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| **Course Code** | **14ME2001 / 17ME2001 / 18ME1003** | **Duration** | **3hrs** |
| **Course Name** | **ENGINEERING MECHANICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **CO / BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | |
| 1. | \_\_\_\_\_\_\_\_\_ is the branch of science, which deals with the study of a body at rest. | CO1 / R | 1 |
| 2. | State the difference between moment and couple. | CO1 / U | 1 |
| 3. | Write the M.I formula for hollow rectangle. | CO 2 / A | 1 |
| 4. | Define centroidal axes. | CO 2 / A | 1 |
| 5. | What are the characteristics of kinematics? | CO 3 / U | 1 |
| 6. | List out the terms used in kinematics of particle. | CO3/ An | 1 |
| 7. | When a large force acts for a long period of time, that force is called as impulsive force. (TRUE / FALSE) | CO4 / C | 1 |
| 8. | Write the symbols denoted by Angular displacement, angular velocity and acceleration. | CO5 / E | 1 |
| 9. | Mention the terms involved in rotation of rigid bodies. | CO6 / A | 1 |
| 10. | Classify the dry friction. | CO6 / E | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | An electric light fixture weighting 15 N hangs from a point C, by two strings AC and BC. The string AC is inclined at 60° to the horizontal and BC at 45° to the horizontal as shown in Fig. | | | CO1 / A | 3 | |
| 12. | Find the center of gravity of a 100 mm × 150 mm × 30 mm T-section. | | | CO 2 /E | 3 | |
| 13. | The brakes of a train reduces its speed from 60 km/hr to 20 km/hr while it runs 200m.Assuming that there exists constant retarding force. Find how much distance travelled by train before coming to rest. | | | CO3 / E | 3 | |
| 14. | A railway wagon of weight 4 KN is moving with a velocity of 25 m/s.A force of 200N acts on the wagon for 2 minutes. Calculate the velocity of the wagon, If the direction of the applied force is, (i) in the direction of motion. (ii) in the opposite direction. | | | CO4 / E | 3 | |
| 15. | A flywheel starts rotating from rest and is given an acceleration of 2 rad/s2. Find the angular velocity and speed in rpm after 60sec. | | | CO5/An | 3 | |
| 16. | A wooden block of mass 40 kg is on rough inclined plane as shown in fig. What is the external force required to be applied parallel to the inclined plane in downward direction for impending motion. Coefficient of friction between block and plane is 0.4. | | | 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. | | Three coplanar concurrent forces are acting at a point shown in the figure. Determine the resultant in magnitude and direction. | CO1/ A | | 6 |
| b. | | Explain the concept of forces in space with neat diagrams and equations | CO1 / E | | 6 |
|  |  | |  |  | |  |
| 18. | a. | | A system of four forces acting on a body is shown in figure below. Determine the resultant force and its direction.  120 N  200 N  1  4  2  3  60o  40o  100 N  50N | CO 2 / U | | 12 |
|  |  | |  |  | |  |
| 19. | a. | | A 4.8m beam is subjected to the forces shown in fig. Reduce the given system of forces to a) a single force b) an equivalent force- couple system at A c) force couple system at B.  C:\Users\Admin\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.Word\Picture3.jpg | CO 3 / A | | 12 |
|  |  | |  |  | |  |
| 20. | a. | | Calculate the moment of inertia of the figure. | CO 4 / E | | 12 |
|  |  | |  |  | |  |
| 21. | a. | | A block of weight 150N is resting on a rough inclined plane as shown in the fig. The block is tied up by a horizontal string, which has a tension of 50N.Find ( i) the frictional force on the block (ii) the normal reaction of the inclined plane (iii) the co-efficient of friction between the surfaces of contact.  Untitled 1 | CO 2/ E | | 12 |
|  |  | |  |  | |  |
| 22. | a. | | A train is travelling from A to D along the track as shown in fig; Its initial velocity at A is zero. The train takes 7 min to cover the distance AB,3000m length and 3,5 minutes to cover the distance BC 3500m in length on the reaching the station C, the brakes are applied and the train stops 3000m beyond at D. (i) Find the retardation on CD. (ii) the time it takes the train to get from A to D, and (iii) its average speed for the whole distance.  t1 =7 min t2 =3.5 min t3 =?  A 3000m B 3500m C 3000m D | CO4/ A | | 12 |
|  |  | |  |  | |  |
| 23. | a. | | Two blocks A and B of weights 80N and 60N are connected by a string passing through a smooth pulley as shown. Calculate the acceleration of the body and the tension in the string. | CO 5/An | | 12 |
|  |  | | **Compulsory:** | | | |
| 24 | a. | | A uniform ladder weighing 100N and 5m long has lower end B resting on the ground and upper end A resting against a vertical wall as shown in fig. The inclination of the ladder with horizontal is 60° .If the coefficient of friction at all surfaces of contact is 0.25.Determine how much distance up along the ladder a man weighing 600N can ascent without causing it to slip. | CO 6/ A | | 12 |
|  | | **COURSE OUTCOMES** | | | | |
| CO1 | | Determine the resultant force and moment of a given system of forces | | | | |
| CO2 | | Determine centroid and second moment of area of simple solids | | | | |
| CO3 | | Applying fundamental concepts of kinematics and kinetics to analyse of simple/practical problems | | | | |
| CO4 | | Understand basic kinematics concepts – displacement ,velocity and acceleration | | | | |
| CO5 | | Understand basic dynamic concepts – force, momentum, work and energy. | | | | |
| CO6 | | Determine friction and its effects as per the laws of friction | | | | |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 1 | 9 |  | 6 |  | 17 |
| CO2 |  | 12 | 1 | 1 | 15 |  | 29 |
| CO3 |  | 1 | 12 | 1 | 3 |  | 17 |
| CO4 |  |  | 12 |  | 15 | 1 | 28 |
| CO5 |  |  |  | 15 |  |  | 15 |
| CO6 |  |  | 4 | 12 | 1 |  | 17 |
|  | | | | | | | **124** |



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| **Course Code** | **14ME2015 / 17ME2011** | **Duration** | **3hrs** |
| **Course Name** | **THERMAL ENGINEERING 1** | **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 ‘Evaporative capacity’. | | CO1 | U | 1 |
| 2. | Classify the Boilers based on the flow arrangement. | | CO1 | An | 1 |
| 3. | Write the importance of Zenner’s equation. | | CO2 | A | 1 |
| 4. | Define ‘Critical pressure ratio’. | | CO2 | R | 1 |
| 5. | Define the term “Blade friction factor”. | | CO3 | U | 1 |
| 6. | The maximum blade efficiency for a single stage impulse turbine is------ | | CO3 | A | 1 |
| 7. | Write the formula for efficiency of Rankine cycle. | | CO4 | A | 1 |
| 8. | Differentiate between reheat and regeneration cycle. | | CO4 | A | 1 |
| 9. | Write two applications of air compressor. | | CO5 | An | 1 |
| 10. | Define’ ton of refrigeration. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Define factor of evaporation and efficiency of boiler. | | CO1 | U | 3 |
| 12. | Discuss the effect of friction on the performance of steam nozzle. | | CO2 | An | 3 |
| 13. | Write short notes on compounding of turbine. | | CO3 | An | 3 |
| 14. | Sketch Rankine cycle on T-s diagram. | | CO4 | An | 3 |
| 15. | Classify air compressors according to number of stages. | | CO5 | A | 3 |
| 16. | Write any four applications of refrigeration 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. | In a boiler trial, the following observations were made in which the pressure of the steam is 10 bar, steam condensed is 540 kg/h and fuel used was 65 kg/h. The Moisture present in the fuel is 2% by mass and mass of dry flue gases is 9 kg/kg of fuel. The calorific value of fuel is 32000 kJ/kg and temperature of the flue gases is given by 325°C. The boiler house temperature is 28°C and feed water temperature is given by 50°C. The specific heat of flue gases is 1 kJ/kg K and dryness fraction of steam is given by 0.95. The specific heat of super-heated steam is given as 2.1 kJ/kg K. Draw the heat balance sheet for the boiler. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | Derive the exit velocity of Nozzle and the conditions for maximum  discharge. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | The steam velocity leaving the nozzle of an impulse turbine is 850 m/s and the nozzle angle is 200. The blade velocity is 250 m/s and the blade velocity coefficient is 0.8. For unit mass flow rate of steam and blade symmetry, find (a) Inlet blade angle, (b) driving force on the wheel and the axial thrust. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20 | a. | Explain the reheat Rankine cycle with neat diagram and represent the cycle on T-s and h-s diagrams. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Derive an expression for the work done per kg of air a reciprocating air compressor without and with clearance. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | A single stage steam turbine is supplied with steam at 5 bar, 200°C at the rate of 50 kg/min. It expands into a condenser at a pressure of 0.2 bar. The blade speed is 400 m/s. The nozzles are inclined at an angle of 20° to the plane of the wheel and the outlet blade angle is 30°. Neglecting friction losses, determine the power developed, blade efficiency and stage efficiency. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Air is to be isentropically compressed at the rate 1 m3/s from 1 bar and 20°C to 10 bar. Find the work of compression and the volumetric efficiency if the clearance volume is 4% of stroke volume for all the cylinders for the following cases:   1. Single stage 2. Two stage and   Three stage compression. Assume density of air as 1.2 kg/m3. | CO5 | An | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the working principle of vapour absorption water-lithium bromide system. | CO6 | A | 12 |

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

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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. | | | | | | | |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | | | |
| **CO / P** | | **R** | **U** | **A** | **An** | **E** | **C** | **Total** | |
| CO1 | |  | 4 |  | 13 |  |  | 17 | |
| CO2 | | 1 |  | 13 | 3 |  |  | 17 | |
| CO3 | |  | 1 | 1 | 27 |  |  | 29 | |
| CO4 | |  |  | 2 | 15 |  |  | 17 | |
| CO5 | |  |  | 15 | 13 |  |  | 28 | |
| CO6 | |  | 1 | 15 |  |  |  | 16 | |
|  | | | | | | | | **124** | |



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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** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Thermal conductivity of solid metals \_\_\_\_\_\_\_ with rise in temperature. | | CO1 | U | 1 |
| 2. | The critical thickness of insulation for sphere is given by \_\_\_\_\_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 3. | The characteristic length, in the non-dimensional Biot number, is the ratio of \_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO2 | R | 1 |
| 4. | Grashoff number has significant role in heat transfer by \_\_\_\_\_\_\_\_ convection. | | CO2 | U | 1 |
| 5. | The wavelength for maximum emissive power is given by \_\_\_\_\_\_\_\_\_ law. | | CO3 | R | 1 |
| 6. | A radiation shield should have \_\_\_\_\_\_\_ reflectivity. | | CO3 | U | 1 |
| 7. | Compared to parallel flow heat exchanger log mean temperature difference (LMTD) in case of counter flow heat exchanger will be \_\_\_\_\_\_\_\_\_. | | CO4 | U | 1 |
| 8. | In pool boiling the increase in heat flux after the Leiden Frost Point is due to \_\_\_\_\_\_\_\_\_\_\_. | | CO4 | U | 1 |
| 9. | In film wise condensation the value of *h* will be \_\_\_\_\_\_\_\_\_\_\_\_ compared to dropwise condensation. | | CO5 | U | 1 |
| 10. | Sherwood number for forced convective mass transfer is a function of \_\_\_\_\_\_\_\_ number and \_\_\_\_\_\_\_\_ number. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | State the laws governing three basic modes of heat transfer. | | CO1 | R | 3 |
| 12. | Sketch, temperature and velocity profiles in free convection on a vertical wall | | CO2 | U | 3 |
| 13. | Emissivities of two large parallel planes maintained at 800 οC and 300 οC are 0.3 and 0.5 respectively. Find the net radiant heat exchange per square metre for these plates? | | CO3 | A | 3 |
| 14. | Draw temperature Vs length profiles for  a) Condenser b) Evaporator c) Counter flow Heat exchanger with Ch = Cc. | | CO4 | U | 3 |
| 15. | Differentiate between evaporation and boiling. | | CO5 | U | 3 |
| 16. | Define the following: a) Mass concentration b) Molar concentration | | 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 steel pipe line (k= 50 W/mK) of I.D 100mm and O.D. 110 mm is to be covered with two layers of insulation each having a thickness of 50 mm. The thermal conductivity of the first insulation material is 0.06 W/mK and that of the second is 0.12 W/mK. Calculate the loss of heat per metre length of pipe and the interface temperatures between the two layers of insulation when the temperature of the inside tube surface is 2500C and that of the outside surface of the insulation is 500C | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | An aluminium sphere weighting 6 kg and initially at temperature of 350oC is suddenly immersed in a fluid at 30oC with convection coefficient of 60 W/m2 oC. Estimate the time required to cool the sphere to 100oC. Take thermo physical properties as C = 900 J/kgoK, ρ = 2700 kg/m3 and k = 205 W/moK. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Engine oil 60oC over the upper surface of a 5m long flat plate whose temperature is 20oC with a velocity of 2 m/s. Determine the total drag force and the rate of heat transfer per unit width of the entire plate. | CO2 | A | 6 |
|  | b. | Water at 25oC flows across a horizontal copper tube 1.5 cm outer diameter with a velocity of 2 m/s. Calculate the heat transfer rate per unit length if the wall temperature is maintained at 75oC. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the significance of non-dimensional numbers in convection heat transfer? | CO2 | U | 4 |
|  | b. | A hot square plate 50 cm x 50 cm at 1000C is exposed to atmospheric air at 200C.Find the heat loss from both surfaces of the plate if (i) The plate is kept in vertical plane and (ii)A plate is kept in horizontal plane. Determine the percentage heat loss if the plate is kept horizontal instead of vertical. | CO2 | R | 8 |
|  |  |  |  |  |  |
| 21. | a. | Define emissivity, absorptivity and reflectivity. | CO3 | R | 4 |
|  | b. | Two large parallel planes with emissivities 0.35 and 0.85 exchange heat by radiation. The planes are respectively 1073K and 773K. A radiation shield having the emissivity of 0.04 is placed between them. Find the percentage reduction in radiation heat exchange and temperature of the shield. | CO3 | A | 8 |
|  |  |  |  |  |  |
| 22. |  | In a counter flow double pipe heat exchanger, oil is cooled from 850C to 550 C by water entering at 250 C. the mass flow rate of oil is 9,800kg/h and specific heat of water is 4180 J/kg K. Determine the heat exchanger area and heat transfer rate for an overall heat transfer co-efficient of 280 W/m2K. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Draw heat flux curve for various regions of flow boiling. | CO5 | R | 4 |
|  | b. | A tube of 2 m length and 25 mm outer diameter is to be used to condense saturated steam at 100°C while the tube surface is maintained at 92°C. Estimate the average heat transfer coefficient and the rate of condensation of steam if the tube is kept horizontal. The steam condenses on the outside of the tube. | CO5 | A | 8 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Co2 and air experience equimolar counter diffusion in circular tube whose length and diameter are 1m and 50mm respectively. The system is at a total pressure of 1 atmosphere and a temperature of 250C.The ends of the tube are connected to large chambers in which the species concentration are maintain a fixed values. The partial pressure of Co2at one end is 190 mm of Hg while other end is 95mm of Hg. Estimate the mass transfer rate of Co2 and the air through the tube. | CO6 | A | 12 |

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

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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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 4 | 1 | 24 | - | - | - | 29 |
| CO2 | 9 | 8 | 12 | - | - | - | 29 |
| CO3 | 5 | 1 | 11 | - | - | - | 17 |
| CO4 | - | 5 | 12 | - | - | - | 17 |
| CO5 | 4 | 4 | 8 | - | - | - | 16 |
| CO6 | 4 | - | 12 | - | - | - | 16 |
|  | | | | | | | **124** |



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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** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Discuss degrees of freedom. | | CO1 | U | 1 |
| 2. | Define inversion of a mechanism. | | CO1 | U | 1 |
| 3. | The component of acceleration, parallel to the velocity of the particle at a  given instant is \_\_\_\_\_\_\_ component. | | CO1 | U | 1 |
| 4. | Define centripetal or radial component. | | CO1 | R | 1 |
| 5. | List the types of cams. | | CO2 | R | 1 |
| 6. | State pressure angle with respect to cams. | | CO2 | R | 1 |
| 7. | Define train value of the gear train. | | CO2 | R | 1 |
| 8. | Name the types of journal bearings. | | CO3 | R | 1 |
| 9. | List the functions of bearings. | | CO3 | U | 1 |
| 10. | Discuss creep in belt drive. | | CO3 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | State Grashoff’s Law. | | CO1 | R | 3 |
| 12. | Discuss Coriolis component of acceleration. | | CO1 | U | 3 |
| 13. | **List 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. | Differentiate open and crossed belt drive. | | 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. | Explain constrained motion and its types with examples and neat sketches. | CO1 | U | 4 |
|  | b. | Sketch and explain any two inversions of a double slider crank chain. | CO1 | A | 8 |
|  |  |  |  |  |  |
| 18. | a. | The crank and connecting rod of a theoretical steam engine are 0.5 m and 2 m long respectively. The crank makes 360 r.p.m. in the clockwise direction. When it has turned 45° from the inner dead centre position, analyze: (a) velocity of piston, and (b) angular velocity of connecting rod. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | A cam is to be designed for a knife edge follower with the following data:   1. Cam lift = 50 mm during 120° of cam rotation with simple harmonic motion. 2. Dwell for the next 30°. 3. During the next 120° of cam rotation, the follower returns to its original position with constant velocity. 4. Dwell during the remaining 90°.   Draw the profile of the cam when the line of stroke of the follower passes through the axis of the cam shaft. The radius of the base circle of the cam is 30 mm. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | The gearing of a machine tool is shown in Fig. The motor shaft is connected to gear A and rotates at 975 r.p.m. The gear wheels B, C, D and E are fixed to parallel shafts rotating together. The final gear F is fixed on the output shaft. Compute the speed of gear F. The number of teeth on each gear are as given below:  Gear A: 20 teeth; B: 50 teeth; C: 25 teeth; D: 75 teeth; E: 26 teeth; F: 65 teeth. | CO3 | A | 4 |
|  | b. | A pair of gears having 40 and 30 teeth respectively are of 25o involute form. The addendum length is 5 mm and the module pitch is 2.5 mm. If the smaller wheel is the driver and rotates at 1500 rpm, examine the velocity of sliding at the point of engagement and at the point of disengagement. | CO3 | A | 8 |
|  |  |  |  |  |  |
| 21. | a. | Identify the important factors upon which the selection of belt drive depends. | CO3 | U | 4 |
|  | b. | Determine the power transmitted by a belt running over a pulley of 600 mm diameter at 200 r.p.m. 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 |
|  |  |  |  |  |  |
| 22. | a. | Distinguish compound and epicyclic gear trains. | CO3 | U | 4 |
|  | b. | An epicyclic gear train is arranged as shown in the Fig. Determine 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 | 8 |
|  |  |  |  |  |  |
| 23. | a. | A cam is to give the following motion to a roller (diameter 16 mm) follower :   1. Outstroke during 120° 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 150° of cam rotation.     The stroke of the follower is 40 mm and the minimum radius of the cam is 30 mm. The follower moves with simple harmonic motion during both the ascent and descent. Use the displacement diagram shown in figure. Draw the profile of the cam when the axis of the follower passes through the axis of the cam shaft. Determine the maximum velocity and acceleration of the follower during its ascent and descent, if the cam rotates at 300 r.p.m. | CO2 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Discuss angle of friction and coefficient of friction. | CO3 | U | 4 |
|  | b. | A multi plate clutch has three pairs of contact surfaces. The outer and inner radii of the contact surfaces are 100 mm and 50 mm respectively. The maximum axial spring force is limited to 1 kN. If the coefficient of friction is 0.35 and assuming uniform wear, estimate the power transmitted by the clutch at 1500 rpm. | CO3 | An | 8 |

**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 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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 4 | 10 | 8 | 12 | - | - | 34 |
| CO2 | 3 | 3 | 12 | 12 | - | - | 30 |
| CO3 | 1 | 20 | 23 | 16 | - | - | 60 |
|  | | | | | | | **124** |



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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** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define strength. | | CO1 | R | 1 |
| 2. | Describe elasticity. | | CO1 | U | 1 |
| 3. | Define bearing. | | CO2 | R | 1 |
| 4. | List out a few types of lubricants used in bearing. | | CO2 | R | 1 |
| 5. | Illustrate the various stresses induced in the key. | | CO3 | U | 1 |
| 6. | Classify rigid couplings. | | CO3 | U | 1 |
| 7. | List a few examples of permanent and temporary joints. | | CO4 | R | 1 |
| 8. | Describe the coefficient of fluctuation of speed. | | CO5 | U | 1 |
| 9. | Describe the function of the crankshaft in an internal combustion engine. | | CO5 | U | 1 |
| 10. | Illustrate the type of brake commonly used in motor cars. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Write the various stages of the design process. | | CO1 | A | 3 |
| 12. | Differentiate hydrodynamic and hydrostatic bearing. | | CO2 | An | 3 |
| 13. | Compare solid and hollow shafts. | | CO3 | An | 3 |
| 14. | Write short notes on helical springs. | | CO4 | A | 3 |
| 15. | Explain the various parts of the piston. | | CO5 | A | 3 |
| 16. | Sketch a cone clutch and show its parts. | | 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 theories of failures in detail with suitable examples. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Calculate the dimensions of d for a centrifugal pump, if the diameter of the Journal is 120 mm, the load on the Journal is 30 kN and the speed of the Journal is 1000 rpm. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Calculate the dimensions of a cast iron protective type flange coupling to transmit 15 kW at 900 rpm. from an electric motor to a compressor. The following permissible stresses may be used : Shear stress for shaft, bolt and key material = 40 MPa, Crushing stress for bolt and key = 80 MPa, Shear stress for cast iron = 8 MPa | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Calculate the dimensions of a knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | The turning moment diagram for a petrol engine is drawn to the following scales:  Turning moment, 1 mm = 5 N-m; Crank angle, 1 mm = 1º.  The turning moment diagram repeats itself at every half revolution of the engine and the areas above and below the mean turning moment line, taken in order are 295, 685, 40, 340, 960 and 270 mm2.  Determine the mass of the 300 mm diameter flywheel rim when the coefficient of fluctuation of speed is 0.3% and the engine runs at 1800 rpm. Also, determine the cross-section of the rim when the width of the rim is twice of thickness. Assume the density of rim material as 7250 kg / m3. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Calculate the diameter of a solid steel shaft to transmit 20 kW at 200 rpm. The shear stress for the steel may be taken as 45 MPa. If a hollow shaft is to be used in place of the solid shaft, find the inside and outside diameter when the ratio of inside to outside diameters is 0.5. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | It is required to design a helical compression spring subjected to a maximum force of 1250 N. The deflection of the spring corresponding to the maximum force should be approximately 30mm. The spring index can be taken as 6. The spring is made of patented and cold-drawn steel wire. The ultimate tensile strength and modulus of rigidity of the spring material are 1090 and 81370 N/mm2 respectively. The permissible shear stress for the spring wire should be taken as 50% of the ultimate tensile strength. Design the spring and calculate:  (i) wire diameter; (ii) mean coil diameter;  (iii) number of active coils; (iv) total number of coils;  (v) free length of the spring; and (vi) pitch of the coil. | CO4 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | A multi-disc clutch has three discs on the driving shaft and two on the driven shaft. The inside diameter of the contact surface is 120 mm. The maximum pressure between the surfaces is limited to 0.1 N/mm2. Calculate the clutch dimensions for transmitting 25 kW at 1575 rpm. Assume uniform wear condition and coefficient of friction as 0.3. | CO6 | An | 12 |

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

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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 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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 1 | 15 | - | - | - | 17 |
| CO2 | 2 | - | - | 15 | - | - | 17 |
| CO3 | - | 2 | - | 27 | - | - | 29 |
| CO4 | 1 | - | 3 | 24 | - | - | 28 |
| CO5 | - | 2 | 15 | - | - | - | 17 |
| CO6 | - | 1 | 3 | 12 | - | - | 16 |
|  | | | | | | | **124** |



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| **Course Code** | **14ME2051 / 17ME2046** | **Duration** | **3hrs** |
| **Course Name** | **REFRIGERATION AND AIRCONDITIONING** | **Max. Marks** | **100** |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | | **CO / BL** | | **Marks** | | |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | | |
| 1. | Mention the other name of Bell-Coleman cycle. | | | CO1 / U | | 1 | | |
| 2. | The simple air cooling system is good for \_\_\_\_\_\_\_\_\_\_ flight speed. | | | CO1 / U | | 1 | | |
| 3. | Compression efficiency is compared against \_\_\_\_\_\_\_\_\_\_. | | | CO2 / R | | 1 | | |
| 4. | In a refrigeration system, the expansion device is connected between the \_\_\_\_\_. | | | CO2 / U | | 1 | | |
| 5. | How many vapour-compression cycles with different refrigerants are used in a cascade refrigeration system? | | | CO3 / A | | 1 | | |
| 6. | Multiple refrigerants can be used in the cascade refrigeration system. True or false? | | | CO3 / U | | 1 | | |
| 7. | The study of the air-water mixture is called \_\_\_\_\_\_\_\_. | | | CO4 / R | | 1 | | |
| 8. | Adiabatic cooling lines which are the same (for water vapour only) as the wet bulb or psychrometric line. True or False? | | | CO4 / A | | 1 | | |
| 9. | Rapid heating and cooling of milk is called as \_\_\_\_\_\_\_\_\_\_. | | | CO5 / R | | 1 | | |
| 10. | Which refrigerant is used in Ice plant? | | | CO6 / U | | 1 | | |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | | Define air refrigeration. | | | CO1 / R | | 3 |
| 12. | | What are absorbers in vapour absorption refrigeration systems? | | | CO 2/ U | | 3 |
| 13. | | Describe the advantages of a cascade refrigeration system. | | | CO 3/ U | | 3 |
| 14. | | Enumerate bypass factor. | | | CO 4/ A | | 3 |
| 15. | | Write short notes on infiltration. | | | CO 5 / U | | 3 |
| 16. | | Draw the layout of the Ice plant. | | | CO 6 / 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. | Enumerate the advantages of a boot-strap cycle? | | CO1 /A | | 4 |
| b. | A dense air refrigeration machine works on the Bell-Coleman cycle with 10 TR capacity. The cooler pressure is 4.2 bar and the refrigerator pressure is 1.4 bar. The air is cooled to a temperature of 50°C in the cooler. The temperature of the air fromthe inlet to the compressor is -20°C. Determine the COP of the system. | | CO1 /An | | 8 |
|  | |  |  | |  | |  |
| 18. | | a. | Draw a neat diagram of the lithium bromide absorption refrigeration system and explain its working. | | CO2 / A | | 8 |
| b. | State the merits and demerits of vapour compression and vapour absorption refrigeration system. | | CO2 / U | | 4 |
|  | |  |  | |  | |  |
| 19. | | a. | Describe and explain the working principle of a cascade refrigeration system with a neat sketch. | | CO3 / U | | 6 |
| b. | Draw p-h and T-S diagrams of a cascade refrigeration system. | | CO3 /A | | 6 |
|  | |  |  | |  | |  |
| 20. | |  | Discuss briefly the followings:   1. By-pass factor of heating and cooling coil 2. Efficiency of heating and cooling coil 3. Humidification and dehumidification processes. | | CO4 /A | | 12 |
|  | |  |  | |  | |  |
| 21. | |  | A sling psychrometer reads 40°C DBT and 28°C WBT. Calculate the following:  i) Specific humidity  ii) Relative humidity  iii) Vapour density in air  iv) Enthalpy of mixture per kg of dry air. | | CO5 /An | | 12 |
|  | |  |  | |  | |  |
| 22. | |  | A single-stage ammonia refrigeration system has a cooling capacity of 500 kW. The evaporator and condenser temperatures are -10°C and 30°C respectively. Assuming saturation cycle, determine compressor work and C.O.P. | | CO2 / E | | 12 |
|  | |  |  | |  | |  |
| 23. | |  | Discuss the factors governing optimum effective temperature. | | CO3 / U | | 12 |
|  | |  | **Compulsory:** | | | | |
| 24. | |  | Explain the central air conditioning system, its classification and its applications. | | CO6 / U | | 12 |

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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 equipment |
| CO6 | Select suitable refrigeration and air-conditioning systems for various applications |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 3 | 2 | 4 | 8 | - | - | 17 |
| CO2 | 1 | 7 | 8 | - | 12 | - | 28 |
| CO3 | - | 22 | 7 | - | - | - | 29 |
| CO4 | 1 | - | 16 | - | - | - | 17 |
| CO5 | 1 | 3 | - | 12 | - | - | 16 |
| CO6 | - | 16 | - | - | - | - | 16 |
|  | | | | | | | **124** |



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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. | State Pascal's law. | | CO1 | R | 1 |
| 2. | List the three basic types of fluid power control systems. | | CO1 | R | 1 |
| 3. | Name different designs of gear pump. | | CO2 | U | 1 |
| 4. | State the function of servo valve. | | CO2 | U | 1 |
| 5. | List the components of hydraulic power pack unit. | | CO3 | R | 1 |
| 6. | Mention the causes of overheating in hydraulic systems. | | CO3 | An | 1 |
| 7. | Draw the graphical symbol of pneumatic shuttle valve. | | CO4 | A | 1 |
| 8. | Name the different types of air motors. | | CO4 | R | 1 |
| 9. | Draw the symbol and truth table of YES gate. | | CO5 | A | 1 |
| 10. | Identify the purpose of time delay valve. | | CO5 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain the fundamental law crucial to the application of fluid power and elaborate on its importance. | | CO1 | A | 3 |
| 12. | Classify the types of materials used for seals, and highlight the type of sealing materials used for high temperature operations. | | CO2 | U | 3 |
| 13. | List the parameters that relate to the selection of hydraulic cylinders. | | CO3 | A | 3 |
| 14. | Describe in detail the key factors in the selection of pneumatic actuators. | | CO4 | A | 3 |
| 15. | Differentiate the closed and open loop system. | | CO5 | U | 3 |
| 16. | List the basic components of electrical controls. | | 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. | Differentiate between hydraulics and pneumatics system. | CO1 | An | 6 |
|  | b. | Identify the distinct characteristics of hydraulic fluid properties and provide descriptions for each. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | A hydraulic motor has a displacement of 150 cm3 and operates with a pressure of 120 bar and a speed of 2500 rpm. The actual flow rate consumed by the motor is 0.00781 m3/s and the actual torque delivered by the motor is 250 Nm. Find a. Volumetric efficiency, b. Mechanical efficiency, c. Overall efficiency and d. Power delivered by the motor. | CO2 | An | 10 |
|  | b. | List the types of direction control valve and draw a graphical symbol of two position four way valve. | CO2 | U | 2 |
|  |  |  |  |  |  |
| 19. | a. | Design a fail-safe circuit for hydraulic system to protect from overload. | CO3 | An | 6 |
|  | b. | Develop and explain the regenerative circuit for hydraulic system. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the air treatment process with suitable sketch. | CO4 | A | 4 |
|  | b. | Explain the working principle of air lubricator with suitable neat sketch. | CO4 | A | 8 |
|  |  |  |  |  |  |
| 21. | a. | Develop a pneumatic circuit for punching operation and show a displacement step diagram. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain the accumulator as an auxiliary power source with suitable sketch. | CO2 | A | 6 |
|  | b. | Explain the internal gear pump with suitable sketch, and give few advantages and disadvantages. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Design and explain the diaphragm type accumulator. | CO3 | A | 6 |
|  | b. | Develop a hydraulic circuit for synchronizing two cylinders with flow control valve. | CO3 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Design a hydraulic circuit with ladder diagram for control of cylinder using a single limit switch. | CO6 | An | 6 |
|  | b. | List the various approaches for entering the program in the PLC and provide a brief explanation of one of these approaches. | CO6 | A | 6 |

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

|  |  |
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|  | **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 / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 |  | 9 | 6 |  |  | 17 |
| CO2 |  | 7 | 6 | 16 |  |  | 29 |
| CO3 | 1 |  | 9 | 19 |  |  | 29 |
| CO4 | 1 |  | 16 |  |  |  | 17 |
| CO5 | 2 | 3 |  | 12 |  |  | 17 |
| CO6 |  | 3 | 6 | 6 |  |  | 15 |
|  | | | | | | | **124** |



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| --- | --- | --- | --- |
| **Course Code** | **18ME2034** | **Duration** | **3hrs** |
| **Course Name** | **OPERATIONS RESEARCH** | **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 the applications of Operations Research. | | | CO 1 | U | 1 |
| 2. | Compare ‘decision variable’ with ‘slack variable’. | | | CO 1 | U | 1 |
| 3. | Name the three methods to arrive initial solution in transportation problem. | | | CO 2 | U | 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 | | | | CO 2 | U | 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 | | | | CO 3 | A | 1 |
| 6. | Identify the significance of the dummy activity(3-4) in the following network. | | | CO 3 | U | 1 |
| 7. | Distinguish ‘inventory ordering cost’ and ‘inventory holding cost’. | | | CO 4 | U | 1 |
| 8. | Interpret the concept of Economic Ordering Quantity (EOQ). | | | CO 5 | U | 1 |
| 9. | Differentiate ‘inter arrival time’ and ‘arrival rate’. | | | CO 6 | U | 1 |
| 10. | List some applications of queuing. | | | CO 6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | | |
| 11. | Compare the ‘unbounded solution space’ with ‘bounded solution space’ of LPP graphical problem. | | CO 1 | | An | 3 |
| 12. | 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 | | | CO 2 | | A | 3 |
| 13. | Interpret the method to resolve degeneracy in transportation problem. | | CO 3 | | A | 3 |
| 14. | Compute allocation in the following table (Operators I,II and III and Machines P,Q and R)   |  |  |  |  | | --- | --- | --- | --- | |  | P | Q | R | | I | 0 | 15 | 2 | | II | 5 | 0 | 3 | | III | 17 | 8 | 0 | | | CO 4 | | 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. | | CO 5 | | A | 3 |
| 16. | List the properties of Transient and Steady state of Queuing system. | | CO 6 | | 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. | 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. | CO 1 | | A |  |
|  |  |  |  | |  |  |
| 18. | a. | A food manufacturing company has 2 processing plants P1 and P2; three fruit cultivators are willing to supply fruits in the following quantities. Cultivator C1 is willing to supply 190 quintal at the rate of Rs 100 per quintal, Cultivator C2 is willing to supply 290 quintal at the at the rate of Rs 90 per quintal, Cultivator C3 is willing to supply 390 quintal at the rate of Rs 80 per quintal. Cost of transportation from cultivator to plants is given below   |  |  |  | | --- | --- | --- | |  | P1 | P2 | | C1 | 20 | 26 | | C2 | 9 | 16 | | C3 | 49 | 31 |   Plant requirements and labour costs are as follows   |  |  |  | | --- | --- | --- | | Details | Plant P1 | Plant P2 | | Requirement in quintal | 440 | 360 | | Labour cost  Rupeess/Quintal | 30 | 22 |   Processed fruits are sold at the rate of Rs. 480 per quintal .objective of this problem to maximize profit, Infer the initial solution by North-west corner method. | CO 1 | | An |  |
|  |  |  |  | |  |  |
| 19. | a. | In a small machine shop, there are 4 operators available to assign jobs for the day. There are 5 jobs and profit in rupees for each operator on each job is represented in the table   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | JI | J2 | J3 | J4 | J5 | | O 1 | 6.30 | 5.90 | 6.80 | 10.20 | 7.40 | | O 2 | 8.00 | 10.10 | 9.00 | 8.50 | 7.30 | | O 3 | 8.70 | 8.80 | 9.10 | 7.60 | 6.50 | | O 4 | 7.30 | 8.30 | 6.40 | 7.70 | 8.00 |   Determine the optimal assignment and find out which job is to be rejected. | CO 2 | | An |  |
|  |  |  |  | |  |  |
| 20. | a. | The various time estimates of activities involved in a project are given below   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Activities | 1-2 | 1-3 | 2-4 | 2-3 | 3-4 | 3-5 | 4-6 | 5-6 | | Optimistic  Time  (Days) | 2 | 4 | 2 | 2 | 0 | 3 | 6 | 1 | | Normal  Time  (Days) | 6 | 8 | 3 | 4 | 0 | 6 | 10 | 3 | | Pessimistic  Time  (Days) | 10 | 12 | 4 | 6 | 0 | 9 | 14 | 5 |   Draw the network and determine the expected completion time if the project  Find the variance and SD of project  Determine the probability of completing the project within 23 days and 25 days  What is the probability that the project will be completed at least 5 days earlier than the expected time? | CO 3 | | An |  |
|  |  |  |  | |  |  |
| 21. | 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 | | CO 4 | | E |  |
|  |  |  |  | |  |  |
| 22. | a. | Draw network for activities (total 10 activities) of a project which is shown in the following table and perform forward and backward scheduling.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Activities | 1-2 | 2-3 | 2-4 | 3-5 | 3-6 | | Duration  (Days) | 2 | 3 | 5 | 4 | 1 |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Activities | 4-6 | 4-7 | 5-8 | 6-8 | 7-8 | | Duration  (Days) | 6 | 2 | 8 | 7 | 4 |   Compute the critical path of the project and also find out the **total float/total slack** available for each activity. | CO 2 | | E |  |
|  |  |  |  | |  |  |
| 23. | a. | Draw a graph and conduct ABC analysis for the following 10 items in an inventory.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | 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 | | CO 6 | | An |  |
| **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, find   * Utilization factor * Average queue length * Average waiting time of customer | CO 5 | | E |  |

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

|  |  |
| --- | --- |
|  | **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. |

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



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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** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define curl and write the significance. | | CO1 | U | 1 |
| 2. | Classify the forces that exert influence on a fluid particle. | | CO1 | An | 1 |
| 3. | Differentiate between uniform and non-uniform grids | | CO2 | An | 1 |
| 4. | Define ‘cartesian mesh’. | | CO2 | R | 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. | Write the condition to use continuity equation as transport equation for density. | | CO5 | U | 1 |
| 10. | Define’ Reynold’s number. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Identify the common types of boundary conditions used in CFD. | | CO1 | A | 3 |
| 12. | Determine the expression for second derivative using the Taylor series. | | CO2 | A | 3 |
| 13. | Explain Crank-Nicholson’s scheme. | | CO3 | A | 3 |
| 14. | Compare hybrid and power law schemes. | | CO4 | An | 3 |
| 15. | Write the expression for pressure gradient for u-cell control volume in staggered grid. | | CO5 | A | 3 |
| 16. | Sketch the boundary layer for the flow on a flat plate. | | 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 staggered grid in detail explaining the concept of correct prediction of pressure field. | 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. | What is the criterion for a turbulence model to be useful in a CFD code? Explain two equation turbulence model. | CO6 | An | 12 |

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

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|  | **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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 1 | 15 | 13 |  |  | 29 |
| CO2 | 1 |  | 15 | 1 |  |  | 17 |
| CO3 | 1 |  | 4 | 12 |  |  | 17 |
| CO4 | 1 |  | 13 | 15 |  |  | 29 |
| CO5 |  | 1 | 3 | 12 |  |  | 16 |
| CO6 | 1 |  |  | 15 |  |  | 16 |
|  | | | | | | | **124** |



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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** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define “Ton of Refrigeration”. | | CO1 | R | 1 |
| 2. | Mention the other name of Bell-Coleman cycle. | | CO1 | U | 1 |
| 3. | Identify the expansion device in a refrigeration system which is connected between two parts. | | CO2 | U | 1 |
| 4. | State True or False: ‘Multiple refrigerants can be used in the cascade refrigeration system’. | | CO3 | U | 1 |
| 5. | Describe cascade refrigeration system. | | CO3 | R | 1 |
| 6. | List a few refrigerants that are banned due to ozone depletion potential. | | CO4 | R | 1 |
| 7. | Identify the properties of mixtures that are crucial to study of physical and thermodynamic in Psychrometry. | | CO4 | U | 1 |
| 8. | Identify the process of removing from the air in dehumidification. | | CO5 | U | 1 |
| 9. | Trace the maximum temperature required for the Pasteurization process. | | CO6 | U | 1 |
| 10. | Name the refrigerant used in Ice plant. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Sketch the Boot-strap cycle of air refrigeration system, and draw the thermodynamic cycle using Temperature-Entropy diagram. | | CO1 | A | 3 |
| 12. | Classify few desirable properties of an ideal refrigerant. | | CO2 | U | 3 |
| 13. | Explain briefly the working principle of Li- Br vapour absorption refrigeration system. | | CO3 | U | 3 |
| 14. | Define Bypass factor. | | CO4 | U | 3 |
| 15. | Summarize the factors affecting comfort air conditioning process. | | CO5 | U | 3 |
| 16. | Write short notes on Pasteurization process. | | 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. | Explain in detail about the Bell-Coleman refrigeration cycle with T-s and p-v diagram. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Classify different types of condensers used in refrigeration systems with neat sketch. | CO2 | U | 6 |
|  | b. | Solve for the maximum possible C.O.P. if the refrigeration load is 2 tonnes and actual C.O.P is 70% of the maximum C.O.P., find the mass of steam required per hour, take atmospheric temperature as 30°C. In an absorption refrigeration system, the heat is supplied to ammonia generator by condensing steam at 2 bar and 90% dry. The temperature in the refrigerator is to be maintained at -5°C. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain water – ammonia vapour absorption refrigeration system and discuss it’s advantages over vapour compression system. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain the terms i) Grand sensible heat factor ii) Room sensible heat factor. Also describe the method for constructing the Room sensible heat factor line. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the summer air conditioning system for hot and dry condition? Mark the processes on Psychrometric chart? | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | 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. If 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. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 23. | a. | 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. In air conditioning system the inside and outside conditions are: dry bulb temperature 25 °C, RH 50 % and drybulb 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., | CO5 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the following   1. Refrigeration system for food storage plants 2. Train air conditioning system. | CO6 | U | 12 |

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

|  |  |
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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 equipment |
| CO6 | Select suitable refrigeration and air-conditioning systems for various applications |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 1 | 15 | - | - | - | 17 |
| CO2 | - | 10 | 6 | - | - | - | 16 |
| CO3 | 1 | 4 | 12 | - |  | - | 17 |
| CO4 | 1 | 16 | - | - | 12 | - | 29 |
| CO5 | - | 4 | 12 | - | 12 | - | 28 |
| CO6 | 4 | 13 | - | - |  | - | 17 |
|  | | | | | | | **124** |



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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** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Relate the role of good industrial layout with industrial safety. | | CO1 | R | 1 |
| 2. | Indicate the effect of indirect cost due to industrial accidents. | | CO1 | U | 1 |
| 3. | Classify the types of machine guards. | | CO2 | U | 1 |
| 4. | Identify the significance of Zero Mechanical state. | | CO2 | R | 1 |
| 5. | Indicate the purpose of "lockout" procedure. | | CO3 | U | 1 |
| 6. | List the negative consequences of noise on humans. | | CO4 | R | 1 |
| 7. | Write the significance of material safety data sheet (MSDS). | | CO4 | A | 1 |
| 8. | Indicate the role of ‘industrial hygiene’ on the productivity of the industry. | | CO5 | R | 1 |
| 9. | Identify a product which is manufactured using process layout. | | CO5 | U | 1 |
| 10. | Distinguish between natural and artificial lighting. | | CO6 | An | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Write the role of management on Industrial safety. | | CO1 | E | 3 |
| 12. | Explain the indirect costs associated to employees during occupational illness / accidents. | | CO2 | An | 3 |
| 13. | Discuss the factors that influence the selection of material handling equipment. | | CO3 | U | 3 |
| 14. | Distinguish between local effects and systemic effects of toxic substances. | | CO5 | An | 3 |
| 15. | Write down the necessary safety measures that should be followed when working with electrical machines. | | CO4 | A | 3 |
| 16. | Summarize a few adverse effects of poor lighting on the health condition of industrial workers. | | CO6 | E | 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 responsibilities of top level management in enforcing safety in the work environment. | CO1 | A | 6 |
|  | b. | Illustrate how employee involvement plays a crucial role in ensuring workplace safety. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the role of good plant layout in ensuring safety in industries. | CO2 | A | 6 |
|  | b. | Describe the major areas to be safeguarded in manufacturing industries. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain the various types of Personal Protective Equipment that are used to protect employees at work environment. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain the health issues faced by employees due to poor ventilation. | CO4 | An | 6 |
|  | b. | Write the various illnesses associated with heat faced by industrial workers. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. |  | Explain the risks involved in handling hazardous chemicals and their adverse effects on the human body. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Illustrate the safety measures that should be followed to prevent electrical mishaps. | CO4 | U | 6 |
|  | b. | Explain the techniques that can reduce the effect of air pollution in the workplace. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Summarize the biological hazards that exist at work. Discuss the consequences and remedies as well. | CO5 | U | 6 |
|  | b. | Explain the most common routes of entry for toxic substances in the human body. | CO5 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Accidents and illnesses at work are reduced by good sanitation and housekeeping. Justify. | CO6 | A | 6 |
|  | b. | Illustrate the different types of illumination utilized on the work floor and their benefits. | CO6 | U | 6 |

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

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|  | **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 | Appreciate and applying safety procedures in process industries. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 13 | - | - | 3 | - | 17 |
| CO2 | 1 | 1 | 12 | 3 | - | - | 17 |
| CO3 | - | 10 | 18 | - | - | - | 28 |
| CO4 | 1 | 14 | 4 | 6 | - | - | 25 |
| CO5 | 1 | 13 | 4 | 3 | - | - | 21 |
| CO6 | - | 6 | 6 | 1 | 3 | - | 16 |
|  | | | | | | | **124** |



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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** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Identify the function of cylinder liner. | | CO1 | U | 1 |
| 2. | Distinguish between coupes and sedans. | | CO1 | An | 1 |
| 3. | Indicate the purpose of overdrive in an automobile. | | CO2 | U | 1 |
| 4. | Write the working principle of centrifugal clutch. | | CO2 | A | 1 |
| 5. | Distinguish between understeer and oversteer. | | CO3 | An | 1 |
| 6. | Indicate the function of damper in an automobile. | | CO3 | U | 1 |
| 7. | Identify the function of traction control in automobiles. | | CO4 | U | 1 |
| 8. | Distinguish between wheel and tyre. | | CO4 | An | 1 |
| 9. | Identify the benefits of biodiesel over diesel. | | CO6 | U | 1 |
| 10. | Gasohol is a mixture of \_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Compare two wheel drive and four wheel drive. | | CO1 | An | 3 |
| 12. | Identify the functions of a gear box in an automobile. | | CO2 | U | 3 |
| 13. | Distinguish between ‘rolling’ and ‘bouncing’ of an automobile. | | CO3 | An | 3 |
| 14. | Compare disc brake and drum brake. | | CO4 | An | 3 |
| 15. | Identify the benefits of Electronic injection system. | | CO5 | U | 3 |
| 16. | Distinguish between hybrid vehicle and electric vehicle. | | 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 components of IC engine with neat sketches. | CO1 | A | 6 |
|  | b. | Outline the different types of loads acting on the frame of an automobile. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the functions of a differential in a transmission system with a neat sketch. | CO2 | A | 6 |
|  | b. | Distinguish between Hotchkiss drive and Torque tube Drive considering their construction and applications. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Compare independent and dependent suspension systems in terms their constructional features and benefits. | CO3 | An | 6 |
|  | b. | Distinguish between hydraulic power steering system and Electronic power steering system considering their constructional features. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the construction and working of Anti-lock braking system. | CO4 | A | 6 |
|  | b. | Illustrate the construction and working of drum brake. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Turbocharger improves horse power, fuel economy and efficiency of an engine. Justify. | CO5 | E | 6 |
|  | b. | Explain the working principle and salient features of electronic fuel injection system. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Variable valve control technology reduces engine size, fuel consumption and exhaust emissions at all operating conditions. Justify. | CO1 | E | 8 |
|  | b. | Compare Front engine Rear wheel drive with Rear engine Rear wheel Drive. | CO1 | An | 4 |
|  |  |  |  |  |  |
| 23. | a. | Compare Hydraulic and Pneumatic brakes. | CO4 | An | 6 |
|  | b. | Explain the construction and working of electronic brake force distribution. | CO4 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Hydrogen fuel cell technologies has big potential to be used in vehicle or portable power plants as a clean energy supply solution. But there are challenges in its implementation. Justify. | CO6 | E | 12 |

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

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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 and emissions of alternate fuels |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 1 | 6 | 14 | 8 | - | 29 |
| CO2 | - | 4 | 7 | 6 | - | - | 17 |
| CO3 | - | 1 | - | 16 | - | - | 17 |
| CO4 | - | 1 | 18 | 10 | - | - | 29 |
| CO5 | - | 3 | 6 | - | 6 | - | 15 |
| CO6 | - | 2 | - | 3 | 12 | - | 17 |
|  | | | | | | | **124** |



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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** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | \_\_\_\_\_\_\_ production is a type of manufacturing system that uses a series of standardized processes to create a large number of an item in a relatively short time at low cost. | | CO1 | U | 1 |
| 2. | Give an example for thermoplastic material. | | CO1 | U | 1 |
| 3. | Distinguish between amplifying and non-amplifying type of USM tool holders based on their shape. | | CO2 | An | 1 |
| 4. | Identify the mechanism of metal removal in EDM process. | | CO2 | U | 1 |
| 5. | If the metalworking process is carried out above its \_\_\_\_\_\_\_ temperature, it is called as hot working. | | CO3 | U | 1 |
| 6. | Give examples for the explosives used in explosive forming. | | CO3 | U | 1 |
| 7. | Billets are made through \_\_\_\_\_\_\_ casting. | | CO4 | U | 1 |
| 8. | Identify the purpose of using vacuum chamber in Electron Beam Welding. | | CO5 | U | 1 |
| 9. | Arc stability in welding is generally better with a \_\_\_\_\_\_ power supply. | | CO5 | A | 1 |
| 10. | \_\_\_\_ code controls the movement and functioning of the machine in CNC. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Distinguish between production and productivity. | | CO1 | An | 3 |
| 12. | Distinguish between machine tool and cutting tool. | | CO2 | An | 3 |
| 13. | Indicate the significance of recrystallisation temperature. | | CO3 | U | 3 |
| 14. | Identify the difference between moulding and casting. | | CO4 | U | 3 |
| 15. | Distinguish between field start and touch start methods of arc initiation. | | CO5 | An | 3 |
| 16. | Indicate any three benefits of sensors. | | 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 the different types of manufacturing processes with suitable examples. | CO1 | An | 6 |
|  | b. | Classify different types of composites based on reinforcements. Indicate their applications. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the working principle and equipment used in Laser beam machining process. | CO2 | A | 6 |
|  | b. | Explain the working principle and equipment used in Electrochemical machining process. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the working principle and applications of explosive forming. | CO3 | A | 6 |
|  | b. | Distinguish between hot working and cold working processes. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the purpose and components of gating system. | CO4 | A | 6 |
|  | b. | Write about evaporative pattern casting with suitable sketches. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Explain the working principle and equipment used in ultrasonic welding process. | CO5 | A | 6 |
|  | b. | Analyze the effect of different forces during metal transfer on the quality of welded parts. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Distinguish between orthogonal cutting and oblique cutting. | CO2 | An | 6 |
|  | b. | Explain the equipment used in Electric Discharge Machining (EDM). | CO2 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain Electro Hydraulic Forming with a neat sketch. List its advantages, limitations and applications. | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the basic components and functions of NC System. | CO6 | A | 6 |
|  | b. | Robots consistently provide increased productivity and safety. Justify this statement with suitable examples. | CO6 | E | 6 |

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

|  |  |
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|  | **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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 2 | - | 15 | - | - | 17 |
| CO2 | - | 1 | 18 | 10 | - | - | 29 |
| CO3 | - | 5 | 18 | 6 | - | - | 29 |
| CO4 | - | 5 | 12 | - | - | - | 17 |
| CO5 | - | - | 7 | 9 | - | - | 16 |
| CO6 | - | 4 | 6 | - | 6 | - | 16 |
|  | | | | | | | **124** |



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| **Course Code** | **18ME2074** | **Duration** | **3hrs** |
| **Course Name** | **RENEWABLE ENERGY 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. | What are the types of non-convectional energy sources? | | CO1 | U | 1 |
| 2. | State the reason for the rise of world energy needs. | | CO1 | R | 1 |
| 3. | What are the two types of solar collectors? | | CO2 | An | 1 |
| 4. | Instrument used for measuring beam radiation is \_\_\_\_\_\_\_\_\_\_. | | CO2 | A | 1 |
| 5. | The term biomass is referred to \_\_\_\_\_\_\_\_\_\_. | | CO3 | U | 1 |
| 6. | Wind energy systems is used to convert \_\_\_\_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_\_\_. | | CO3 | E | 1 |
| 7. | Power generation contains\_\_\_\_\_\_\_\_\_\_. | | CO4 | C | 1 |
| 8. | How is OTEC caused? | | CO4 | A | 1 |
| 9. | Which turbine can be mounted vertically and horizontally? | | CO5 | R | 1 |
| 10. | Efficiency of geothermal plant is \_\_\_\_\_\_\_\_\_\_. | | CO6 | E | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Write differences between renewable and nonrenewable sources. | | CO1 | U | 3 |
| 12. | List out various photovoltaic solar energy applications. | | CO2 | An | 3 |
| 13. | Discuss the working principle of wind turbine generator. | | CO3 | U | 3 |
| 14. | Write the characteristics of ethanol. | | CO4 | U | 3 |
| 15. | List out components of tidal power plant. | | CO5 | R | 3 |
| 16. | How hydrogen can be a fuel for vehicles? | | 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. | What are the advantages and disadvantages of non-conventional energy sources? | CO1 | U | 6 |
|  | b. | What are the limitations of conventional energy sources? | CO1 | R | 6 |
|  |  |  |  |  |  |
| 18. | a. | Express the estimation process of solar radiation. | CO2 | A | 6 |
|  | b. | Illustrate on direct and indirect utilization of solar energy. | CO2 | C | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the classification of biomass gasifiers. | CO3 | E | 6 |
|  | b. | Explain in detail regarding the applications of gasifers. | CO3 | E | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the site selection for wind energy systems. | CO4 | A | 6 |
|  | b. | Environmental impacts due to wind energy systems. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Explain the wave energy conversion devices. | CO5 | U | 6 |
|  | b. | What are the uses, advantages and disadvantages of tidal energy? | CO5 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain magneto hydrodynamic systems with diagram. | CO6 | R | 6 |
|  | b. | Summarize the hydrogen fuel cell. | CO6 | C | 6 |
|  |  |  |  |  |  |
| 23. | a. | Discuss about photovoltaic cell and its advantages. | CO1 | An | 6 |
|  | b. | Outline all the photovoltaic solar applications. | CO2 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the working of wind turbine with neat diagram. | CO3 | U | 6 |
|  | b. | Compare the advantages and disadvantages of wind energy. | CO3 | R | 6 |

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

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|  | **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. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 7 | 10 |  | 6 |  |  | 23 |
| CO2 |  |  | 13 | 4 |  | 6 | 23 |
| CO3 | 6 | 10 |  |  | 13 |  | 29 |
| CO4 |  | 3 | 7 | 6 |  | 1 | 17 |
| CO5 | 4 | 12 |  |  |  |  | 16 |
| CO6 | 6 |  |  |  | 1 | 9 | 16 |
|  | | | | | | | **124** |



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| **Course Code** | **18ME3039** | **Duration** | **3hrs** |
| **Course Name** | **COMPUTER INTEGRATED MANUFACTURING SYSTEMS** | **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. | Explain the significance and scope of CAD/CAM/CIM in manufacturing systems with a neat block diagram. | CO1 | U | 10 |
|  | b. | Classify the types of automation relative to production quantity and product variety with appropriate sketches and discuss their advantages and limitations. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Enumerate ten significant objectives of a manufacturing system with an example for each objective. | CO1 | A | 10 |
|  | b. | Discuss the following functional sequence of activities that support manufacturing systems with a neat flow diagram. (i) business functions, (ii) product design, (iii) manufacturing planning, and (iv) manufacturing control. | CO1 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain ten important strategies that should be implemented in the industries for automation and process improvement. | CO2 | A | 10 |
|  | b. | Draw a neat schematic sketch and explain the three phases in the automation migration strategy. | CO2 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Suggest the important stages of the ‘USA Principle’ to be followed by the industries for successful manufacturing and automation processes. | CO2 | A | 10 |
|  | b. | Summarize the five levels of automation and control in manufacturing industries with a neat flowchart. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the advantages of the manufacturing of grouping work parts into families. Sketch the process type of un-grouped plant layout and grouped plant layout for batch production in a machine shop. | CO3 | A | 10 |
|  | b. | Tabulate the design and manufacturing attributes typically included in a group technology classification and coding system. Explain the significance of group technology. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Classify the integrated functions of production planning and control that are required to plan the factory resources effectively to achieve the desired output. | CO4 | An | 10 |
|  | b. | Categorize the set of activities in the production control that are concerned with shop floor control (SFC). Explain these with a neat schematic diagram. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 7. | a. | Compare the analogue control loop with the direct digital control components that calculate the desired values of the input parameters and set points. | CO5 | An | 10 |
|  | b. | Distinguish the merits and demerits of In-line and Rotary indexing (dial-indexing) machines in an automated production line system. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the working methodology of a retrieval/variant computer-aided process planning system (CAPP) CAPP system with a neat flowchart. | CO5 | An | 10 |
|  | b. | Distinguish the major advantages of the Generative CAPP system over the Retrieval CAPP system and explain its expert systems applications. | CO5 | An | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Summarize the six important features that characterize the manufacturing systems that can be classified as reconfigurable systems. | CO6 | E | 10 |
|  | b. | Explain the four significant characteristics of agility that tend to be exhibited in manufacturing companies. | CO6 | E | 10 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Demonstrate the Group Technology concepts in a manufacturing environment. |
| CO2 | Influence cellular manufacturing and its performance in an automated production environment. |
| CO3 | Estimate utilization and performance measures of each workstation in FMS. |
| CO4 | Evaluate database simulation accuracy in a FMS system. |
| CO5 | Analyse the automated manufacturing systems for FMS. |
| CO6 | Implement modern manufacturing support systems for the realization of Industry 4.0. |

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



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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** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | State parallelogram law of forces. | | CO1 | U | 1 |
| 2. | Define Equilibrium. | | CO1 | R | 1 |
| 3. | Discuss Varignon’s theorem. | | CO2 | U | 1 |
| 4. | State the types of supports in a beam. | | CO2 | U | 1 |
| 5. | The moment of inertia (Ixx) of a triangle of width (b) and height (h) is given by \_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO3 | R | 1 |
| 6. | The centroid for a semi-circle is \_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO3 | R | 1 |
| 7. | Describe the term ‘Range’ of a projectile. | | CO4 | U | 1 |
| 8. | Discuss D’Alembert’s principle. | | CO4 | U | 1 |
| 9. | Describe Impulse and momentum method. | | CO5 | R | 1 |
| 10. | Define limiting friction. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Distinguish between collinear and concurrent force system. | | CO1 | U | 3 |
| 12. | State Lami’s Theorem. | | CO2 | R | 3 |
| 13. | Discuss the parallel axis theorem. | | CO3 | U | 3 |
| 14. | A car moving with a velocity of 20 m/s is brought to rest by applying brakes, in 6 seconds. Calculate the retardation. | | CO4 | A | 3 |
| 15. | Discuss and derive the Work Energy equation. | | CO5 | U | 3 |
| 16. | Describe about the laws of 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. | a. | An unknown force P keeps the four coplanar concurrent forces in equilibrium shown below. Compute the force P and its direction.  18_0 | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Two rollers, each weighing 50 N and of radius 10 cm rest in a  horizontal channel of width 36 cm, as shown in the figure. Analyze the  reaction at the point of contacts A, B and C.  1B | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Estimate the moment of inertia of a T-section with flange as 150 mm × 50 mm and web as 150 mm × 50 mm about X-X and Y-Y axes through the centre of gravity of the section. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | A vehicle moves along a straight line whose equation of motion is given by s = 12t + 3t2 – 2t3, where (s) is in metres and (t) is in seconds. calculate  (i) velocity and acceleration at start, and  (ii) acceleration, when the velocity is zero. | CO4 | A | 6 |
|  | b. | An elevator in an industry, is required to carry a body of mass 100 kg. Calcuate the force exerted by the body on the floor of the lift, when (a) the lift is moving upwards with retardation of 0.8 m/s2 ; (b) moving downwards with a retardation of 0.8 m/s2. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | A sphere of mass 1 kg moving with a velocity of 2 m/s impinges directly on a sphere of mass 2 kg at rest. If the first sphere comes to rest after the impact, compute the velocity of the second sphere and co-efficient of restitution. | CO5 | A | 6 |
|  | b. | A 10 kg block slides down from rest on an surface, inclined at 25º  with the horizontal. Analyze the speed of the block at the end of 3 seconds. Take co-efficient of kinetic friction between the block and  plane as 0.25. Use Impulse – Momentum equation. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | A simply supported beam, AB of span 6 m is loaded as shown in Fig. Estimate the reactions at the supports A and B of the beam. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | Two blocks A and B of weight 80 N and 60 N are connected by a string,  passing through a smooth pulley, as shown in the fig. Evaluate the  acceleration of the body and the tension in the string. Use work-energy  method.  4b | CO5 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | A uniform ladder of length 3.25 m and weighing 250 N is placed against a smooth vertical wall with its lower end 1.25 m from the wall. The coefficient of friction between the ladder and floor is 0.3.  Calculate the frictional force acting on the ladder at the point of contact between the ladder and the floor. | CO6 | An | 12 |

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

|  |  |
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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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 4 | 12 | - | - | - | 17 |
| CO2 | 3 | 2 | - | 24 | - | - | 29 |
| CO3 | 2 | 3 | - | 12 | - | - | 17 |
| CO4 | - | 2 | 15 | - | - | - | 17 |
| CO5 | 1 | 3 | 6 | 18 | - | - | 28 |
| CO6 | - | 4 | - | 12 | - | - | 16 |
|  | | | | | | | **124** |



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| **Course Code** | **19ME2020** | **Duration** | **3hrs** |
| **Course Name** | **DRONE 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. | List two types of payloads of a drone. | | CO1 | R | 1 |
| 2. | Nuclear radiation detection by humans is often termed a \_\_\_\_\_\_\_\_\_\_role. | | CO1 | R | 1 |
| 3. | Flight stability of a drone is carried out by controlling the \_\_\_\_\_\_\_\_\_\_ in the opposite direction. | | CO2 | R | 1 |
| 4. | State the terms of the following with respective to drone flight control: Pitch, Yaw and Roll. | | CO2 | R | 1 |
| 5. | The distance between any two given points on a rigid body remains \_\_\_\_\_\_\_\_\_. | | CO3 | R | 1 |
| 6. | The pressure under the wings of an aircraft increases with a decrease in \_\_\_\_\_\_\_\_\_\_\_. | | CO3 | R | 1 |
| 7. | 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. | | CO4 | R | 1 |
| 8. | The amount of lift produced is equal to the product of the mass flow of air entrained and the velocity *‘u’* that is given to it in the downward direction is \_\_\_\_\_\_\_. | | CO4 | R | 1 |
| 9. | The combustion frequency of a small two-cycle engine operating at, typically, 5000 rpm will produce noise predominantly at about\_\_\_\_\_\_\_\_\_. | | CO5 | R | 1 |
| 10. | Directorate General of Civil \_\_\_\_\_\_\_\_\_\_ is the government body that regulates the permission to fly drones in India. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Describe the features and applications of *‘MQ Reaper’* developed by the USA. | | CO1 | U | 3 |
| 12. | Sketch neatly Bernoulli’s principle of lift and drag for an aircraft wing. | | CO2 | U | 3 |
| 13. | List out the typical action forces with the sketched notations as examples. | | CO3 | U | 3 |
| 14. | The thermal signature of a drone can be detected by \_\_\_\_\_\_\_\_ camera. | | CO4 | U | 3 |
| 15. | Describe the significant application of radio frequencies in drone usage. | | CO5 | U | 3 |
| 16. | How does the concept of *‘Radar Confusion’* help the drone in military applications? | | 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 covert and research roles carried out by drones. | CO1 | A | 6 |
|  | b. | Summarize the features and specifications of ‘*Firebird and Pathfinder* drones. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the working features of HALE, MALE, MUAV and UCAV. | CO1 | A | 6 |
|  | b. | Discuss the environmentally critical roles carried out by the drones. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the economic aspects of the design and development of drones. (a) First Costs and (b) Operating Costs. | CO2 | A | 6 |
|  | b. | Enumerate the cost of the basic elements in fabricating quadcopter drones. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Articulate the main reasons for designing and developing a drone into stealth mode functioning. | CO2 | A | 6 |
|  | b. | Summarize the Radar imaging payloads that are used for ground target surveillance. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Illustrate the technology that is designed to avoid the audio signatures of a drone. | CO3 | An | 6 |
|  | b. | Describe important steps to consider in the design aspects of a visual detection system to avoid a drone being detected by enemy radars. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Describe the working principle of a drone mid-air collision avoidance system. | CO4 | An | 6 |
|  | b. | Differentiate between autonomous flying and manual flying control parameters of drones. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the applications of drones used by the local police administration in civilian and traffic areas. | CO5 | An | 6 |
|  | b. | Describe the rules and regulations of how drones can be used in the entertainment and commercial fields. | CO5 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Summarize the significant applications of drones in agriculture fertilizer and pesticide spraying operations. | CO6 | An | 6 |
|  | b. | Compare and explain the critical works carried out by the Indian Army and Indian Navy using drones. | CO6 | An | 6 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Understand the design parameters of UAV systems |
| CO2 | Understand the aerodynamics and selection of power plants of UAV systems |
| CO3 | Identify stealth and payload types of UAV systems |
| CO4 | Analyze the principles of communication and control station systems used in UAV’s |
| CO5 | Design launch and recovery systems of UAV’s |
| CO6 | Apply the application of UAS for various applications |

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



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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | State zeroth law of thermodynamics. | | CO1 | U | 1 |
| 2. | Indicate extensive property. | | CO1 | U | 1 |
| 3. | Which quantity is fixed in a closed system? | | CO1 | A | 1 |
| 4. | Write the Property introduced by the first law of thermodynamics. | | CO2 | U | 1 |
| 5. | Prove that (COP of heat pump) = (COP of refrigerator + 1). | | CO2 | A | 1 |
| 6. | Indicate the four processes involved in the Carnot cycle. | | CO2 | U | 1 |
| 7. | Define dryness fraction of steam. | | CO3 | U | 1 |
| 8. | List the difference between mass fraction and mole fraction of an ideal gas mixture. | | CO4 | U | 1 |
| 9. | Dry bulb and wet bulb temperatures are equal at the dew point temperature (True/False). | | CO5 | A | 1 |
| 10. | Express the air-standard efficiency relation of Diesel cycle. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Prove that Cp – Cv = R. | | CO1 | A | 3 |
| 12. | Define Clausius statement of the second law of thermodynamics with source and sink diagram. | | CO2 | U | 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. | Prove that the mole fraction, pressure fraction and the volume fraction of a gas mixture are equal. | | CO4 | A | 3 |
| 15. | Write the difference between Relative Humidity (RH) and Dew Point Temperature (DPT). | | CO5 | A | 3 |
| 16. | Draw the P-V and T-S diagram for Diesel 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. | Apply the first law of thermodynamics to assess an open system and derive the steady flow energy equation to calculate the exit velocity of the nozzle. | CO1 | A | 6 |
|  | b. | A gas at a pressure of 1.2 bar and a volume of 0.5 m3 expands in a piston cylinder arrangement to a volume of 1m3. Find the work done by the gas during an isobaric, isothermal and isochoric processes. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | A cyclic heat engine operates between a source temperature of 800oC and a sink temperature of 30oC. What is the least rate of heat rejection per kW net output of the engine? | CO2 | A | 6 |
|  | b. | When the outside temperature is -10oC, a residential heat pump must provide 3.5x106 kJ per day to a dwelling to maintain its temperature at 20oC. If the electricity cost is Rs. 5.0 per kWh, determine the minimum theoretical operating cost for each day of operation. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 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. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 21. | 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 |
|  |  |  |  |  |  |
| 22. | a. | Express the Dalton’s law of partial pressure and prove that the sum of the mole fractions and the mass fractions of a gas mixture will always be one. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | A piston and cylinder machine contains a fluid system which passes through a complete cycle of four processes. During a cycle, a sum of all the heat transfers is –170 kJ. The system completes 100 cycles per minute. Complete the following table showing the method for each item, and compute the net rate of work output in kW.   |  |  |  |  | | --- | --- | --- | --- | | **Process** | **Q (kJ/min)** | **W (kJ/min)** | **ΔE (kJ/min)** | | a – b | 0 | 2,170 | --- | | b – c | 21,000 | 0 | --- | | c – d | –2,100 | --- | –36, 600 | | d – a | --- | --- | --- | | CO2 | 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 | A | 12 |

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

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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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 2 | 10 | 6 | - | - | 18 |
| CO2 | - | 5 | 7 | 6 | 12 | - | 30 |
| CO3 | - | 1 | - | 3 | 24 | - | 28 |
| CO4 | - | 1 | 15 | - |  | - | 16 |
| CO5 | - | - | 4 | - | 12 | - | 16 |
| CO6 | 1 | 3 | 12 | - | - | - | 16 |
|  | | | | | | | **124** |



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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** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define the factor of evaporation. | | CO1 | R | 1 |
| 2. | Describe the unique features of the high-pressure boilers. | | CO1 | U | 1 |
| 3. | Sketch the Rankine reheat cycle on which steam prime movers work. | | CO2 | U | 1 |
| 4. | Determine regenerative cycle efficiency. | | CO2 | A | 1 |
| 5. | Express the importance of the divergent part in a nozzle. | | CO3 | U | 1 |
| 6. | State the compounding of steam turbine. | | CO3 | R | 1 |
| 7. | Describe swept volume in an air compressor. | | CO4 | U | 1 |
| 8. | Explain the importance of intercooler in a multi stage air compressor. | | CO4 | U | 1 |
| 9. | Classify different refrigeration systems. | | CO5 | A | 1 |
| 10. | Express the equation considering friction for the velocity of steam flowing through the nozzle. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Analyze different factors on which boiler efficiency depends. | | CO1 | A | 3 |
| 12. | Distinguish between a Rankine cycle and a Carnot cycle. | | CO2 | An | 3 |
| 13. | Establish the effect of friction on the steam flow through the nozzle and determine its efficiency. | | CO3 | A | 3 |
| 14. | Construct the equation of work with clearance for a single-stage air compressor. | | CO4 | A | 3 |
| 15. | Discuss the co-efficient of performance of a refrigeration system. | | CO5 | U | 3 |
| 16. | Evaluate the tangential thrust from a composite superimposed diagram. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | The following readings were obtained during a boiler trial of 6 hours duration.  Mean steam pressure = 12 bar ; mass of steam generated = 40000 kg;  mean dryness fraction = 0.85; mean feed water temperature = 30°C,  coal used = 4000 kg. The calorific value of coal = 33400 kJ/kg. Calculate:  (i) Factor of equivalent evaporation;  (ii) Equivalent evaporation from and at 100°C;  (iii) efficiency of the boiler. | CO1 | An | 8 |
|  | b. | Differentiate between water tube boilers and fire tube boilers. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 35 bar and the exhaust pressure is 0.2 bar. Determine  (i) The pump work,  (ii) The turbine workR,  (iii) The Rankine efficiency,  (iv) The condenser heat flou,  (v) The dryness at the end of expansion.  Assume flow rate of 9.5 kg/s | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | The velocity of steam from the nozzle is 1200m/s and nozzle angle is 20° and the mean blade velocity is 400m/s, Note inlet, and outlet blade angles are equal. The mass of the steam flowing through the turbine per hour is 1000kg. Calculate i) blade angles ii) the relative velocity of steam entering the blades and outlet. iii) tangential force on the blade iv) power developed v) blade efficiency. Balade velocity co. efficient is 0.8. | CO3 | An | 8 |
|  | b. | Derive the velocity of steam flowing through the nozzle. | CO3 | A | 4 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate with a neat sketch the working principle of a reciprocating air compressor. | CO4 | An | 8 |
|  | b. | A single stage single acting compressor has to compress air isentropically from 1 bar and 303 K to 5 bar. Find the work of compression required for unit mass flow rate of air. | CO4 | A | 4 |
|  |  |  |  |  |  |
| 21. | a. | Analyze the working principle of a vapour compression refrigeration system with a neat sketch. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain different types of refrigerants and their properties. | CO5 | A | 8 |
|  | b. | Determine the volumetric efficiency of an air compressor. | CO2 | A | 4 |
|  |  |  |  |  |  |
| 23. | a. | Examine the discharge through the nozzle and conditions for maximum value. | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain with a neat sketch the velocity - compounded steam turbine working principle. | CO6 | A | 8 |
|  | b. | Represent the metastable expansion of steam in a nozzle with a neat sketch. | CO6 | U | 4 |

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

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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 the performance of reciprocating compressors. | | | | | | | |
| CO5 | Apply principles of refrigeration and air conditioning for analysis and performance evaluation. | | | | | | | |
| CO6 | Design turbine and nozzles and compressors. | | | | | | | |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | | | |
| **CO / P** | | **R** | **U** | **A** | **An** | **E** | **C** | **Total** | |
| CO1 | | 1 | 5 | 3 |  | 8 |  | 17 | |
| CO2 | |  | 1 | 5 | 3 | 12 |  | 21 | |
| CO3 | | 1 | 1 | 19 | 8 |  |  | 29 | |
| CO4 | |  | 2 | 7 | 8 |  |  | 17 | |
| CO5 | |  | 3 | 9 | 12 |  |  | 24 | |
| CO6 | |  | 5 | 11 |  |  |  | 16 | |
|  | | | | | | | | **124** | |



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| **Course Code** | **19ME3001** | **Duration** | **3hrs** |
| **Course Name** | **ADDITIVE MANUFACTURING AND APPLICATIONS** | **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. | What is the AM process chain, and what are the critical steps involved in taking a digital design to a physical product using additive manufacturing? | CO1 | R | 10 |
|  | b. | Analyze the role of AM in the production of complex geometries and structures. How does AM enable designs that were previously impossible with traditional manufacturing methods? | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Discuss the challenges associated with model reconstruction in rapid prototyping and how they can be addressed. | CO2 | A | 10 |
|  | b. | Explain the concept of reverse engineering and its role in model reconstruction for rapid prototyping. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Differentiate the Principal process for additive manufacturing using   1. Liquid Based Additive Manufacturing 2. Solid Based Additive Manufacturing | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Compare and contrast the types of light sources used in liquid-based AM processes With a neat sketch distinguish the light sources used in Stereo lithography Apparatus (SLA) process and Solid Ground Curing (SGC) process. | CO3 | E | 20 |
|  |  |  |  |  |  |
| 5. | a. | Describe the Selective Laser Sintering (SLS) process with the biomedical applications. | CO4 | U | 10 |
|  | b. | Explain Laser Engineered Net Shaping (LENS) in detail in the aspect of a biomedical application. | CO4 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the principles of Selective Laser Melting (SLM) in rapid manufacturing. | CO5 | A | 20 |
|  |  |  |  |  |  |
| 7. | a. | Briefly describe Electron Beam Melting (EBM) and its role in rapid manufacturing. | CO5 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Analyze the evolution of solid-based 3D printing systems and their role in the development of rapid prototyping techniques. Provide examples of how these systems have accelerated product development in various industries. | CO5 | An | 10 |
|  | b. | Explain the role of liquid-based 3D printing in the creation of customized medical implants and prosthetics. Share case studies that demonstrate the personalized solutions offered by this technology. | CO5 | A | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Develop a novel orthopedic device that integrates advanced materials and technologies to improve patient outcomes and comfort. | CO6 | A | 10 |
|  | b. | Design a concept for a fuel-efficient aircraft that reduces carbon emissions. Justify your design choices based on aerodynamic principles. | CO6 | A | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Recognize the need for additive manufacturing in the modern industry |
| CO2 | Illustrate techniques for processing of CAD models for additive manufacturing |
| CO3 | Summarize the importance of additive manufacturing in product development cycle |
| CO4 | Articulate the construction, working principles and process variables of various additive  manufacturing technologies |
| CO5 | Correlate the selection of appropriate additive manufacturing techniques and product  development |
| CO6 | Design additive manufacturing process to solve real time industrial problems |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 10 |  |  | 10 |  |  | 20 |
| CO2 |  | 10 | 10 |  |  |  | 20 |
| CO3 |  | 20 |  |  | 20 |  | 40 |
| CO4 |  | 20 |  |  |  |  | 20 |
| CO5 |  | 20 | 30 | 10 |  |  | 60 |
| CO6 |  |  | 20 |  |  |  | 20 |
|  | | | | | | | **180** |

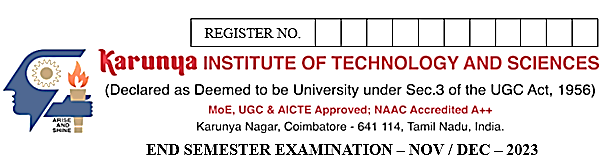


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| **Course Code** | **20ME1006** | **Duration** | **3hrs** |
| **Course Name** | **PROFESSIONAL ETHICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Define ‘Ethics’. | | | CO1 | R | 1 |
| 2. | Describe Professionalism. | | | CO1 | R | 1 |
| 3. | Discuss the principle of duty ethics. | | | CO2 | U | 1 |
| 4. | Summarize the key effectiveness of society activities. | | | CO2 | U | 1 |
| 5. | Explain the term ‘Consequentialism’. | | | CO3 | U | 1 |
| 6. | Define Engineering Ethics. | | | CO3 | R | 1 |
| 7. | Define the term Uncertainty. | | | CO4 | R | 1 |
| 8. | Describe the term professional rights. | | | CO5 | R | 1 |
| 9. | Discuss about Employee rights. | | | CO5 | U | 1 |
| 10. | Summarize the need for peer reviews. | | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | List the limitations of Code of Ethics. | | | CO1 | R | 3 |
| 12. | List some examples of Improved Safety. | | | CO2 | R | 3 |
| 13. | Relate the term Integrity in work ethics. | | | CO3 | A | 3 |
| 14. | Illustrate the steps involved in detection of falsified data. | | | CO4 | U | 3 |
| 15. | Explain the safety measures that an engineer should know before assessing the safety of any product. | | | CO5 | U | 3 |
| 16. | List the objectives of collective bargaining. | | | 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. | |  | Discuss the professional ethics in work environment. | CO1 | U | 12 |
|  | |  |  |  |  |  |
| 18. | |  | Define Conflicts of Interest and its significance in decision making process. | CO2 | R | 12 |
|  | |  |  |  |  |  |
| 19. | |  | Explain Codes of ethics along with its functions and limitations. | CO3 | U | 12 |
|  | |  |  |  |  |  |
| 20. | |  | Illustrate the entire process of collecting the research data. | CO4 | A | 12 |
|  | |  |  |  |  |  |
| 21. | |  | Describe the entire process in writing a technical manuscript and its review process. | CO4 | R | 12 |
|  | |  |  |  |  |  |
| 22. | |  | Explain the various Occupational Crimes in the work environment and mention the necessary steps to reduce it. | CO5 | U | 12 |
|  | |  |  |  |  |  |
| 23. | |  | Illustrate some common unethical behaviour in the work environment. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | |  | Explain the concept of Risk Benefit analysis with example. | CO5 | U | 12 |

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|  | **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 Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 5 | 12 | - | - | - | - | 17 |
| CO2 | 15 | 2 | - | - | - | - | 17 |
| CO3 | 1 | 13 | 3 | - | - | - | 17 |
| CO4 | 13 | 3 | 12 | - | - | - | 28 |
| CO5 | 4 | 28 | - | - | - | - | 32 |
| CO6 | - | 1 | 12 | - | - | - | 13 |
|  | | | | | | | **124** |



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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. | Highlight the scope of developing a prototype of a product. | | CO1 | U | 1 |
| 2. | Define: Concurrent design and manufacturing. | | CO1 | U | 1 |
| 3. | State how model reconstruction is used in 3D printing technology. | | CO2 | U | 1 |
| 4. | Mention one software used for CAD model slicing. | | CO2 | U | 1 |
| 5. | Expand SLA. | | CO3 | U | 1 |
| 6. | Explain how part quality could be achieved in SGC. | | CO3 | U | 1 |
| 7. | Define FDM. | | CO4 | U | 1 |
| 8. | Indicate the advantages of solid based 3D printing in product development. | | CO4 | A | 1 |
| 9. | Expand LENS. | | CO5 | U | 1 |
| 10. | Infer the importance of 3D printing in Aerospace sector. | | CO6 | An | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Differentiate between: Rapid tooling and Virtual prototyping. | | CO1 | An | 3 |
| 12. | Explain the data requirements for 3D printing. | | CO2 | A | 3 |
| 13. | Categorize the resins used in SLA process. | | CO3 | An | 3 |
| 14. | Examine the types of FDM processes used in product development. | | CO4 | A | 3 |
| 15. | State few important aspects of indirect SLS. | | CO5 | U | 3 |
| 16. | Illustrate the various process parameters of mold SDM process. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Illustrate and explain Product Development Cycle in detail. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the benefits and applications of Rapid Tooling in detail. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain in detail: data digitization techniques used in 3D printing. | CO2 | E | 6 |
|  | b. | Examine the applications of digital manufacturing. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Sketch and explain the construction and working of SGC process. | CO3 | A | 6 |
|  | b. | Explain the advantages and limitations of LOM. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Appraise the applications of liquid based 3D printing systems. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 22. | a. | Sketch and explain the construction and working of SLS process. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain in detail: the support structure design with neat sketches. | CO2 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Appraise with a case study the applications of Selective Laser Melting. | CO6 | E | 12 |

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

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|  | **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 / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 14 | 12 | 3 | - | - | 29 |
| CO2 | - | 2 | 9 | - | 18 | - | 29 |
| CO3 | - | 2 | 6 | 3 | - |  | 11 |
| CO4 | - | 1 | 10 | - | 12 | - | 23 |
| CO5 | - | 4 | 12 | - | - | - | 16 |
| CO6 | - | - | 3 | 1 | 12 | - | 16 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | In NC (Numerical Control) machine tool, the position feedback package is connected between \_\_\_\_\_\_\_and \_\_\_\_\_\_\_ | | CO1 | R | 1 |
| 2. | Several machine tools can be controlled by a central computer in \_\_\_\_ | | CO1 | R | 1 |
| 3. | What type of device is used to drive the centre axis of a CNC machine? | | CO2 | R | 1 |
| 4. | State the interpolation method used for rough interpolation. | | CO3 | U | 1 |
| 5. | Frequency of pulses determines \_\_\_\_\_\_\_ | | CO3 | R | 1 |
| 6. | Mention the operating parameters used in adaptive control system, during the machining. | | CO5 | U | 1 |
| 7. | Tracking control minimize the \_\_\_\_\_\_ error. | | CO5 | U | 1 |
| 8. | Write the equation to calculate the position error. | | CO5 | A | 1 |
| 9. | Machine code for Rapid traverse Positioning \_\_\_\_ | | CO6 | U | 1 |
| 10. | In the CNC statement, G71 P100 Q200 U0.2 W.05. The P and Q refers to? | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List the strengths of the servomotor. | | CO1 | R | 3 |
| 12. | Compare encoder and resolver. | | CO2 | U | 3 |
| 13. | Differentiate reference pulse and sample data interpolation methods | | CO3 | U | 3 |
| 14. | Sketch the acceleration/ deceleration profiles used in CNC. | | CO5 | A | 3 |
| 15. | Draw the flowchart for implementing the NCK with Acc/Dec control after interpolation. | | CO5 | An | 3 |
| 16. | State the limitations of the cutter radius compensation. | | 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 NC motion control systems and the interpolation techniques | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the control systems used in CNC Machine tools. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Analyze how a tool can be reached to a position and also explain the use of servomotor compensation in reaching the position. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | A radius of 10 mm to interpolate in clockwise. Analyze this interpolation using Stair’s software interpolator method and explain with a flow chart. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the elements of Programmable logic control and why it is preferred for real time applications. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Develop the CNC Program for machining the 30 mm thick block as shown in figure. | CO6 | A | 8 |
|  | b. | Develop the CNC program for the shown outer profile for the depth of 5 mm in the 10 mm thick block. Take the speed as 1500 rpm and feed as 100 mm/min. | CO6 | A | 4 |
|  |  |  |  |  |  |
| 23. | a. | Construct the CNC program for the profile shown in figure. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Analyze the position response in CNC using PID controller. | 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 / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 5 | 12 |  |  |  |  | 17 |
| CO2 | 1 | 15 |  | 12 |  |  | 28 |
| CO3 | 1 | 4 | 12 |  |  |  | 17 |
| CO4 |  |  | 12 |  |  |  | 12 |
| CO5 |  | 2 | 4 | 15 |  |  | 21 |
| CO6 |  | 4 | 25 |  |  |  | 29 |
|  | | | | | | | **124** |



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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** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name any two needs in engineering design. | | CO1 | R | 1 |
| 2. | Design \_\_\_\_\_\_\_\_\_\_\_\_\_\_, is in place to ensure that the design output can consistently meet the design input. | | CO1 | R | 1 |
| 3. | Define biomaterial. | | CO2 | U | 1 |
| 4. | Define Baddeleyite. | | CO2 | U | 1 |
| 5. | Expand 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. | Identify the primary function of a bone screw. | | CO4 | A | 1 |
| 9. | The polymer compounds that can be found naturally in environment are known as\_\_\_\_\_\_\_\_\_\_\_\_\_polymers. | | CO5 | U | 1 |
| 10. | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_is a graphical tool used to explore the causes of system-level failures. It uses Boolean logic to combine a series of lower-level events. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List the requirements of product, according to Joseph Edward Shigley’s Engineering Design. | | CO1 | A | 3 |
| 12. | Identify various properties for an ideal material or material combination. | | CO2 | E | 3 |
| 13. | Discuss the advantages and disadvantages of BPAP. | | CO3 | A | 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 | A | 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. | Classify hierarchy of needs according to Maslow. | CO1 | An | 6 |
|  | b. | Choose a case study for medical device design control. | CO1 | E | 6 |
|  |  |  |  |  |  |
| 18. | a. | Elaborate the properties of zirconia implant material. | CO2 | C | 8 |
|  | b. | Discuss the implant material requirements in orthopedic applications. | CO2 | C | 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. | Choose various bone defect classifications. | CO4 | A | 6 |
|  | b. | Assess the biocompatibility and its need with the classification of biological tests to be conducted for a device used for implantation. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 21. | a. | Describe the various physical and mechanical properties that can be measured using Universal Testing Machine. | CO4 | A | 6 |
|  | b. | Appraise the paradigm for implant design. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 22. | a. | Compare 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. | a. | Interpret various steps involved in writing own Failure Mode Effects Analysis (FMEA). | CO6 | E | 8 |
|  | b. | List and describe briefly various types of FMEA. | CO6 | An | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | 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

|  |  |
| --- | --- |
| **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 / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | - | 3 | 6 | 6 |  | 17 |
| CO2 | - | 2 | - | - | 3 | 12 | 17 |
| CO3 | - | - | 4 | 12 | 1 | - | 17 |
| CO4 | - | - | 17 | 2 | 12 | - | 31 |
| CO5 | - | 1 | 9 | 6 | - | - | 16 |
| CO6 | - | 3 | 1 | 4 | 18 | - | 26 |
|  | | | | | | | **124** |



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| **Course Code** | **20ME2006** | **Duration** | **3hrs** |
| **Course Name** | **ENGINEERING ECONOMICS AND OPERATION RESEARCH** | **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. | Write the scope of engineering economics. | | CO 1 | | U | 1 |
| 2. | Compare ‘fixed cost’ with ‘variable cost’. | | CO 1 | | An | 1 |
| 3. | In a manufacturing plant, the fixed cost is computed as Rupees 2000, unit selling price is Rupees 50 and unit variable cost is Rupees 30. Calculate the break-even quantity in number of units. | | CO 2 | | An | 1 |
| 4. | Define ‘time value of money’. | | CO 2 | | R | 1 |
| 5. | Compare ‘decision variable’ with ‘slack variable’. | | CO 3 | | An | 1 |
| 6. | Distinguish bounded space and unbounded solution space. | | CO 3 | | U | 1 |
| 7. | What is degeneracy in transportation problem? | | CO 4 | | A | 1 |
| 8. | Articulate the method to balance an assignment problem from its unbalanced condition. | | CO 5 | | A | 1 |
| 9. | Define Burst Event and indicate the same in a network. | | CO 6 | | R | 1 |
| 10. | Identify the use of a dummy activity in a network. | | CO 6 | | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | | |
| 11. | State the ‘Law of Demand’ and its significance. | | CO 1 | | An | 3 |
| 12. | The initial cost of a TIG welding machine is Rs 60,000, its scrap value is Rs 20,000 and its useful life is 5 years. Calculate the depreciation per year using straight line method. | | CO 2 | | A | 3 |
| 13. | There are 6 jobs each of which must go through the two machines A and B in the order A-B, their processing time in hours are given in the table. Determine the optimal sequence; Elapse time of jobs and idle time of machines A & B.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Job | 1 | 2 | 3 | 4 | 5 | 6 | | Processing time in Machine A (Hours) | 3 | 6 | 4 | 7 | 5 | 8 | | Processing time in Machine B (Hours) | 2 | 5 | 6 | 3 | 2 | 8 | | | CO 3 | | A | 3 |
| 14. | Compare ‘transportation problem’ with ‘assignment problem’. | | CO 4 | | An | 3 |
| 15. | Assess the applications of assignment problem. | | CO 5 | | A | 3 |
| 16. | Determine the critical path of the following project   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Activities | 1-2 | 1-4 | 1-3 | 2-4 | 3-4 | | Duration(Weeks) | 3 | 6 | 4 | 5 | 2 | | | CO 6 | | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | | |
| 17. | a. | Summarize the various classifications of costs with respect to engineering economics. | CO 1 | An | | 12 |
|  |  |  |  |  | |  |
| 18. | a. | Evaluate the value engineering procedure. | CO 2 | E | | 6 |
|  |  | The initial cost of a project is Rs 4000, the forecast of year-end cash inflows are Rs. 1900, Rs. 1600, Rs. 1400, Rs. 1200 and Rs 1100 respectively during the 5 years of its useful life. If the rate of interest is 10%, determine the Net Present Value (NPV) of the project using Present Worth Factor (PWF). | CO 2 | A | | 6 |
| 19. | a. | Solve the following Linear Programming problem by **graphical method**  Minimize Z=30X1+20X2 :  Subjected to the constraints  5X1+X2≥10  2 X1+2X2≥12  X1+4X2≥12  X1, X2 ≥ 0 | CO 3 | E | | 12 |
|  |  |  |  |  | |  |
| 20. | a. | Solve the following LPP by **simplex method**  Maximize Z =X1 + 3X2  Subjected to the constraints  X1 ≤ 5  X1 + 2X2 ≤ 10  X2≤ 4  X1 and X2 ≥ 0 | CO 3 | A | | 12 |
|  |  |  |  |  | |  |
| 21. | a. | A food manufacturing company has 2 processing plants P1 and P2; three fruit cultivators are willing to supply fruits in the following quantities. Cultivator C1 is willing to supply 190 quintal at the rate of Rs 100 per quintal, Cultivator C2 is willing to supply 290 quintal at the at the rate of Rs 90 per quintal, Cultivator C3 is willing to supply 390 quintal at the rate of Rs 80 per quintal. Cost of transportation from cultivator to plants is given below   |  |  |  | | --- | --- | --- | |  | P1 | P2 | | C1 | 20 | 26 | | C2 | 9 | 16 | | C3 | 49 | 31 |   Plant requirements and labour costs are as follows   |  |  |  | | --- | --- | --- | | Details | Plant P1 | Plant P2 | | Requirement in quintal | 440 | 360 | | Labour cost  Rupeess/Quintal | 30 | 22 |   Processed fruits are sold at the rate of Rs. 480 per quintal .objective of this problem to maximize profit, Infer the initial solution by North-west corner method. | CO 4 | An | | 12 |
|  |  |  |  |  | |  |
| 22. | a. | A company has 4 plants W,X,Y and Z, Each of which can produce any one of the four products P,Q,R and S. Production cost and sales revenue differ from one plant to another. Determine the optimal allocation/assignment of plant-product which will maximize the profit of the company. Details of production cost and sales revenue are shown in the following tables.   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | **Sales Revenue in thousands of Rupees** | | | | | PLANTS | PRODUCTS | | | | |  | P | Q | R | S | | W | 70 | 60 | 66 | 75 | | X | 73 | 63 | 68 | 72 | | Y | 55 | 58 | 60 | 62 | | Z | 63 | 68 | 71 | 76 |  |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | **Production cost in thousands of Rupees** | | | | | PLANTS | PRODUCTS | | | | |  | P | Q | R | S | | W | 62 | 58 | 60 | 71 | | X | 71 | 58 | 62 | 71 | | Y | 50 | 51 | 53 | 59 | | Z | 61 | 66 | 65 | 70 | | CO 5 | An | | 12 |
|  |  |  |  |  | |  |
| 23. | a. | Draw network for activities (total 10 activities) of a project which is shown in the following table and perform forward and backward scheduling.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Activities | 1-2 | 2-3 | 2-4 | 3-5 | 3-6 | | Duration  (Days) | 2 | 3 | 5 | 4 | 1 |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Activities | 4-6 | 4-7 | 5-8 | 6-8 | 7-8 | | Duration  (Days) | 6 | 2 | 8 | 7 | 4 |   Compute the critical path of the project and also find out the **total float/total slack** available for each activity. | CO 6 | A | | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | The various time estimates of activities involved in a  project are given below.   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Activities | 1-2 | 1-3 | 2-4 | 2-3 | 3-4 | 3-5 | 4-6 | 5-6 | | Optimistic  Time  (Days) | 2 | 4 | 2 | 2 | 0 | 3 | 6 | 1 | | Normal  Time  (Days) | 6 | 8 | 3 | 4 | 0 | 6 | 10 | 3 | | Pessimistic  Time  (Days) | 10 | 12 | 4 | 6 | 0 | 9 | 14 | 5 |   i) Determine the expected completion time of the project with the help of network diagram-(2)  ii) Assess the variance and SD of project (2)  iii) Appraise the probability of completing the project  within 23 days and 25 days (4)  iv) Assess the probability NOT COMPLETING that the project within the due date 25 days (4) | CO 6 | | A | 12 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 1 |  | 16 |  |  | 17 |
| CO2 | 1 |  | 9 | 1 | 6 |  | 17 |
| CO3 |  | 1 | 15 | 1 | 12 |  | 29 |
| CO4 |  |  | 1 | 15 |  |  | 16 |
| CO5 |  |  | 4 | 12 |  |  | 16 |
| CO6 | 2 |  | 27 |  |  |  | 29 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | |
| 1. | One of the primary reasons for automation is to reduce the worker \_\_\_\_\_\_\_\_\_\_\_ or effort. | | | CO1 | R | | 1 |
| 2. | Preventing non-\_\_\_\_\_\_\_\_\_\_\_\_ components or parts from shipping saves a huge amount of money and time. | | | CO1 | R | | 1 |
| 3. | List any four important reasons for implementing automation in the industries. | | | CO2 | R | | 1 |
| 4. | Sketch a diagram depicting the three types of automation relative to production quantity and product variety. | | | CO2 | R | | 1 |
| 5. | Mention the significance of implementing Group Technology in the manufacturing industry. | | | CO3 | R | | 1 |
| 6. | Write the benefits of Group Technology. | | | CO3 | R | | 1 |
| 7. | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_integrates people, data, processes, and business systems and provides a product information backbone for companies and their extended enterprise. | | | CO4 | R | | 1 |
| 8. | Negative profit appears in the \_\_\_\_\_\_\_\_\_\_product life cycle. | | | CO4 | R | | 1 |
| 9. | Decisions made in the \_\_\_\_\_\_\_\_\_ process cost very little in terms of the overall product cost but have a major effect on the cost of the product. | | | CO5 | R | | 1 |
| 10. | The \_\_\_\_\_\_\_\_\_\_\_ engineering methodology aims to develop quality, cost-competitive products in the shortest possible time. | | | CO6 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | List the various ways to identify the part families. | | | CO1 | | U | 3 |
| 12. | Describe the methods of part coding classification. | | | CO2 | | U | 3 |
| 13. | Sketch neatly the PLM architecture. | | | CO3 | | U | 3 |
| 14. | Give a few examples of digital transformation. | | | 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. | Describe briefly the eight reasons for automation with an example. | CO1 | | A | 6 |
|  | | b. | Sketch the Automation pyramid and explain its five levels in detail. | CO1 | | A | 6 |
|  | |  |  |  | |  |  |
| 18. | | a. | Tabulate the basic structure of the Opitz Parts Classification and Coding System. | CO2 | | A | 6 |
|  | | b. | Sketch neatly the machine cell design (types of GT cells) and briefly describe its functions. | CO2 | | A | 6 |
|  | |  |  |  | |  |  |
| 19. | | a. | List some significant real-life applications of the digital transformation. | CO3 | | A | 6 |
|  | | b. | Enumerate the characteristics of the environmentally responsible design. | CO3 | | A | 6 |
|  | |  |  |  | |  |  |
| 20. | | a. | Draw a neat flowchart and explain the Taguchi method that prevents manufacturing defects through process improvements. | CO4 | | A | 6 |
|  | | b. | How does the concept of design of experiments improve the quality of manufacturing? Give a case study of DoE levels on 3D printing. | CO4 | | A | 6 |
|  | |  |  |  | |  |  |
| 21. | | a. | Explain how the QFD plays a major role in the product development process. | CO5 | | An | 6 |
|  | | b. | Depict diagrammatically and explain the significance of the four houses of the complete QFD process. | CO5 | | An | 6 |
|  | |  |  |  | |  |  |
| 22. | | a. | Explain the principles of human factors engineering applied in designing the driver seat and controls of a four-wheeler car. | CO5 | | An | 6 |
|  | | b. | Describe the role of ergonomics in reducing musculoskeletal disorders in industrial workers and increasing overall productivity. | CO5 | | An | 6 |
|  | |  |  |  | |  |  |
| 23. | | a. | Explain the variant type of Computer-aided process planning with a neat sketch. | CO6 | | An | 6 |
|  | | b. | How the generative type of computer-aided process planning is advantageous over the variant type? Use a flowchart to explain the process. | CO6 | | An | 6 |
| **COMPULSORY QUESTION** | | | | | | | |
| 24. | | a. | Sketch a neat schematic diagram that depicts the functions of product data management and explain the concepts and their benefits. | CO6 | | An | 6 |
|  | | b | Draw a neat schematic of a metal scrap recycling plant. Enumerate its economies, advantages and limitations. | CO6 | | An | 6 |

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|  | **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. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **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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| **Course Code** | **20ME2008** | **Duration** | **3 hrs** |
| **Course Name** | **APPLICATION OF MACHINE LEARNING FOR MECHANICAL ENGINEERING SYSTEMS** | **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 Machine Learning. | | CO1 | R | 1 |
| 2. | List the role of regression model. | | CO2 | R | 1 |
| 3. | Define ridge regression. | | CO2 | R | 1 |
| 4. | Describe the term Linear regression. | | CO3 | U | 1 |
| 5. | Define Decision trees. | | CO3 | R | 1 |
| 6. | Describe Probabilistic Clustering. | | CO4 | U | 1 |
| 7. | Identify the types of clustering. | | CO4 | U | 1 |
| 8. | Describe "overfitting" in deep learning. | | CO5 | U | 1 |
| 9. | Describe an application of deep learning. | | CO5 | U | 1 |
| 10. | Define prognostics. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | List the types of machine learning algorithms. | | CO1 | R | 3 |
| 12. | Distinguish regression and classification. | | CO2 | U | 3 |
| 13. | Describe basic structure of a decision tree. | | CO3 | U | 3 |
| 14. | Discuss probabilistic based learning. | | CO4 | U | 3 |
| 15. | Distinguish [Machine Learning and Deep Learning](https://intellipaat.com/blog/interview-question/deep-learning-interview-questions/#1). | | 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 multiple linear regression with an example. | CO2 | A | 6 |
|  | b. | Discuss the Kernel regression neighbor 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. | Differentiate Classification and Clustering. | CO2 | U | 6 |
|  | b. | Write short notes on feature selection using decision tree. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Differentiate between KNN and K means. | 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 reciprocating machines. | CO6 | A | 12 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Obtain the basics terminologies of artificial intelligence and machine learning. |
| CO2 | Formulate and evaluate the prediction models using supervised learning algorithms. |
| CO3 | Design and 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** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Describe Robot as per the Robot Institute of America. | | CO1 | U | 1 |
| 2. | Identify the part that is connected to the manipulator is called \_\_\_\_\_\_\_. | | CO1 | A | 1 |
| 3. | Define SHAKEY. | | CO2 | R | 1 |
| 4. | The robot manipulator is designed to perform a task in\_\_\_\_\_\_\_\_ space. | | CO2 | A | 1 |
| 5. | Natural landmarks require \_\_\_\_modification to the environment. | | 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. | Define laws of robotics. | | CO1 | R | 3 |
| 12. | Illustrate the percept and percept sequence. | | CO2 | U | 3 |
| 13. | Recall the MAP matching navigation. | | CO3 | U | 3 |
| 14. | What are the assumptions 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. | a. | Illustrate in detail about virtual reality. | 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. | a. | 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 procedure for the autonoms robot application using hybrid architecture. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | List the model based approaches and elaborate with neat sketches. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Construct the AVR architecture in detail with suitable sketches. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Outline the robot expressing behaviour with suitable sketches and examples. | CO4 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the following  1. Vision sensors  2. Muscle wires  3. Power supply  4. Electric motors (AC/DC) | CO6 | An | 12 |

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|  | **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 / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **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 | 1 | 3 | - | 12 | - | - | 16 |
|  | | | | | | | **124** |



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| --- | --- | --- | --- |
| **Course Code** | **20ME2010** | **Duration** | **3hrs** |
| **Course Name** | **KINEMATICS AND DYNAMICS OF MACHINERY** | **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. | Give an example for exact straight-line mechanisms. | | CO1 | U | 1 |
| 2. | If n links are connected at the same joint, the joint is equivalent to \_\_\_\_\_\_\_\_\_ binary joints. | | CO1 | R | 1 |
| 3. | The direction of linear velocity of any point on a link with respect to another point on the same link is -------------- | | CO2 | A | 1 |
| 4. | A point B on a rigid link AB moves with respect to A with angular velocity ω rad/s. The radial component of the acceleration of B with respect to A, is ----------. | | CO2 | A | 1 |
| 5. | List out the material used for belts. | | CO3 | U | 1 |
| 6. | Illuminate the types of power transmitting chains. | | CO3 | U | 1 |
| 7. | Write the expression for the module of gear. | | CO4 | R | 1 |
| 8. | Identify few industrial applications of gear trains | | CO4 | U | 1 |
| 9. | The ratio of the height of a Porter governor (when the length of arms and links are equal) to the height of a Watt’s governor is \_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO5 | U | 1 |
| 10. | The rotor of a ship rotates in clockwise direction when viewed from the stern and the ship takes a left turn. The effect of the gyroscopic couple acting on it will be \_\_\_\_\_\_\_\_\_\_\_\_. | | CO5 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Describe about the nodes and types of link with neat diagrams. | | CO1 | U | 3 |
| 12. | Write the important concepts in velocity analysis. | | CO2 | A | 3 |
| 13. | Describe velocity ratio of a compound belt drive | | CO3 | U | 3 |
| 14. | Draw the schematic diagram of compound gear train and mention uses of it. | | CO4 | U | 3 |
| 15. | Differentiate proell and watt governor with a neat diagram. | | CO5 | A | 3 |
| 16. | Discuss briefly with neat sketches the longitudinal, transverse and torsional free vibrations. | | 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 inversions of four bar mechanism with neat diagrams and examples. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | 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°. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | The power is transmitted from a pulley 1 m diameter running at 200 r.p.m. to a pulley 2.25 m diameter by means of a belt. Find the speed lost by the driven pulley as a result of creep, if the stress on the tight and slack side of the belt is 1.4 MPa and 0.5 MPa respectively. The Young’s modulus for the material of the belt is 100 MPa. | CO3 | An | 6 |
|  | b. | An engine, running at 150 r.p.m., drives a line shaft by means of a belt. The engine pulley is 750 mm diameter and the pulley on the line shaft being 450 mm. A 900 mm diameter pulley on the line shaft drives a 150 mm diameter pulley keyed to a dynamo shaft. Find the speed of the dynamo shaft, when 1. there is no slip, and 2. there is a slip of 2% at each drive. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the terms applied to gear: (i) Module, (ii) Pressure angle. | CO4 | U | 4 |
|  | b. | A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20° pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and the contact ratio. | CO4 | An | 8 |
|  |  |  |  |  |  |
| 21. | a. | A cam is to be designed for a knife edge follower with the following data : 1. Cam lift = 40 mm during 90° of cam rotation with simple harmonic motion. 2. Dwell for the next 30°. 3. During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion. 4. Dwell during the remaining 180°. Draw the profile of the cam when the line of stroke of the follower passes through the axis of the cam shaft. The radius of the base circle of the cam is 40 mm. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 22. | a. | With neat diagram, explain the effect of the gyroscopic couple on an aeroplane. | CO5 | U | 4 |
|  | b. | An aeroplane makes a complete half circle of 50 metres radius, towards left, when flying at 200 km per hr. The rotary engine and the propeller of the plane has a mass of 400 kg and a radius of gyration of 0.3 m. The engine rotates at 2400 r.p.m. clockwise when viewed from the rear. Find the gyroscopic couple on the aircraft and state its effect on it. | CO5 | An | 8 |
|  |  |  |  |  |  |
| 23. | a. | A shaft which rotates at a constant speed of 160 r.p.m. is connected by belting to a parallel shaft 720 mm apart, which has to run at 60, 80 and 100 r.p.m. The smallest pulley on the driving shaft is 40 mm in radius. Determine the remaining radii of the two stepped pulleys for a crossed belt. Neglect belt thickness and slip. | CO3 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Write a short note on primary and secondary balancing. | CO6 | U | 4 |
|  | b. | A shaft of length 0.75 m, supported freely at the ends, is carrying a body of mass 90 kg at 0.25 m from one end. Find the natural frequency of transverse vibration. Assume E = 200 GN/m2 and shaft diameter = 50 mm. | CO6 | An | 8 |

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

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|  | **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. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 4 | 12 |  |  |  | 17 |
| CO2 |  |  | 5 | 12 |  |  | 17 |
| CO3 |  | 5 |  | 12 | 12 |  | 29 |
| CO4 | 1 | 8 |  | 8 |  |  | 17 |
| CO5 |  | 6 | 3 | 8 | 12 |  | 29 |
| CO6 |  | 4 | 3 | 8 |  |  | 15 |
|  | | | | | | | **124** |



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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** | | **Marks** | |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | | |
| 1. | State the three phases of finite element analysis according to computer implementations. | | CO6 | | R | | 1 | |
| 2. | Classify the types of node. | | CO1 | | U | | 1 | |
| 3. | Write the basic concept of finite element analysis. | | CO1 | | A | | 1 | |
| 4. | Express the interpolation polynomial equation for 1D cubic element. | | CO2 | | C | | 1 | |
| 5. | Write the application of finite element analysis in electrical engineering. | | CO6 | | A | | 1 | |
| 6. | What do you mean by scalar field problem? | | CO4 | | R | | 1 | |
| 7. | Define degrees of freedom. | | CO1 | | R | | 1 | |
| 8. | Write the expression of the stiffness matrix for 1D link element. | | CO2 | | A | | 1 | |
| 9. | Classify the types of boundary condition in FEA. | | CO3 | | U | | 1 | |
| 10. | Write the general stiffness matrix for 1-D heat transfer in a fin. | | CO5 | | A | | 1 | |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | | |
| 11. | Write the steps involved in the weighted residual method. | | CO2 | | A | | 3 | |
| 12. | Write the properties of stiffness matrix. | | CO2 | | A | | 3 | |
| 13. | Differentiate between static and dynamic analysis. | | CO6 | | An | | 3 | |
| 14. | Define plane stress analysis and specify an example for a plane stress problem. | | CO5 | | R | | 3 | |
| 15. | Write the purpose of the Grid Independence study. | | CO1 | | A | | 3 | |
| 16. | Differentiate between local, global, and natural coordinate systems. | | CO3 | | 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 discretization process in finite element analysis. | | CO1 | | An | | 6 | |
|  | b | Discuss convergence requirements with examples. | | CO1 | | U | | 6 | |
|  |  |  | |  | |  | |  | |
| 18. | a. | Evaluate the elongation, strain and stresses for the stepped bar shown in Figure 1.  A1=20mm2  A2=10mm2  E1=2x105N/mm2 E2=7x104N/mm2  (1)  (2)  20kN  5kN  800mm  500mm    Figure1 | | CO5 | | E | | 12 | |
|  |  |  | |  | |  | |  | |
| 19. | a. | Consider the differential equation for the problem as ; 0 ≤x ≤ 10 ; with the boundary conditions y (0) = 0 and y(10) = 0. Approximate function is y = ax (10 – x). Solve the problem and obtain a solution using Galerkin’s method, point collocation method, subdomain method, and least square method. Compare the solutions obtained using the weighted residual method with the exact solution | | CO3 | | A | | 12 | |
|  |  |  | |  | |  | |  | |
| 20. | a. | Evaluate the element shape functions and calculate the value of temperature at point ‘P’ as shown in Figure 2. The nodal values of temperature are Ti = 80oC; Tj = 100 oC ; Tk= 150 oC. Point ‘P’ is located at (2, 5). (All dimensions are in cm)  •  P  X  Y  i (1,1)  j(3,4)  k(2,7)  Figure 2 | | CO4 | | E | | 12 | |
|  |  |  | |  | |  | |  | |
| 21. | a. | 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  Figure3 | | CO5 | | A | | 12 | |
|  |  |  | |  | |  | |  | |
| 22. | a. | Explain the concept of higher-order element with illustration and also derive the shape functions for any one higher-order element. | | CO2 | | An | | 12 | |
|  |  |  | |  | |  | |  | |
| 23. | a. | Explain the lagrangian element and establish the shape functions for any one lagrangian family of element. | | CO3 | | An | | 12 | |
| **COMPULSORY QUESTION** | | | | | | | | |
| 24. | a. | Determine the temperature distribution in a one-dimensional fin which is rectangular in shape, 8cm long, 4cm wide, and 1cm thick. The left side of the fin (inlet) is kept at 80oC. Assume that convection heat loss occurs from the right end of the fin. Use 2 element idealization.  ; | | 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 / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 7 | 4 | 6 | - | - | 18 |
| CO2 | - | - | 7 | 12 | - | 1 | 20 |
| CO3 | - | 1 | 12 | 15 | - | - | 28 |
| CO4 | 1 | - | - | - | 12 | - | 13 |
| CO5 | 3 | - | 25 | - | 12 | - | 40 |
| CO6 | 1 | - | 1 | 3 | - | - | 05 |
|  | | | | | | | **124** |



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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** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | The cloud operates remotely and has limited storage capacities. (True/False) | | CO1 | U | 1 |
| 2. | Smart products can sense their environment by collecting data about their surroundings. (True/False) | | CO1 | R | 1 |
| 3. | State the three-virtualization methodologies | | CO2 | An | 1 |
| 4. | The V of Big Data, which defines high speed of accumulation of data, is called \_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO2 | R | 1 |
| 5. | Define dynamic marketing. | | CO3 | U | 1 |
| 6. | The manufacturing process that adds one layer on top of another, making it an additive process is known as \_\_\_\_\_\_\_\_\_\_. | | CO3 | R | 1 |
| 7. | Augmented reality is the use of computer technology to create a simulated environment, which can be explored in 360 degrees. (True/False) | | CO4 | U | 1 |
| 8. | Mention any one advantage in automotive cyber physical system. | | CO4 | An | 1 |
| 9. | Define AI/Autonomy. | | CO5 | R | 1 |
| 10. | \_\_\_\_\_\_\_\_\_\_\_\_ is a digital representation of the complete physical and functional characteristics of a built asset. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Name any four sensors used in an IoT application. | | CO1 | A | 3 |
| 12. | Sketch the predictive analysis process cycle. | | CO2 | U | 3 |
| 13. | List four key Ingredients of an Inventory Optimization formula that works. | | CO3 | An | 3 |
| 14. | Contrast Industry 4.0 and the Internet of Things (IoT) | | CO4 | An | 3 |
| 15. | Classify the resource constraints. | | CO5 | An | 3 |
| 16. | Define Container Ship Trim Optimization with examples. | | 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. | With an example, describe the advantages and working of a consumer IOT product. | CO1 | An | 6 |
|  | b. | With an example, expound on the advantages and working of an industrial IOT product. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate with appropriate examples the predictive analysis process. | CO2 | A | 6 |
|  | b. | Classify the network virtualization with a neat diagram. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Interpret inventory optimizations and mention three advantages of inventory optimization. | CO3 | A | 6 |
|  | b. | In detail, explain the IOT based predictive maintenance architecture in a neat diagram. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate with a neat diagram eight methods to boost smart manufacturing. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Elaborate on the varieties of cybercrime in detail. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Define Code Halo Thinking with three examples. | CO2 | U | 6 |
|  | b. | Draw the parts of a 3D printing machine | CO2 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | With the help of a flowchart, describe the cyber physical systems in terms of modelling, design and analysis. | CO4 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | With a help of a block diagram, show the components of Bluetooth controlled robot and explain the working of robot remote service. | CO6 | A | 6 |
|  | b. | With the help of a schematic diagram, elaborate on the working of an Electrical Vehicle Charging. | CO6 | An | 6 |

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

|  |  |
| --- | --- |
|  | **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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 1 | 3 | 12 |  |  | 17 |
| CO2 | 1 | 9 | 12 | 7 |  |  | 29 |
| CO3 | 1 | 1 | 6 | 9 |  |  | 17 |
| CO4 |  | 1 | 12 | 16 |  |  | 29 |
| CO5 | 2 |  |  | 15 |  |  | 17 |
| CO6 |  | 3 | 6 | 6 |  |  | 15 |
|  | | | | | | | **124** |



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| --- | --- | --- | --- |
| **Course Code** | **18ME2013** | **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. | Distinguish between ‘sensor’ and ‘transducer’. | | CO1 | An | 1 |
| 2. | Predict the significance of the term ‘True Value’ in the sensor measurement system. | | CO1 | A | 1 |
| 3. | Define the term ‘Magnetic Flux’. | | CO2 | U | 1 |
| 4. | Write the effect of Attenuation in ultrasonic sensor. | | CO3 | A | 1 |
| 5. | List out any two motion detecting sensors used in industrial robots. | | CO3 | R | 1 |
| 6. | Identify the mobile phone sensor that recognizes when a user is holding the phone close to his face during a call. | | CO6 | An | 1 |
| 7. | Define windowing in machine vision system. | | CO4 | R | 1 |
| 8. | Indicate the materials used for the fabrication of Diaphragm used in pressure sensors. | | CO5 | U | 1 |
| 9. | Indicate the application of thermistor sensors. | | CO5 | U | 1 |
| 10. | List out the advantages of implementing SCADA in food industry. | | CO2 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Distinguish between ‘Passive sensor’ and ‘Active sensor’ with an example. | | CO1 | An | 3 |
| 12. | Articulate the principle of Faraday’s first law of induction with an example. | | CO2 | A | 3 |
| 13. | State the working principle of the sensors used in gas and liquid chromatography. | | CO3 | R | 3 |
| 14. | Indicate the significance of Debye temperature in selection of sensor materials in high temperature applications. | | CO5 | A | 3 |
| 15. | Articulate the term ‘Edge Detection’ in robotic vision system. | | CO4 | A | 3 |
| 16. | List out the basic components of automated sensor system. | | CO2 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Illustrate the crucial characteristics of sensors used in mechanical systems. | CO1 | A | 8 |
|  | b. | Articulate the significance’s of Microelectronic system (MEMs) and its applications. | CO1 | A | 4 |
|  |  |  |  |  |  |
| 18. | a. | Indicate the principle of ‘capacitance’ with neat sketch, | CO3 | U | 6 |
|  | b. | Illustrate the working principle of eddy current sensors with a neat sketch. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Describe the operational function of inductive proximity sensor with neat sketch and its potential application in industries. | CO6 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate the working procedure of sensor used for detecting breathing rate of a sleeping child with neat line Sketch. | CO6 | An | 8 |
|  | b. | Indicate the principle of piezo-resistive effect with simple sketch. | CO4 | U | 4 |
|  |  |  |  |  |  |
| 21. | a. | Describe the working principle of Hall effect sensor with a clear sketch and its applications. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Illustrate the working principle of Optoelectronic Pressure Sensors with a neat sketch and its industrial applications. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain the working principle of Thermocouples with a neat sketch and its applications. | 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

|  |  |
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|  | **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 |  | 1 | 16 |  |  |  | 17 |
| CO3 | 10 | 13 | 1 |  |  |  | 24 |
| CO4 | 1 | 4 | 15 |  |  |  | 20 |
| CO5 |  | 10 | 9 |  |  |  | 19 |
| CO6 |  | 12 | - | 9 |  |  | 21 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | OSHA stands as an acronym for-------------------------. | | CO1 | U | | 1 |
| 2. | Welding shields are provided to safeguard the eyes from-------------- and----------------which are emanating from arc welding process . | | CO1 | R | | 1 |
| 3. | Outline the application of machine guards. | | CO2 | U | | 1 |
| 4. | Name some ‘safeguarding devices’.. | | CO2 | R | | 1 |
| 5. | Infer the application of ‘pullback devices’. | | CO3 | U | | 1 |
| 6. | Define precision. | | CO3 | R | | 1 |
| 7. | As per the definition of Crossby, conformance to the ----------------- is known as quality | | CO4 | U | | 1 |
| 8. | Two elements with individual reliability of 0.9 are connected in series configuration in a system, find the reliability of the total system. | | CO4 | R | | 1 |
| 9. | DMAIC as an acronym stands for---------------------. | | CO5 | U | | 1 |
| 10. | ISO 14000 certification is to ensure that the company’s products and waste do not harm--------------------------. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Distinguish lockout and tagout. | | CO1 | | An | 3 |
| 12. | State the critical importance of ‘Zero Mechanical State’ with respect to industrial safety. | | CO2 | | U | 3 |
| 13. | List any three safety practices adopted in paint shops. | | CO3 | | An | 3 |
| 14. | Summarize the objective and methodology of six sigma quality control. | | CO4 | | U | 3 |
| 15. | Summarize the methods to compute reliability of series, parallel and mixed configuration systems. | | CO5 | | U | 3 |
| 16. | Appraise ISO 9000 series of quality standards. | | CO6 | | E | 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. | Outline the objectives of safety management and the roles of different members in an organization. | CO1 | | U | 12 |
|  |  |  |  | |  |  |
| 18. | a. | 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 | | An | 6 |
|  | b. | Examine the standard operating procedure to store and use the hazardous metals. | CO3 | | An | 6 |
|  |  |  |  | |  |  |
| 20. | a. | Evaluate the significance and application of ‘seven traditional tools of quality’ in quality control. | CO4 | | E | 12 |
|  |  |  |  | |  |  |
| 21. | a. | Interpret the application of ‘Fault Tree Analysis’ in failure analysis. | CO5 | | E | 6 |
|  | b. | Distinguish the various heads of quality costs. | CO5 | | An | 6 |
|  |  |  |  | |  |  |
| 22. | a. | Appraise the role variable and attribute control charts in ensuring quality. | CO 5 | | E | 12 |
|  |  |  |  | |  |  |
| 23. | a. | Explain personnel protective equipments (PPE) with neat sketches. | CO 3 | | An | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Appraise the ‘Business Process Reengineering ( BPR)’ with suitable example. | CO6 | | E | 8 |
|  | b. | Analyze the role of ‘gap analysis ‘ in bench marking process. | CO6 | | A | 4 |

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|  | **COURSE OUTCOMES** |
| CO1 | Apply safety principles, protocols and Personnel protective equipment (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 / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 19 |  |  |  |  | 20 |
| CO2 | 2 | 6 |  | 12 |  |  | 20 |
| CO3 | 1 | 1 |  | 14 |  |  | 16 |
| CO4 | 1 | 1 | 6 |  | 12 |  | 18 |
| CO5 |  | 4 |  | 12 | 18 |  | 34 |
| CO6 |  | 1 | 4 |  | 11 |  | 16 |
|  | | | | | | | **124** |



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| **Course Code** | **20ME2016** | **Duration** | **3hrs** |
| **Course Name** | **FLUID MECHANICS AND FLUID 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. | Define kinematic viscosity. | | CO1 | R | 1 |
| 2. | Distinguish Newtonian and Non-Newtonian 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. | State Pascal’s law. | | CO3 | R | 1 |
| 6. | Differentiate laminar and turbulent flow. | | CO3 | U | 1 |
| 7. | List a few assumptions made while deriving Bernoulli’s equation. | | CO4 | R | 1 |
| 8. | Write Newton’s second law of motion. | | CO5 | R | 1 |
| 9. | Give any two examples of fundamental dimensions. | | CO5 | U | 1 |
| 10. | List two advantages of multi staging in pumps. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Two horizontal plates are placed 1.25cm apart, the space between them being filled with oil of viscosity 1.4 Ns/m2. Calculate the shear stress in oil if upper plate is moved with the velocity of 2.5m/s. | | CO1 | A | 3 |
| 12. | The velocity potential function is given by Φ = 5 (x2 – y2). Calculate the velocity components at the point (4, 5). | | CO2 | A | 3 |
| 13. | A hydraulic press has a ram of 30cm diameter and the plunger of 4.5cm diameter. Find the weight lifted by the hydraulic press when the force applied at the plunger is 500 N. | | CO3 | A | 3 |
| 14. | Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43 N/cm2 (Gauge) and with mean velocity of 2 m/s. Find the total head or total energy per unit weight of the water at a cross section, which is 5 m above the datum line. | | CO4 | A | 3 |
| 15. | Is it true that if centrifugal pump runs in reverse, it will generate zero head? | | CO5 | U | 3 |
| 16. | Distinguish impulse and reaction turbine with examples. | | 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. | Calculate the capillary rise in a glass tube of 2.5 mm of diameter when immersed vertically in (a) water and (b) mercury. Take surface tensions σ = 0.0725 N/m for water and σ = 0.52 N/m for mercury in contact with air. The specific gravity for mercury is given as 13.6 and angle of contact is1300. | CO1 | A | 6 |
|  | b. | A U-tube manometer is used to measure the pressure of water in a pipeline that exceeds atmospheric pressure. The right limb of the manometer contains mercury and is open to the atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line if the difference in the level of mercury in the limbs of the U-tube is 10 cm and the free surface of mercury is in level with the center of pipe. If the pressure of water in pipe line is reduced to 9810 N/m2, calculate the new difference in the level of mercury. Sketch the arrangements in both cases. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Derive the three-dimensional continuity equation for a steady flow process. | CO2 | A | 6 |
|  | b. | If for a two-dimensional potential flow, the velocity potential is given by φ = x(2y-1). Determine the velocity at the point P (4,5). Determine also the value of stream function ψ at the point P. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | An orifice meter with an orifice diameter of 15 cm is inserted in a pipe of 30 cm diameter. The pressure difference measured by a mercury oil differential manometer on the two sides of the orifice meter gives a reading of 50 cm of mercury. Find the rate of flow of oil of specific gravity 0.9 when the coefficient of discharge of the orifice meter is 0.64. | CO3 | A | 6 |
|  | b. | Derive Bernoulli’s equation from Euler’s equation and summarize the assumptions used. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | The 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 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Find the head lost due to friction in a pipe of diameter 300 mm and length 50 m, through which water is flowing at a velocity of 3 m/s using (i) Darcy formula, (ii) Chezy's formula for which C = 60. Take kinematic viscosity for water = 0.01 stoke. | CO4 | E | 6 |
|  | b. | A horizontal venture meter with inlet diameter 30 cm and throat diameter 15 cm is used to measure the flow of water. The reading of differential manometer connected to the inlet and the throat is 20 cm of mercury. Determine the rate of flow. Take coefficient of discharge as 0.98. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Jet of water of diameter 10 cm strikes a flat plate normally with a velocity of 15 m/s, the plate is moving with a velocity of 6 m/s in the direction of the Jet and away from the Jet. Find the (i) the force exerted by the jet on the plate (ii) work done by the jet on the plate per second (iii) Power of the jet (iv) Efficiency of the jet | CO5 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | Elucidate the working principle, operation, and components of the centrifugal pump in detail with a neat sketch. | CO5 | U | 6 |
|  | b. | Explain the operation of two-stage impeller pumps connected in series and parallel with a neat sketch. | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the operation of the Pelton wheel with a neat sketch. | CO6 | U | 12 |

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

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|  | **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 |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 1 | 15 | - | - | - | 17 |
| CO2 | 1 | 1 | 9 | 6 | - | - | 17 |
| CO3 | 1 | 1 | 9 | 6 | - | - | 17 |
| CO4 | 1 | - | 21 | - | 6 | - | 28 |
| CO5 | 1 | 16 | - | 12 | - | - | 29 |
| CO6 | - | 16 | - | - | - | - | 16 |
|  | | | | | | | **124** |



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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** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | | |
| 1. | Define the term toughness. | | | CO1 | R | 1 |
| 2. | \_\_\_\_\_\_\_\_\_\_\_is the property of sudden fracture without any visible permanent deformation. | | | CO1 | U | 1 |
| 3. | List some applications of white cast iron material. | | | CO2 | R | 1 |
| 4. | The carbon content of medium carbon steel is \_\_\_\_\_to \_\_\_\_\_. | | | CO2 | U | 1 |
| 5. | The \_\_\_\_\_\_\_\_ head is mounted on top of the engine block. | | | CO3 | U | 1 |
| 6. | Connecting rod is made of \_\_\_\_\_\_\_\_\_\_\_\_\_material. | | | CO3 | U | 1 |
| 7. | Identify the main functions of fuel injection system? | | | CO4 | A | 1 |
| 8. | The\_\_\_\_\_\_\_\_\_\_\_\_\_\_ battery is used in IC engine. | | | CO4 | R | 1 |
| 9. | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_converts an electrical signal to a physical output. | | | CO5 | U | 1 |
| 10. | Define lighting system. | | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | | |
| 11. | Classify lightweight non-ferrous metals. | | | CO1 | U | 3 |
| 12. | Distinguish between material attributes and material indices. | | | CO2 | An | 3 |
| 13. | List some applications of helical gear. | | | CO3 | R | 3 |
| 14. | Distinguish between sensor and transducer. | | | CO4 | An | 3 |
| 15. | Identify the measurement methods for CO2, CO and HC. | | | CO5 | A | 3 |
| 16. | List out the main functions of lighting system? | | | 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 properties and application of low, medium and high carbon steels. | CO1 | | An | 8 |
|  | b. | Write some important bearing alloys and its compositions. | CO1 | | R | 4 |
|  |  |  |  | |  |  |
| 18. | a. | With neat sketches explain the material property of young's modulus-density chart. | CO2 | | A | 8 |
|  | b. | Define metals. Classify engineering metals. | CO2 | | R | 4 |
|  |  |  |  | |  |  |
| 19. | a. | Explain briefly the following IC engine components of manufacturing methods; materials that are used for manufacturing give their applications.  i)Piston  ii)Cylinder head  iii)Gear  iv)Clutch | CO3 | | An | 12 |
|  |  |  |  | |  |  |
| 20. | a. | With a schematic layout, explain the working principle of CRDI and GDI System. | CO4 | | A | 10 |
|  | b. | State the main objectives of an electronic control system for IC engines. | CO4 | | R | 2 |
|  |  |  |  | |  |  |
| 21. | a. | Write short notes on: (i) Torque converter lockup (ii) Electric power steering(EPS) | CO5 | | A | 12 |
|  |  |  |  | |  |  |
| 22. | a. | Explain the composition and properties of malleable and white cast iron. | CO1 | | A | 6 |
|  | b. | Explain the effect of chromium and molybdenum in low alloy steels. | CO1 | | A | 6 |
|  |  |  |  | |  |  |
| 23. | a. | With neat sketches illustrate the working and constructional details of the Electronic ignition systems. | CO4 | | An | 8 |
|  | b. | Distinguish between starter motor and alternator. | CO4 | | An | 4 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Explain the role of electronics in modern automotive vehicles. | | CO6 | A | 6 |
|  | b. | Describe briefly Exhaust emission control methods. | | CO6 | An | 6 |

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

|  |  |
| --- | --- |
|  | **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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 5 | 4 | 12 | 8 | - | - | 29 |
| CO2 | 5 | 1 | 8 | 3 | - | - | 17 |
| CO3 | 3 | 2 | - | 12 | - | - | 17 |
| CO4 | 3 | - | 11 | 15 | - | - | 29 |
| CO5 | - | 1 | 15 | - | - | - | 16 |
| CO6 | 4 | - | 6 | 6 | - | - | 16 |
|  | | | | | | | **124** |



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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. | State Hooke’s law. | | CO1 | U | 1 |
| 2. | Define Poisson’s ratio. | | CO1 | R | 1 |
| 3. | Define point of contra flexure in a beam. | | CO2 | U | 1 |
| 4. | Describe an overhanging beam. | | CO2 | R | 1 |
| 5. | Interpret the term neutral axis. | | CO3 | U | 1 |
| 6. | Define the term resilience. | | CO4 | U | 1 |
| 7. | Write the torsional equation. | | CO4 | U | 1 |
| 8. | Name the stress acting on thin cylinders. | | CO5 | R | 1 |
| 9. | Discuss about Macaulay’s method. | | CO5 | U | 1 |
| 10. | Define the term crippling load. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Discuss on Mohr’s circle of 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 spherical shell 1400 mm in diameter is subjected to an internal pressure of 1.8 N/mm2. If the permissible stress in the material is 140 N/mm2 and the joint efficiency is 75%, find the minimum thickness. | | 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. | A tensile test was conducted on a mild steel bar. The following data was obtained from the test: (i) Diameter of the steel bar = 30 mm; (ii) Gauge length of the bar = 200 mm; (iii) Load at elastic limit = 250 kN; (iv) Extension at a load of 150 kN = 0.21 mm; (v) Maximum Load = 380 kN; (vi) Total extension = 60 mm; (vii) Diameter of rod at failure = 22.5 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. | A cantilever of length 2 m fails when a load of 2 kN is applied at the free end. If the section of the beam is 40 mm x 60 mm, calculate the stress at failure. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | A solid shaft is 100 mm in diameter. The shaft transmits 120 kW at 200 rpm. Compute the maximum intensity of shear stress induced and also the angle of twist for a length of 6 m. Take Modulus of Rigidity C = 8 x 104 N/mm2. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | A beam of length 8 m is simply supported at its ends. It carries a uniformly distributed load of 40 kN/m as shown in Fig. Estimate the deflection of the beam at its mid-point using Macaulay’s method. Take E = 2 x 105 N/mm2 and I = 4.3 x 108 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 cylindrical pipe of diameter 1.5 m and thickness 15 mm is subjected to an internal fluid pressure of 1.2 N/mm2. Determine the Longitudinal stress and Circumferential stress developed in the pipe. | 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. | A strut 2.5 m long is 60 mm in diameter. One end of the strut is fixed and the other end is hinged. Calculate the safe compressive load for the member using Euler’s formula, allowing a factor of safety of 3.5. Take E = 2.1 x 105 N/mm2. | CO6 | A | 4 |

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

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|  | **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 / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 4 | 12 | - | - | - | 17 |
| CO2 | 1 | 1 | 3 | 12 | - | - | 17 |
| CO3 | - | 4 | 12 | - | - | - | 16 |
| CO4 | 3 | 2 | 18 | - | - | - | 23 |
| CO5 | 1 | 1 | 9 | 12 | - | - | 23 |
| CO6 | 4 | - | 4 | 20 | - | - | 28 |
|  | | | | | | | **124** |



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| **Course Code** | **21ME2003** | **Duration** | **3hrs** |
| **Course Name** | **DESIGN OF MACHINE ELEMENTS** | **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 factor of safety | | CO1 | R | 1 |
| 2. | Give examples of a machine member subjected to bending and torsional stresses | | CO2 | U | 1 |
| 3. | List the materials used for the manufacture of shaft. | | CO3 | R | 1 |
| 4. | Write the function of coupling | | CO3 | A | 1 |
| 5. | State some applications of permanent joint. | | CO5 | R | 1 |
| 6. | Classify the types of spring. | | CO3 | An | 1 |
| 7. | Define crushing stress | | CO2 | R | 1 |
| 8. | List some applications of eccentric loading | | CO1 | R | 1 |
| 9. | Write the purpose of belt drive | | CO5 | A | 1 |
| 10. | Classify the types of brake | | CO5 | An | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | List the factors to be considered in the selection of materials for the machine elements | | CO1 | R | 3 |
| 12. | Differentiate between the stress distribution of a rod subjected to axial force and a beam subjected to bending. | | CO3 | An | 3 |
| 13. | Write the purpose of cotter joint. | | CO3 | C | 3 |
| 14. | Define flywheel and for what purpose it is used? | | CO3 | R | 3 |
| 15. | Distinguish between active and inactive coils in spring. | | CO5 | E | 3 |
| 16. | Examine the different methods used for reducing fatigue failure | | CO2 | 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. | A short cast iron column of hollow circular section with 250mm outside diameter and 150mm inside diameter carries a vertical load of 400kN acting at a point of 100mm from the axis of the column. Identify   1. Normal and bending stresses induced in the column 2. Maximum and minimum stresses induced at the extreme ends of the column | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. | a. | A bolt is subjected to an axial force of 10 kN along with a transverse shear force of 5 kN. The permissible tensile stress at elastic limit is 100 MPa and the Poisson's ratio is 0.3 for the bolt material. Determine the diameter of the bolt required according to different theories of failure. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Calculate the diameter of the shaft to transmit twisting moments varying from 500Nm to 2000Nm. The ultimate tensile strength is 600N/mm2 and yield strength is 450N/mm2. Assume stress concentration factor as 1.2, surface finish factor as 0.8, size factor as 0.85 and factor of safety as 2. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | 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 5600kW at 150rpm. The maximum axial propeller thrust is 500kN and the shaft weighs 70kN. Evaluate   1. The maximum shear stress developed in the shaft. 2. Angular twist between the bearings. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 21. | a. | A helical compression spring made of oil tempered carbon steel, is subjected to a load which varies from 600 N to 1600 N. The compression at the maximum load is 40mm. The spring index is 6 and the design factor of safety is 1.5. If the yield shear stress is 700 MPa and the endurance stress in shear is 350 MPa, design the spring. Take modulus of rigidity as 80GPa. | CO6 | C | 12 |
|  |  |  |  |  |  |
| 22. | a. | Design a muff coupling which is used to connect two steel shafts transmitting 40 kW at 350 rpm. The material for the shafts and key is plain carbon steel for which allowable shear and crushing stresses may be taken as 40 MPa and 80 MPa respectively. The material for the muff is cast iron for which the allowable shear stress may be assumed as 15 MPa. | CO5 | C | 12 |
|  |  |  |  |  |  |
| 23. | a. | Design a connecting rod of I- section for an engine from the following data.  Crank radius=300mm; Connecting rod length=1800mm; speed of the crank=400rpm; specific weight of the material=7.2gm/cc. Neglect weight of the reciprocating parts. | CO5 | C | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | A knuckle joint connects two parts of a tie-rod subjected to an axial load of 120KN. The safe working stresses are 55N/mm2 in tension, 80N/mm2 in crushing and 40N/mm2 in shear. Design the joint. | CO3 | C | 12 |

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

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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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 17 | - | - | - | - | - | 17 |
| CO2 | 1 | 1 | 15 | - | - | - | 17 |
| CO3 | 4 | - | 1 | 4 | 12 | 15 | 36 |
| CO4 | - | - | - | 12 | - | - | 12 |
| CO5 | 1 | - | 1 | 1 | 3 | 24 | 30 |
| CO6 | - | - | - | - | - | 12 | 12 |
|  | | | | | | | **124** |



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| **Course Code** | **21ME2006** | **Duration** | **3hrs** |
| **Course Name** | **HEAT AND MASS TRANSFER** | **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. | Conduction resistance due to a plane wall of thickness L of material with thermal conductivity K and area A is \_\_\_\_\_\_\_\_\_\_\_\_. | | CO1 | U | 1 |
| 2. | Write the two dimensional steady state heat conduction equation in differential form. | | CO1 | R | 1 |
| 3. | The highly ordered fluid motion characterized by smooth streamlines is called \_\_\_\_\_\_\_\_. | | CO2 | U | 1 |
| 4. | The concept of boundary layer was introduced by \_\_\_\_\_\_\_\_\_. | | CO2 | R | 1 |
| 5. | Reciprocity theorem for shape factor is \_\_\_\_\_\_\_\_\_\_\_\_ . | | CO2 | R | 1 |
| 6. | If the temperature of a solid surface changes from 27°C to 627°C, then its emissive power changes in the ratio of \_\_\_\_\_\_\_. | | CO3 | A | 1 |
| 7. | Sketch the temperature profile along the length of the heat exchanger for evaporator. | | CO4 | R | 1 |
| 8. | In pool boiling the increase in heat flux after the Leiden Frost Point is due to \_\_\_\_\_\_\_\_\_\_\_. | | CO5 | U | 1 |
| 9. | The rate of heat transfer in dropwise condensation is \_\_\_\_\_\_\_\_\_\_ than film condensation. | | CO5 | U | 1 |
| 10. | Give any two examples for mass transfer. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | A chromel-alumel thermocouple (diameter 0.71 mm) is used to measure the temperature of a gas stream for which h=600 W/m2K. Estimate the time constant of the thermocouple. What is the time period after which an acceptable reading of temperature can be recorded? Take C= 430 J/kg K, density = 8600 kg/m3. | | CO1 | A | 3 |
| 12. | State Buckingham’s pi theorem. | | CO2 | R | 3 |
| 13. | Explain Wien’s displacement law. | | CO3 | R | 3 |
| 14. | How is ε-NTU method superior to LMTD method? | | CO4 | U | 3 |
| 15. | Explain film wise and drop wise condensation. | | CO5 | U | 3 |
| 16. | Write down the analogues terms in heat and mass transfer. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | A wall of 0.5m thickness is to be constructed from a material which has an average thermal conductivity of 1.4 W/mK. The wall is to be insulated with a material having an average thermal conductivity of 0.35W/mK so that the heat loss per square metre will not exceed 1450 W. Assuming that the inner and outer surface temperature are 12000C and 150C respectively. Calculate the thickness of insulated material. | CO1 | A | 6 |
|  | b. | One end of a long rod 3 cm in diameter in inserted into a furnace with the outer end projecting into the outside air. Once the steady state is reached the temperature of the rod is measured at two points, 15cm apart and found to be 1400C and 1000 C, when the atmospheric air is at 300C with convection coefficient of 20 W/m2K. Calculate the thermal conductivity of the material. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | A current of 200A is passed through a stainless-steel wire [ k=19 W/m0C] 3mm in diameter. The resistivity of the steel may be taken as 70μΩcm and the length of the wire is 1m. The wire is submerged in a liquid at 1100C and experiences a convection heat transfer coefficient of 4 kW/m2 0C. Calculate the centre temperature of the wire. | CO1 | A | 8 |
|  | b. | A small cubical furnace 50 by 50 by 50 cm on the inside is constructed of fireclay brick [k 1.04 W/m0C] with a wall thickness of 10cm. The inside of the furnace is maintained at 5000 C and the outside is maintained at 500C. Calculate the heat loss through the walls. | CO1 | A | 4 |
|  |  |  |  |  |  |
| 19. |  | Water entering at 100C is heated to 400C in the tube of 0.02 m ID at a mass flow rate of 0.01 kg/s. The outside of the tube is covered with an insulated electric heating element that produces a uniform heat flux of 15000 W/m2 over the surface. Neglecting any entrance effect, determine;   1. Reynolds Number 2. The heat transfer coefficient 3. The length of pipe needed for a 300C increase in average temperature 4. The inner tube surface temperature at the outlet 5. The friction factor 6. The pressure drop in the pipe. 7. The pumping power required, if the pump is 50% efficient. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | A vertical plate 0.5 m high and 1 m wide is maintained at uniform temperature of 1170C. It is exposed to ambient air at 230C. Calculate i) the heat transfer rate from the plate. Ii) Boundary layer thickness at 0.5m from the leading edge of the plate. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | A spherical liquid oxygen tank 0.3 m in diameter is enclosed concentrically in a spherical container of 0.4 m diameter and the space in between is evacuated. The tank surface is at -1830C and has an emissivity of 0.2. The container surface is at 150C and has an emissivity of 0.25. Determine the net radiant heat transfer rate and rate of evaporation of liquid oxygen if its latent heat is 220 kJ/kg. | CO3 | A | 6 |
|  | b. | 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 | 6 |
|  |  |  |  |  |  |
| 22. |  | The amount of F-12 used in compression refrigeration system is 4 tonnes/hour. The brine, flowing at 850 kg/min, with inlet temperature of 120C, is cooled in an evaporator. Assuming F-12 entering and leaving the evaporator as saturated liquid and saturated vapour respectively. Determine the area of evaporator required. Take the following properties  For F-12 saturation temperature = -230C, cp=1.17 kJ/kg.K, hfg=167.4 kJ/kg  For brine cp=6.3 kJ/kg.K, U=2325 kW/m2.K. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Water is to be boiled at atmospheric pressure in a mechanically polished stainless steel pan placed on top of a heating unit. The inner surface of the bottom of the pan is maintained at 1080C. If the diameter of the bottom of the pan is 30cm, determine a) the rate of heat transfer to the water and b) the rate of evaporation of water. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain Fick’s law of diffusion with neat sketch. | CO6 | R | 4 |
|  | b. | Dry air at 270C and 1 atm flows over a wet flat plate 60cm long at a velocity of 45 m/s. Calculate the mass transfer coefficient of water vapour in air at the end of the plate.  Take D=0.26 x 10-4m2/sec, ρ=1.14 kg/m3, µ=184.6 x 10-7 Ns/m2, Pr=0.707. | CO6 | A | 8 |

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

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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 / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 1 | 27 | - | - | - | 29 |
| CO2 | 5 | 1 | 24 | - | - | - | 30 |
| CO3 | 3 | - | 13 | - | - | - | 16 |
| CO4 | 1 | 3 | 12 | - | - | - | 16 |
| CO5 | - | 5 | 12 | - | - | - | 17 |
| CO6 | 4 | 4 | 8 | - | - | - | 16 |
|  | | | | | | | **124** |



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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. | Write the different types of energy considered in the source term of energy equation. | | CO1 | A | 1 |
| 2. | Classify the forces that exert influence on a fluid particle. | | CO1 | An | 1 |
| 3. | Write the importance of hybrid grids. | | CO2 | A | 1 |
| 4. | Define ‘cartesian mesh’. | | CO2 | R | 1 |
| 5. | Write the condition for implicit discretization of the unsteady conductive heat transfer. | | CO3 | A | 1 |
| 6. | Write the differential form of 2D steady diffusion. | | CO3 | A | 1 |
| 7. | The flow in which property which is not varying with time is called----- | | CO4 | R | 1 |
| 8. | Write the essential requirement for the boundedness. | | CO4 | A | 1 |
| 9. | Define ‘no-slip condition’ | | CO5 | U | 1 |
| 10. | PISO algorithm stands for-------------------- | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Write the differential form of general transport equation. | | CO1 | A | 3 |
| 12. | Differentiate between structured and unstructured grids. | | CO2 | U | 3 |
| 13. | Determine the expression for central difference first derivative using the Taylor series. | | CO3 | A | 3 |
| 14. | Write the advantage of hybrid differencing scheme. | | CO4 | A | 3 |
| 15. | Sketch u & v velocity cell at the inlet boundary. | | CO5 | A | 3 |
| 16. | Write the two main problems associated with the solution of momentum and continuity equation. | | 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. | Derive the three-dimensional mass conservation equation for a compressible fluid. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the basic steps involved in creating mesh for CFD simulation. Categorize the mesh interms of application and accuracy. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Derive the discretized form of equation for 1D steady diffusion problem. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Derive the discretized equation for convection diffusion using upwind difference scheme. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain how the following boundary conditions are implemented.   1. Outlet boundary condition 2. Periodic or cyclic boundary condition 3. Pressure boundary conditions | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | 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. Calculate the steady state temperature distribution in the rod if the length of the rod is 0.5 m, thermal conductivity equals to 1000 W/mK, and cross-sectional area is 10-2 m2. Divide the rod into five equal control volumes and solve the problem. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain power law discretization technique and QUICK scheme. | CO4 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain SIMPLER algorithm and derive the Discretized equation for pressure. | 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 / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  |  | 4 | 13 |  |  | 17 |
| CO2 | 1 | 3 | 1 | 12 |  |  | 17 |
| CO3 |  |  | 17 | 12 |  |  | 29 |
| CO4 | 1 |  | 28 |  |  |  | 29 |
| CO5 |  | 1 | 3 | 12 |  |  | 16 |
| CO6 | 1 |  | 3 | 12 |  |  | 16 |
|  | | | | | | | **124** |



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| **Course Code** | **21ME3013** | **Duration** | **3hrs** |
| **Course Name** | **INTEGRATED FMS FOR INDUSTRY 4.0** | **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. | Discuss the following in detail with relevant sketches: FMS Layout Configurations implemented in the material handling systems. (a) in-line layout, (b) loop layout, (c) open field layout, and (d) robot-centered cell. | CO1 | U | 10 |
|  | b. | Categorize and explain the significance of the computer control functions performed by the FMS. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Compare the significant merits of CAD systems with manual design and drafting methods during product design and manufacturing. | CO1 | A | 10 |
|  | b. | Enlist and explain the important applications of CAM used for the effective planning and management of production activities in the industries. | CO1 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Classify and explain the four techniques of the production flow analysis (PFA) that identify part families and machine cell formation pioneered by J. Burbidge. | CO2 | A | 10 |
|  | b. | Determine the most logical machine sequence using the Hollier method.  A GT cell has four machines: 1, 2, 3, and 4. An analysis of 50 parts processed on these machines has been summarized in the *‘from–to’* chart in the table given below. 50 parts enter the machine grouping at machine 3, 20 parts leave after processing at machine 1, and 30 parts leave machine 4 after processing.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | From-To Chart | | | | | | From | To | | | | | 1 | 2 | 3 | 4 | | 1 | 0 | 5 | 0 | 25 | | 2 | 30 | 0 | 0 | 15 | | 3 | 10 | 40 | 0 | 0 | | 4 | 10 | 0 | 0 | 0 | | CO2 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the steps of Rank-order Clustering starting with the initial part-machine incidence matrix that was proposed by J. King. | CO2 | A | 10 |
|  | b. | Summarise the three important ways in which group-technology principles can be applied in manufacturing. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Sketch a neat block diagram of the Opitz classification coding system and explain its significance and application in the manufacturing industries. | CO3 | A | 10 |
|  | b. | Enumerate the benefits of implementation of FMS applications in the automotive manufacturing industry. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Summarize typical objectives in cellular manufacturing that are dedicated to the production of a part or product family, or a limited group of families. | CO4 | An | 10 |
|  | b. | Discuss the following FMS analysis techniques in detail: (1) Deterministic models, (2) Queuing models, (3) Discrete event simulation, and (4) Heuristics. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 7. | a. | Derive an equation to estimate the downtime of an automated production line. List out some common reasons for downtime and suggest the best possible solutions to overcome the downtime. | CO5 | An | 10 |
|  | b. | Explain the Standard feed units used with in-line or rotary transfer machines:  (a) horizontal feed drive unit, (b) angular feed drive unit, and (c) vertical column unit. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Sketch neatly the standard feed modules/units used with in-line or rotary transfer machines and list their merits and demerits: (a) horizontal feed drive unit, (b) angular feed drive unit, and (c) vertical column unit. | CO5 | An | 10 |
|  | b. | Explain in detail, why the *‘internal storage buffer’* in transfer lines is implemented. Discuss a case study on starving and blocking. | CO5 | An | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Compare the merits and demerits of mass production and lean production in a table. | CO6 | E | 10 |
|  | b. | Sketch the structure of the lean production system and tabulate the elements of just-in-time production, worker involvement, and autonomation. | CO6 | E | 10 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Demonstrate the Group Technology concepts in a manufacturing environment. |
| CO2 | Influence cellular manufacturing and its performance in an automated production environment. |
| CO3 | Estimate utilization and performance measures of each workstation in FMS. |
| CO4 | Evaluate database simulation accuracy in a FMS system. |
| CO5 | Analyze the automated manufacturing systems for FMS. |
| CO6 | Implement modern manufacturing support systems for the realization of Industry 4.0. |

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



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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** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Analyse how product life management (PLM) aid product development. | CO1 | An | 10 |
|  | b. | Predict the reasons for product development. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 2. | a. | Explain verification and validation in relation to FEA. | CO1 | A | 16 |
|  |  |  |  |  |  |
| 3. | a. | Explain the operation reference mode of Digital manufacturing system. | CO2 | U | 16 |
|  |  |  |  |  |  |
| 4. | a. | Describe the role of Biomechanics, intelligent manufacturing and technical management in digital manufacturing science. | CO2 | U | 16 |
|  |  |  |  |  |  |
| 5. | a. | Examine how the geometric modeling and reasoning are useful in intelligent manufacturing. | CO3 | An | 16 |
|  |  |  |  |  |  |
| 6. | a. | Determine how to use multi-agent systems to accomplish intelligence of manufacturing systems. | CO4 | A | 16 |
|  |  |  |  |  |  |
| 7. | a. | Develop a plan to protect the property right of network manufacturing product. | CO5 | A | 16 |
|  |  |  |  |  |  |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Choose the appropriate process of building an RP of computer mouse made of a polymer and explain how the product will be manufactured. | CO6 | A | 20 |
|  |  |  |  |  |  |

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

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|  | **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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  |  | 10 | 22 |  |  | 32 |
| CO2 |  | 32 |  |  |  |  | 32 |
| CO3 |  |  |  | 16 |  |  | 16 |
| CO4 |  |  | 16 |  |  |  | 16 |
| CO5 |  |  | 16 |  |  |  | 16 |
| CO6 |  |  | 20 |  |  |  | 20 |
|  | | | | | | | **132** |



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| **Course Code** | **23ME1001** | **Duration** | **3hrs** |
| **Course Name** | **ENGINEERING 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. | Differentiate a Materials Scientist and a Materials Engineer. | | CO1 | U | 1 |
| 2. | Demonstrate the relationship between a microstructure and the material property with a simple example. | | CO1 | C | 1 |
| 3. | Name any one solid-state recrystallization technique used by engineers to refine the microstructure of a material. | | CO2 | R | 1 |
| 4. | List the applications of the X-Ray diffraction technique in Materials Engineering. | | CO2 | R | 1 |
| 5. | Compare a Unary system and a Binary system in Phase Diagrams. | | CO3 | An | 1 |
| 6. | In ferrous alloys, the martensitic structures are \_\_\_\_\_\_ and \_\_\_\_\_. | | CO3 | R | 1 |
| 7. | Differentiate between an Anelastic material and a Viscoelastic material. | | CO4 | U | 1 |
| 8. | Specify the type of smart material that can be used in a pressure sensor. | | CO6 | C | 1 |
| 9. | A nanomaterial is classified based on its size. Indicate the order of the size of such materials. | | CO5 | R | 1 |
| 10. | List any two metals that have very high wear-resistant properties. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Derive the atomic packing factor and coordination number for a BCC structure. | | CO1 | A | 3 |
| 12. | Compile the step-by-step process to derive Miller Indices. | | CO2 | C | 3 |
| 13. | List the three applications of a Phase Diagram. | | CO3 | R | 3 |
| 14. | Discuss the true stress – true strain relationship. | | CO4 | U | 3 |
| 15. | Enumerate the most significant properties of an electrostrictive material. | | CO5 | R | 3 |
| 16. | Compare the unique properties of a material used in cryogenic temperatures with a material used in high-temperature applications. | | 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. | Distinguish between amorphous and polycrystalline materials. | CO1 | U | 6 |
|  | b. | List all the desired physical and chemical properties of an engineering material. | CO1 | R | 6 |
|  |  |  |  |  |  |
| 18. | a. | Summarize the types of dislocations present in metals and the point defect and the impurity defect with a neat sketch. | CO2 | E | 6 |
|  | b. | With neat sketches, explain the theory of Edge dislocation and screw dislocation. | CO2 | E | 6 |
|  |  |  |  |  |  |
| 19. | a. | Draw the construction of a Scanning Electron Microscope and explain its working principle. | CO2 | A | 6 |
|  | b. | Draw and Fe-C Diagram and interpret the diagram to understand the functionalities of it. | CO3 | E | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the various stages in ductile fracture with neat sketches. | CO3 | U | 6 |
|  | b. | Enumerate the various stages in creep. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | What are the common applications of (a) austenitic (b) ferritic and  (c) martensitic steels? | CO3 | R | 6 |
|  | b. | Explain the various heat treatment processed carried out on Ferrous alloys and list their benefit of each process. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Elaborate the Gibbs Phase Rule to draw a Phase Diagram | CO4 | U | 6 |
|  | b. | Differentiate between hard and soft magnet. List the materials classified under these two head. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Discuss the functionalities of a shape memory alloy. | CO5 | U | 6 |
|  | b. | Classify the smart materials under various categories and name the materials associated with this classification. | CO5 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | List and explain the design considerations taken in to account while selectin a material for specific application. | CO6 | E | 6 |
|  | b. | Explain the procedure that is followed to select a material for different applications given below: 1) Space Technologies, 2) Marine Technologies. | CO6 | E | 6 |

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

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|  | **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 | | | | | | | |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | | |
| **CO / BL** | | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | | 6 | 7 | 3 |  |  | 1 | 17 |
| CO2 | | 2 |  | 6 |  | 12 | 3 | 23 |
| CO3 | | 10 | 6 |  | 1 | 6 |  | 23 |
| CO4 | |  | 10 |  | 6 |  |  | 16 |
| CO5 | | 4 | 12 |  | 12 |  |  | 28 |
| CO6 | | 1 |  |  |  | 12 | 4 | 17 |
|  | | | | | | | | **124** |



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| **Course Code** | **23ME1002** | **Duration** | **3hrs** |
| **Course Name** | **DRONE 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. | \_\_\_\_\_\_\_\_\_does not communicate and the results of the mission, e.g. photographs, are usually not obtained from it until it is recovered at the base. | | CO1 | R | 1 |
| 2. | \_\_\_\_\_\_\_\_\_\_has designed and developed ‘The Snark VTOL UAV.’ | | CO1 | R | 1 |
| 3. | Classify drones according to their wing systems. | | CO2 | R | 1 |
| 4. | \_\_\_\_\_\_\_\_type of drone has an altitude of the UAV is over 15,000 m and an endurance is more than 24 wears. | | CO2 | R | 1 |
| 5. | \_\_\_\_\_\_\_\_\_tire rapidly in the case of UAVs in extreme cold conditions. | | CO3 | R | 1 |
| 6. | The radius of action will have a significant impact on the choice of navigation equipment affecting both aircraft and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO3 | R | 1 |
| 7. | 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. | | CO4 | R | 1 |
| 8. | The amount of lift produced is equal to the product of the mass flow of air entrained and the velocity *‘u’* that is given to it in the downward direction is\_\_\_\_\_\_\_\_\_\_\_\_ | | CO4 | R | 1 |
| 9. | The length of the runway required for a UAV to be airborne will depend on the acceleration, lift-off speed and \_\_\_\_\_\_\_\_\_\_of the UAV. | | CO5 | R | 1 |
| 10. | Electro-Optical payload is an example of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_payload. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Describe the features and applications of *‘Black Widow’* developed by the USA. | | CO1 | U | 3 |
| 12. | Sketch neatly the creation of lift and drag by air deflection. | | CO2 | U | 3 |
| 13. | List a few applications of drones in the agriculture sector. | | CO3 | U | 3 |
| 14. | Classify the criteria that determine the ability of the eye to see an airborne object against an open sky or cloud background for a drone. | | CO4 | U | 3 |
| 15. | Describe the significant application of radio frequencies in drone usage. | | CO5 | U | 3 |
| 16. | How the concept of *‘Radar Confusion’* help the drone in military applications? | | 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 rules and regulations introduced by DGCA for drones in India. | CO1 | A | 6 |
|  | b. | Describe the procedure for obtaining a drone pilot license as listed in the digital sky platform. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the working features of HALE, MALE, MUAV and UCAV. | CO1 | A | 6 |
|  | b. | Discuss the Covert and Research roles carried out by the drones. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the economic aspects of the design and development of drones. (a) First Costs and (b) Operating Costs. | CO2 | A | 6 |
|  | b. | Enumerate the cost of the basic elements in fabricating quadcopter drones. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Articulate the main reasons for designing and developing a drone into stealth mode functioning. | CO3 | A | 6 |
|  | b. | Summarize the Radar imaging payloads that are used for ground target surveillance. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Illustrate the technology and the application of the ‘*Laser Target Designation’* system incorporated in the drones. | CO4 | An | 6 |
|  | b. | Describe how important it is to design drones for pollution monitoring with few aspects of pollution control. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Describe the working principle of *‘Catapult Launch System and Recovery’* in drones. | CO5 | An | 6 |
|  | b. | Differentiate between HTOL and VTOL. Give a few applications for each type. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the functional aspects of the Mini-UAV ‘Laptop’ Ground Control Station. | CO5 | An | 6 |
|  | b. | Describe the working principles of a Close-range UAV Ground Control Station. | CO5 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the ethics and legal considerations for drone-based photography and film production. | CO6 | An | 6 |
|  | b. | Enumerate the challenges, opportunities in drone-based agriculture and surveying. | 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 / P** | **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** |



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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** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | State the primary focus of dynamics. | | CO1 | R | 1 |
| 2. | Mention the primary difference between the center of gravity and the centroid of an object. | | CO1 | U | 1 |
| 3. | Define thermodynamics. | | CO2 | R | 1 |
| 4. | List down the fundamental properties of fluids in fluid mechanics. | | CO3 | U | 1 |
| 5. | Define the primary types of engineering materials. | | CO4 | R | 1 |
| 6. | Brass is an alloy of \_\_\_\_\_\_\_\_\_\_\_. | | CO4 | A | 1 |
| 7. | Define a heat exchanger and mention a primary purpose in its applications | | CO5 | A | 1 |
| 8. | Distinguish between natural and forced convection. | | CO5 | U | 1 |
| 9. | Define the basic principle of operation in a thermal power plant. | | CO6 | U | 1 |
| 10. | Differentiate between concentrated solar power (CSP) and photovoltaic (PV) solar power technologies. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain how the principles of statics and dynamics are relevant in real-world engineering and physics applications. | | CO1 | An | 3 |
| 12. | Differentiate between an open and closed system in thermodynamics, providing examples for each. | | CO2 | A | 3 |
| 13. | Define the law of conservation of energy in the context of fluid mechanics. | | CO3 | U | 3 |
| 14. | Explain the reasons behind the material choices of bicycle frame made of metal and polymer components. | | CO4 | An | 3 |
| 15. | Compare and contrast the three modes of heat transfer in terms of how they occur and in what mediums. | | CO5 | A | 3 |
| 16. | Analyze the factors affecting the efficiency of a wind power plant and propose measures to enhance the efficiency. | | CO6 | An | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Define a simple beam and explain its basic components with the types of supports that can be used for simple beams with a neat sketch. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Describe the main components and working of a heat engine with neat sketch. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Discuss the fundamental principles, types, and operating principles of hydraulic pumps in fluid mechanics. Provide real-world examples to illustrate their importance. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Describe the different types of material properties and characteristics with examples. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the importance of material testing in engineering and describe the different types of mechanical testing. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Describe the principle operation of heat exchangers with neat sketch and compare between shell-and-tube and Plate Heat Exchangers. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Enlighten how tidal power plants generate electricity and compare the advantages and disadvantages of tidal power compared to other renewable energy sources. Also discuss the potential of tidal energy as a future sustainable energy source | CO6 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the basic principle of Ocean Thermal Energy Conversion and describe the different types of OTEC systems with neat sketch. Also assess the challenges of OTEC implementation. | CO6 | An | 12 |

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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 various types of 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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 13 | - | 3 | - | - | 17 |
| CO2 | 1 | 12 | 3 | - | - | - | 16 |
| CO3 | - | 4 | - | 12 | - | - | 16 |
| CO4 | 1 | 24 | 1 | 3 | - | - | 29 |
| CO5 | - | 1 | 16 | - | - | - | 17 |
| CO6 | - | 2 | - | 27 | - | - | 29 |
|  | | | | | | | **124** |