a pipe of diameter 300 mm at the rate of 500 litres/s. Find the head lost due to friction and power required to maintain the flow for a length of 1000m. Take υ=0.29 stokes. | CO3 | A | 6 |
|  | b. | A 30cm diameter pipe, conveying water branches into two pipes of diameters 20 cm and 15cm respectively. If the average velocity in the 30 cm diameter pipe is 2.5 m/s. Find the discharge in this pipe. Also determine the velocity in 15cm pipe if the average velocity in 20cm diameter pipe is 2 m/s. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Compare the Rockwell hardness test method with Brinell hardness test method. | CO4 | U | 6 |
|  | b. | Explain the measurement of thermal conductivity using the guarded hot plate method with a neat sketch. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | A copper rod with a length of 0.5 m, a cross sectional area of 0.02 m2 and a thermal conductivity of 398 W/mK has one end maintained at a temperature of 1000C and the other end at 500C. Determine the rate of heat transfer through the rod. | CO5 | A | 6 |
|  | b. | A steel pipe 50 mm in diameter is maintained at a temperature of 700C in a large room where the air and wall temperature are 270C. The surface emissivity of steel is 0.65. Calculate the total head loss per unit length of pipe if convective heat transfer coefficient is 6.5 W/m2K. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Describe the main components and working of a heat engine with neat sketch. | CO2 | U | 6 |
|  | b. | Explain the construction and working of Gear Pump with neat sketches. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 23. |  | Explain the working principle of Geo-thermal power plant with neat sketch. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the working principle of hydroelectric power plant with neat sketch. | CO6 | U | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Draw free body diagram and analyze the systems under equilibrium |
| **CO2** | Design heat engine and refrigeration systems |
| **CO3** | Apply fluid mechanics principles in designing hydraulic pumps |
| **CO4** | Select appropriate materials required for mechanical systems |
| **CO5** | Design heat exchangers specific to heat transfer applications. |
| **CO6** | Analyze the performance of renewable energy production systems. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 5 | - | 12 | - | - | - | 17 |
| **CO2** | 1 | 6 | 16 | - | - | - | 23 |
| **CO3** |  | 8 | 15 | - | - | - | 23 |
| **CO4** | 5 | 6 | 6 | - | - | - | 17 |
| **CO5** | 3 | 1 | 12 | - | - | - | 16 |
| **CO6** |  | 28 |  | - | - | - | 28 |
|  | | | | | | | **124** |